OBJECTIVE 5DS-BASED MEASURES IN CONJUNCTION WITH SYNTACTIC PROPERTIES OF STREET NETWORK TO ASSESS WALKABILITY IN RESIDENTIAL NEIGHBORHOODS IN PUTRAJAYA, MALAYSIA

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the requirements for the Degree of Doctor of Philosophy

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Chair : Associate Professor Ts. Mohd Yazid bin Mohd Yunos, PhD
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Recently, neighbourhood walkability has emerged as a critical concept for sustainable urban development and promoting active mobility. The creation and replication of walkability indices involve the use of geographic information systems (GIS) and require exploration of assumptions implicit in various research disciplines. While the current GIS-based approach to neighbourhood walkability assessment relies on the 5Ds of the built environment (density, design, diversity, destination accessibility, and distance to transit), these metrics have been shown to lack contextual validity and be scale-dependent. Combining them with syntactic metrics of street networks based on space syntax, has been proposed as a solution, holding greater potential to explain walking behaviour. However, despite this theoretical promise, the compatibility of these two measures is constrained at neighbourhood level due to the absence of an operational framework for combining the parameters of both methods, and the lack of geographical standards for data aggregation. Therefore, this study aims to develop a model for neighbourhood walkability assessment, based on 5Ds and street network metrics across different neighbourhood scales. Putrajaya city was chosen for this study due to its dendriform network structure conducive to space syntax analysis. Using GIS, multiple buffer-service areas (240, 400, 600, and 1,000 meters) were generated around each housing unit within Precincts 9 and 11 (N = 2,392). Data on the built environment and street network were sourced, respectively, from the Integrated Land Use Planning Information System (I-Plan) and OpenStreetMap (OSM). The study begins by examining the association and impact of syntactic metrics in shaping the 5Ds. Subsequently, it tests each method against the observed walking volume collected through systematic manual counting at 123 observation gates, followed by investigating the impact of scale selection on each method, and finally, it examines the predictability of the combined model across multiple scales. Utilizing correlation, linear, and negative binomial regression, this study revealed several key findings. Firstly, syntactic metrics emerged not just as street-related but also as functional measures, representing various aspects of the built environment influencing walking behaviour. Specifically, the distribution of distances and land use

patterns within the neighbourhood. Secondly, the assumption of syntactic metrics demonstrated a superior explanatory power for pedestrian volume when compared to the 5Ds across diverse geographical scales. Thirdly, the findings underscore the substantial impact of scale selection on the association between GIS-based attributes and pedestrian counting. Nevertheless, syntactic metrics consistently outperform 5Ds, irrespective of the analysis scale chosen. Moreover, the results suggested that a 600-meter network scale appears most suitable for identifying the association between the combination of the 5Ds and pedestrian counts in residential neighbourhoods. Finally, syntactic metrics, when integrated with 5Ds measures, significantly enhance the overall predictability of the model at both micro and macro levels. Building on these outcomes, a novel syntactic-based index, SLM (Syntactic Local Measure) was introduced. SLM demonstrated high predictability of walking volume at the neighbourhood level, requiring less data and mitigating scaling impacts. This dissertation holds the potential to advance objective analytical methods, particularly relevant to Malaysia or similar context where shorter walking distances due to the tropical climate pose unique challenges for promoting active transportation.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

LANGKAH-LANGKAH BERASASKAN 5DS OBJEKTIF BERSAMAAN DENGAN SIFAT-SIFAT SINTAKSIS RANGKAIAN JALANAN UNTUK MENILAI KEBOLEHJALANAN DI KAWASAN KEJIRANAN KEDIAMAN DI PUTRAJAYA, MALAYSIA.

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Baru-baru ini, kebolehjalanan kawasan perumahan telah muncul sebagai konsep penting untuk pembangunan bandar lestari dan pemudahan mobiliti aktif. Pembentukan dan replikasi indeks kebolehjalanan melibatkan penggunaan sistem maklumat geografi (GIS) dan memerlukan penerokaan tanggapan tersirat dalam pelbagai disiplin penyelidikan. Walaupun pendekatan semasa berdasarkan GIS untuk penilaian kebolehjalanan kawasan perumahan bergantung pada 5Ds persekitaran binaan (ketumpatan, reka bentuk, kepelbagaian, kemudahan capaian destinasi, dan jarak ke pengangkutan awam), metrik ini telah terbukti kurang pengesahan kontekstual dan bergantung kepada skala. Gabungannya dengan metrik sintaksis rangkaian jalan berdasarkan sintaks ruang, telah dicadangkan sebagai penyelesaian, membawa potensi lebih besar untuk menerangkan tingkah laku berjalan. Namun, meskipun janji teoretikal ini, keserasian kedua-dua ukuran terhad pada peringkat kawasan perumahan kerana kekurangan rangka operasi untuk menggabungkan parameter kedua-dua kaedah itu, dan ketiadaan piawai geografi untuk pengagregatan data. Oleh itu, kajian ini bertujuan untuk membangunkan model penilaian kebolehjalanan kawasan perumahan, berdasarkan 5Ds dan metrik rangkaian jalan di pelbagai skala kawasan perumahan yang berbeza. Bandar Putrajaya dipilih bagi kajian ini disebabkan struktur rangkaian dendriformnya yang sesuai untuk analisis sintaks ruang. Menggunakan GIS, kawasan perkhidmatan pelbagai buffer (240, 400, 600, dan 1,000 meter) dihasilkan di sekitar setiap unit perumahan dalam Presint 9 dan 11 (N = 2,392). Data mengenai persekitaran binaan dan rangkaian jalan diperoleh masing-masing dari Sistem Maklumat Guna Tanah Perancangan Bersepadu (i-Plan) dan pengkalan data OpenStreetMap (OSM). Kajian ini bermula dengan mengkaji hubungan dan impak metrik sintaksis dalam membentuk 5Ds. Seterusnya, ia menguji setiap kaedah berbanding jumlah berjalan yang diperhatikan melalui pengiraan manual sistematik di 123 pintu pengamatan, diikuti dengan menyiasat impak pemilihan skala pada setiap kaedah, dan akhirnya, mengkaji kebolehjangkaan model yang digabungkan di pelbagai skala. Menggunakan hubungkait, regresi lelurus, dan regresi binomial negatif, kajian ini menunjukkan beberapa penemuan utama. Pertama, metrik sintaktik muncul bukan sahaja

sebagai perkaitan dengan jalan tetapi juga sebagai ukuran berfungsi, mewakili pelbagai aspek persekitaran binaan yang mempengaruhi tingkah laku berjalan. Khususnya, pengagihan jarak dan corak penggunaan tanah dalam kawasan perumahan. Kedua, andaian metrik sintaktik menunjukkan keupayaan penjelasan yang lebih baik untuk jumlah pejalan kaki berbanding 5Ds di pelbagai skala geografi. Ketiga, penemuan menunjukkan kesan besar pemilihan skala terhadap hubungan di antara sifat berdasarkan GIS dan pengiraan pejalan kaki. Walau bagaimanapun, metrik sintaktik secara konsisten melebihi 5Ds, tidak bergantung pada skala analisis yang dipilih. Selain itu, hasil kajian menyarankan bahawa skala rangkaian 600 meter kelihatan paling sesuai untuk mengenalpasti hubungan antara gabungan 5Ds dan pengiraan pejalan kaki di kawasan perumahan. Akhirnya, metrik sintaktik, apabila digabungkan dengan ukuran 5Ds, secara signifikan meningkatkan kebolehjangkaan keseluruhan model di kedua-dua peringkat mikro dan makro. Membangunkan atas hasil ini, satu indeks berasaskan sintaktik baru diperkenalkan, SLM (Syntactic Local Measure). SLM telah menunjukkan kebolehjangkaan yang tinggi terhadap jumlah aktiviti berjalan di peringkat kawasan perumahan, memerlukan kurang data dan mengurangkan impak penskalaan. Disertasi ini mempunyai potensi untuk memajukan kaedah analitik objektif, terutamanya yang berkaitan dengan Malaysia atau konteks serupa di mana jarak berjalan yang lebih pendek disebabkan iklim tropika mencipta cabaran unik untuk mempromosikan pengangkutan aktif.

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AVR_AL	Average proximity to all destinations
BLO_LE	Block size
GLO_CH	Global choice
GLO_IN	Global integration
GRO_RE	Gross residential density
HH_IN	Herfindahl-Hirschman Index
INT_DE	Intersection density
LOC_CH	Local choice
LOC_IN	Local integration
LUM_EN	Land use mix entropy
PR_ CO	Proximity to commercial
PR_CF	Proximity to community facility
PR_RE	Proximity to recreational)
PR_SC	Proximity to school
PR_TR	Proximity to transport
RES_LR	Residential land ratio
STR_DE	Street density

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The Asian developing countries are currently facing high levels of obesity, declining physical activity, and increasing rates of chronic disease (Mathis et al., 2023). Malaysia, like many Asian countries, is grappling with rising rates of overweight and obesity, associated with lack of physical activity (Kyaw et al., 2022). According to the National Health and Morbidity Survey (NHMS, 2019), a staggering 50.1 % of Malaysian adults were either overweight or obese, marking the highest rate among adults in South-East Asia (Asia World Population Review, 2022). The causes of this health issue are multifaceted, involving various interconnected determinants, including both behavioural and environmental factors. It is essential to recognize that individual-level stressors alone cannot fully explain the surge in overweight and obesity (Townshend & Lake, 2017). Consequently, in recent decade, the focus has shifted from the personal level to community empowerment through the built environment of cities (Kwan et al., 2021).

To combat obesity and promote physical activity, research on "Walkability" focuses on how to design or redesign the built environment to support walking as a mode of active transportation integrated into daily activities. Walkability refers to the measure of how conducive the built environment is to walking, whether for physical activity, active mobility, recreation, or access to services (Battista & Manaugh, 2019). Guidelines from the World Health Organization have shown that moderate physical activity, such as 30 minutes of walking per day, can significantly reduce mortality risk by at least 10% and decrease overweight and obesity levels, along with other associated health benefits, such as reduced diabetes (Booth et al., 2019; Sundquist et al., 2015), cholesterol, and heart diseases (Lee & Buchner, 2008; Okura et al., 2016). Furthermore, high walkability leads to various environmental and social implications, from reducing automobile dependency and energy expenditure (Lewis & Grande del Valle, 2019) to providing a solution for environmental injustice and social isolation (Forsyth, 2015; Karjalainen & Juhola, 2019). Moreover, a walkable environment contributes to a liveable city (Shamsuddin et al., 2012), providing people with better places to live and improving levels of place satisfaction (S. M. Lee et al., 2016; Dyck et al., 2011).

However, Malaysia's cities and urban areas are generally car-oriented, with moderate to high population densities accommodating approximately 77.16 % of the total population (O'Neill, 2021). According to the National Health and Morbidity Survey (NHMS, 2019), 24.6% of urban residents are not physically active, a figure higher compared to other Asian countries such as China, India, and Hong Kong (Nik-Nasir et al., 2022). Encouraging walking in city planning has become a timely issue in Malaysia due to rapid urbanization associated with changes in the mobility behaviour of city inhabitants (Hidayati et al., 2021). In metropolitan areas like Kuala Lumpur, private motorized vehicles account for 80% of the mode share (Chiu Chuen et al., 2014), while non-motorized transport modes like walking and cycling are nearly non-existent, except in tourist areas. This issue can be attributed to inadequate infrastructure, including discontinuous sidewalks and cycling paths, as well as the humid climate, misperceptions about pedestrian safety, and deteriorating street liveability (Mahmoudi et al., 2015; Rahman et al., 2015; Zakaria & Ujang, 2015; Hidayati et al., 2021; Harumain et al., 2022).

While the Malaysian government has long emphasized urban development concepts and planning mechanisms that promote the proximity of residential, commercial, and social amenities to encourage walking behaviour at the local level (e.g., Eleventh Malaysia Plan 2016, KL Structure Plan 2020), however, several reports indicate that neighbourhoods within Kuala Lumpur, Putrajaya, or Shah Alam cities still lack pedestrian-friendliness. Zaly Shah (2010) argues that the impediment in pedestrian planning in Malaysia does not result from a shortage of policies or standards. Instead, it is rooted in a deficiency of political resolve, indirectly connected to the lack of an objective methodology for assessing the establishment of pedestrian walkways. Zaly Shah (2010) contends that the absence of objective tools gives rise to subjective assessments, making them vulnerable to scrutiny and critique. Tackling these issues demands a holistic approach to walkability assessment, a pivotal stride in fostering physical activity and sustainable urban development (Liao et al., 2022).

Conceptualizing and assessing the physical aspects of urban environments and neighbourhoods can be approached through two distinct methods: perceived-based assessment and objective assessments. The difference lies in the techniques used to measure the walkability of a neighbourhood. Objective assessment of walkability involves quantifiable measures such as street connectivity, land use mix, and residential density. These measures are often assessed using geographical information systems (GIS) and environmental audits (Hajna et al., 2015; Rodrigue et al., 2022; Mayne et al., 2013). On the other hand, perceived-based assessment relies on individuals' subjective perceptions of their neighbourhood's walkability, which may not always align with objective measures (Sylvers et al., 2022; Koohsari et al., 2014; Baxter et al., 2022).

The integration of perceived-based assessments of the built environment into policymaking encounters a bottleneck wherein the translation of research outcomes into practical applications may be hindered by the arbitrary nature of research results (Sarkar et al., 2015). Conversely, using big data approaches, including GIS, consensus, and national travel surveys, in an urban study assess the association among built environments ensures the validity and robustness of findings. This approach facilitates evidence-based interventions that can enhance residents' quality of life by creating pedestrian-friendly neighbourhoods (Sarkar et al., 2015; Sarkar et al., 2017).

However, this approach is still lagging behind in the Malaysian walkability research. According to Qureshi (2018), there is a lack of studies conducting objective assessments using GIS, with descriptions limited to general environmental characteristics and work on a broad scale. As it is argued to be contextual (Arellana et al., 2020), the relationship between the objective-built environment and walking behaviour holds significance in the Malaysian context due to particularities in the built environment and weather conditions. A better understanding of this relationship will assist in comprehending the mechanisms underlying the built environment-walking behaviour relationship and provide support for the global body of literature.

1.1.1 Objective assessment based on 5Ds-GIS and space syntax methods

Several studies have examined the association between built environment and walking behaviour using objective methods. In particular, the use of Geographic Information Systems (GIS) applications has enhanced computational power and increased the availability of spatial data (Koohsari, Badland, et al., 2014). These advancements allow researchers to develop and apply composite spatial measures of neighbourhood walkability which quantify the built environment based on 5 indices called the "5Ds": (street network) design, (land-use) diversity, density (residential), distance to transit, and destination accessibility (Lu et al., 2018; Deng et al., 2020).

Previous studies have suggested that each of the 5Ds can have a unique relationship with different types of walking at the neighbourhood level (Cervero & Kockelman, 1997, Saelens & Handy, 2008, Frank et al., 2010; Im & Choi, 2019; Fonseca et al., 2022). Street design, including factors such as street connectivity and intersection density, has been identified as a key determinant of neighbourhood walkability (Carlson et al., 2015; Tewahade et al., 2019). Additionally, land-use diversity, which encompasses the mix of different types of land uses within a neighbourhood, has been found to significantly impact walkability (De Siqueira et al., 2023; Yazid et al., 2023). Moreover, higher residential density and improved access to public transit and local destinations have been linked to increased walking activity, as they provide more opportunities and incentives for individuals to engage in walking for transportation and leisure purposes (Deng et al., 2020; Huang et al., 2019).

Despite the prevalence of the 5Ds as a solid approach for objectively assessing neighbourhood walkability, several studies have argued that it is context dependent (Lotfi & Javad, 2009; Hino et al., 2013; Salvo et al., 2014; Day, 2016). This is because the measurements and weights of the 5Ds indices were tested and validated in American, Canadian, and Australian contexts (Ramakreshnan & Aghamohammadi, 2020). Therefore, it is not necessarily generalizable to other contexts where the built form and cultural context may differ (Sallis, 2011; Day, 2016). For example, studies from Asian cities such as China (Qin et al., 2020; Cerin et al., 2020) and Japan (Inoue et al., 2010) suggested that residential density has a reversed impact on walking volume in overpopulated areas since it causes a lack of opportunities for walking and introduces barriers such as pedestrian congestions. In another example, Salvo et al. (2014) found a negative impact of land use mix entropy (LUM) on overall walking in Cuernavaca, Mexico. Consistently, recent studies from China (Lu et al., 2018) and Korea (Im & Choi, 2019) have indicated that the measure of land use mix was insignificantly related to any domains of walking.

This inconsistency becomes more evident when considering street-related measurements, specifically connectivity metrics such as intersection density—a fundamental index for assessing neighbourhood walkability. This measure was argued to be inconsistent with connectivity for walking when different urban layouts were applied. Intersection density effectively assesses connectivity in areas with grid-pattern street layouts, as found in American and Canadian cities; however, its effectiveness as an indicator is questioned due to the influence of street patterns on its value (Stangl & Guinn, 2011; Boeing, 2021; Lima et al., 2022). Given the diverse patterns of street layouts in cities due to sequential expansions, reflecting the spatial design paradigms of each era, intersection density as a connectivity measure may not effectively capture connectivity for walking (Yagi, 2022). Therefore, several studies from the Netherlands (Liao et al., 2020), Iran (Habibian & Hosseinzadeh, 2018), China (Lu et al., 2017; Zang et al., 2020), and Italy (Gori et al., 2014), reported non-significant or negative relationships between intersection density and overall walking.

Additionally, the variation in street layout was suggested to impact proximity to different destinations (Boeing, 2019; Ozbil et al., 2012; Sheng et al., 2021). Recent research has shown that neighbourhoods with grid-like street designs and finer grid patterns offer more direct travel options between origins and walkable destinations (Zhou et al., 2021; Hajna et al., 2015) due to their high street density and fewer cul-de-sacs. On the other hand, the complexity of organic or tree-like street networks may hinder efficient walking by introducing longer distances to destinations (Ozbil et al., 2011; Mohamad & Said, 2018). However, it is important to note that the proximity measure of 5Ds relies on the concept of physical distance metrics, such as meters, yards, miles, or time measures. These metrics are argued to be limited in their ability to capture the spatial complexity of built environments related to pedestrian movement in different street grids (Koohsari et al., 2013). This limitation is evidenced by several studies that found no relationship with the metric distance to particular land uses, such as parks in Hong Kong (Lu et al., 2018, 2019), or marketplaces in the Netherlands (Liao et al., 2020).

Another issue that continues to impede the 5Ds in current practice is the definition of the geographical unit of data aggregation (in this study is defined as neighbourhood). GIS-based measures of built environment walkability commonly operationalize the neighbourhood using three main types of definitions. Firstly, the administrative unit, such as census tracts or postal codes. This definition is largely affected by the modifiable areal unit problem (MAUP), where the results can vary depending on the division of the study area, zonation, or aggregation efficiency (Openshaw, 1984). Second, the circular buffer, also referred to as the Euclidean buffer, is a circle cantered on the housing unit. Finally, the street network buffer, which is formed by tracing an area around the unit address that can be reached by walking a predetermined distance along streets.

Conceptually, road network buffers are more appealing for walkability studies because they better represent where people might travel, particularly in areas with features like rivers, lakes, or a poorly connected road network (Oliver et al., 2007). Despite the fact that the last two definitions have the advantage of eliminating MAUP, they are still subject to scaling effects. Choosing the geographic scale used to measure the built environment related to walking is a difficult task because different buffer sizes produce different results (Mavoa et al., 2019; Gehrke & Wang, 2020; Li et al., 2022). Furthermore, the lack of standardization may pose a serious problem when comparing and combining evidence from different studies (Learnihan et al., 2011; Mayne et al., 2019).

To overcome prior limitations related to 5Ds walkability assessment, recent research has focused on the relational properties between built environment spaces, which are overlooked by the 5Ds when examining walkability. The fundamental perspective is that the street network layout is not equivalent to other built environment traits, as it serves as a salient factor for walking that harmonizes and links the 5Ds measures (C. D. Kang, 2018), impacting the way individuals interact with their built environment (Baran et al., 2008). This approach relies on space syntax, which is a set of theories and techniques for analysing the relational properties of built environment spaces. It was originally introduced in the architecture field by (Hillier & Hanson, 1984) as a tool to help architects and urban designers simulate the social effects of the built environment. However, due to its high predictive value in terms of pedestrian movement (Hillier, 1999), space syntax is being considered by urban design researchers as a valid alternative for quantifying the built environment in relation to walking (Baran, Rodríed;guez, and Khattak, 2008; Cutumisu, 2011; Koohsari et al., 2019).

Space syntax, along with its natural movement theory, posits that the morphological characteristics of the urban grid are the primary generators of pedestrian movement. People navigate through space by decoding configurations of its layout; the straighter and more accessible the space within the system is, the more pedestrian movement it will attract (Penn et al., 1998). This suggests that people tend to perceive and move through urban spaces in terms of geometry and topology, rather than metrics (Hillier & Hanson, 1984), which means that individuals may prefer a route with fewer turns, even if it is the same length as an alternative route with more turns (Chiang & Li, 2019; Koohsari et al., 2013; Soltani et al., 2022; Liu et al., 2016; Wang et al., 2014). Therefore, relying solely on the metric assumption of the 5Ds is not sufficient to fully capture the spatial configuration of an urban space or how people experience and navigate through it (Koohsari et al., 2019).

Additionally, natural movement theory suggests that “attractors,” especially the location of commercial land uses, are driven by the configurational aspects of the space layout. It relies on the assumption that land uses are a “by-product” of movement (Hillier et al., 1993), as attractors tend to position themselves in configurational hotspots to take advantage of economic flows created by movement (Hillier, 1996). This, in turn, reinforces movement. Reciprocally, attractors have a “multiplying” effect on the pre-existing impact of syntactic properties of system spaces (Hillier, 1999; Hillier et al., 1993). As highlighted by previous studies, the impact of syntactic properties of a network on the distribution of commercial land use. For instance, Scoppa & Peponis (2015) found that areas with a more integrated and hierarchical street network in Buenos Aires had shorter distances to retail frontages. Similarly, Porta et al. (2009) demonstrated a strong correlation between the integration of the street network and the location and distance distribution of retails and service activities in Bologna, Italy. Similar findings were reported in Barcelona, Spain (Porta et al., 2012), and Wuhan, China (Liu et al., 2016).

As the theory of natural movement serves as a connection between street layout and destinations (land use), both crucial environmental elements that support walking (Neatt et al., 2017; Paydar & Kamani Fard, 2022; Fareh & Alkama, 2022), recent studies have suggested that combining syntactic properties of street networks with 5Ds differently affects walking choice and behaviour (Kang, 2018; Koohsari et al., 2019; S. Lee et al.,

2020) and has a greater potential to explain walking volume (Cutumisu, 2011). Moreover, this combination can transform the way in which relationships between environmental factors and walking are examined by omitting the MAUP, as it allows consideration of the relationships at the scale of streets.

However, walkability assessments based on this combination are still limited to providing evidence related to built environment that influence walking behaviour in different contexts, particularly the residential environment (Koohsari, Owen, et al., 2016; Koohsari et al., 2019). Therefore, this study aims to provide insights into the impact of the 5Ds of the built environment and syntactic properties on walking at multiple scales, which holds particular significance in the Malaysian context, where shorter walking distances influenced by the tropical climate present unique challenges for promoting active transportation. Understanding these associations in such contexts is vital for informing studies regarding neighbourhood walkability.

1.2 Statement of the problem

As discussed earlier, 5Ds GIS-based walkability indices, such as net residential density, mixed land use, or distances to destinations, have proven to be less accurate in assessing neighbourhood walkability when different built environment settings were applied, including different street layouts (Liao et al., 2020). This is mainly because they depend on metric assumption that do not capture the relational properties of the built environment concerning walking (Cutumisu, 2011). For example, intersection density measure within 5Ds is a useful for assessing connectivity in areas with grid-like street layouts. However, its reliability as a connectivity indicator has been questioned due to its sensitivity to different street patterns, such as tree-like or organic structure (Stangl & Guinn, 2011). Additionally, factors such as the size of the network and the presence of barriers (Hillier et al., 2007), which cannot be detected by conventional 5Ds measures, can significantly impact the walked distance to different destinations (Batty, 2022; Lima et al., 2022).

Moreover, land-use measures within 5Ds, such as the entropy index of mixed use, have shown inconsistent findings regarding the association with walking. This is attributed firstly to the types of land uses incorporated into the index, which include any land use rather than specific land uses that may provide attraction for walking (Koohsari et al., 2019). Secondly, its sensitivity to the impact of MAUP, which is a significant methodological challenge in the application of 5Ds-GIS indices (Mavoa et al., 2019), where any change of boundary in which data are aggregated may produce different results. The current practice defines the unit of analysis (defined as a neighbourhood in this research) by drawing a buffer within a certain walkable distance from participants' residential units. However, this distance can vary based on demographic or weather factors, impacting the level of associations between walkability measures and walking. Thus, it introduces a serious challenge when it comes to comparing and combining evidence across studies (Mayne et al., 2019).

On the other hand, the theory of space syntax and its supporting empirical findings suggest that street configurations can link form (street connectivity) and function (land use distribution) with pedestrian movement (Hillier & Hanson, 1984; Hillier et al., 1993), which points to the possibility of combining them within the 5Ds framework to better measure neighbourhood walkability (Cutumisu & Spence, 2009; Koohsari et al., 2016). Recent studies have suggested that the 5Ds combined with syntactic metrics of the street network may have greater potential to explain walking behaviour and choice in urban areas (Kang, 2018; Jabbari et al., 2018; Koohsari et al., 2019; Lee et al., 2020) due to the ability of syntactic measures to capture the relational properties of the built environment that are overlooked by 5Ds (Cutumisu, 2011), and overcome the Modifiable Areal Unit Problem (MAUP), providing a more nuanced and contextually relevant analysis.

Despite this theoretical promise, the application of 5Ds in conjunction with space syntax measures to assess neighbourhood walkability is a critical gap remains in the literature partly from the absence of an operational framework substantiated by empirical evidence for combining the parameters of both methods and the lack of geographical standards for data aggregation. Moreover, the compatibility of these two measures is constrained, emphasizing the ongoing necessity for studies that examine both methods against observed walking. Therefore, the purpose of this study is to empirically investigate the relationship between neighbourhood objective-built environment and walking volume by comparing and combining two distinct sets of measures, 5Ds and syntactic metrics of street network, and their relative effects on pedestrian movement. Moreover, this study investigated the role of neighbourhood definition in terms of geographical scale on this association. Employing both methodologies to assess walkability across different street network structures enhances analysis depth, offering insights into context-specific challenges. The dendritic layout, exemplified by Putrajaya, provides a novel perspective on the relationship between the built environment and walking behaviour. Thus, this study can provide valuable insights for researchers seeking to understand the effectiveness of the dendritic urban grid, as in the case of Putrajaya city, in promoting neighbourhood walkability.

1.3 Research questions, objectives, and hypotheses

To achieve this aim, this study aims to address the following four questions:

1. What is the association between objectively measured built environment attributes based on the 5Ds and syntactic metrics of the street network?

2. How do these objective-built environment, as measured by both 5Ds and syntactic metrics, correspond to observed pedestrian movement?

3. How do neighbourhood definitions, in terms of geographical scale, influence the associations between the built environment and walking volume?

4. How can the framework for objective assessment be optimized to better capture the impact of the built environment on walking behaviour in a neighbourhood setting?

To answer these questions and ultimately achieve the aim of the study, the objectives of this research were outlined as follows:

1. To investigate the associations between two distinct objective measures of walkability: (a) the 5Ds framework and (b) syntactic metrics of the street network, both applied in a neighbourhood context.

2. To compare the predictive power of each approach in explaining observed pedestrian movement across diverse walkable environments.

3. To analyse the influence of geographical scale on the relationship between the built environment and walking volume.

4. To propose a framework for objective neighbourhood walkability assessment, informed by insights from the 5Ds and syntactic analysis.

The four hypotheses of the study were developed as follows:

H1: There is a strong association between syntactic and -based measures Syntactic measures of the street network can effectively depict land use patterns, design, and destination accessibility for human activity, resulting in stronger association with 5Ds.

H2: There is a strong association between syntactic and 5Ds-based measures and observed pedestrian movement across different scales.

H3: The magnitude of the association between the built environment and walking volume depends on the geographical scale of the neighbourhood definition.

H4: The combined predictive power of syntactic and 5Ds-based measures for observed pedestrian movement surpasses that of each individual method across diverse walkable environments.

1.4 Operational definitions

1. **Objective built environment:** Refers to built environment attributes measurable through quantifiable indicators like intersection density, land-use mix entropy, or residential density.

2. **Objective assessment of walkability:** Quantifies the physical built environment aspects that may impact walking behaviour using various GIS indices.

3. **Neighbourhood definition:** Refers to the defined boundaries or parameters used to delineate the geographical extent of a residential or urban area.

4. **Modifiable Areal Unit Problem (MAUP):** Refers to the sensitivity of statistical results to the chosen spatial units or zones in the analysis. It's a common issue in spatial analysis where results can vary based on boundary definitions.

5. **Space syntax:** is a set of theories and method for analysing the configuration of spaces and their relationships to understand how they influence human behaviour and movement.

6. **Syntactic metrics:** Quantitative measures derived from space syntax theory, analysing spatial configurations to understand relationships between urban form and function, like integration and choice.

7. **Metric assumption:** suggests that physical distance metrics (meters, yards, miles, etc.) adequately capture how people perceive, navigate, and make distance decisions in real-world settings.

8. **Topological assumptions:** suggest that people tend to perceive and move through urban spaces in terms of geometry and topology, which means that individuals may prefer a route with fewer turns, even if it is the same length as an alternative route with more turns

9. **Street layout:** Refers to the overall pattern and configuration of streets and roads within an area.

10. **Walking volume:** refers to the quantitative measure of pedestrian activity or the number of individuals walking within a particular area over a specified period.

1.5 Research scope and limitations

This study defines its scope and limitations to align with the inquiry's objectives. It exclusively focuses on objective-built environment data, emphasizing the 5Ds and syntactic metrics within Putrajaya neighbourhoods. Perceived assessments are deliberately excluded to maintain the focus on quantifiable and measurable factors. In addition, cultural, social, psychosocial aspects are not included in this study, This intentional omission aims to provide a more objective and data-driven analysis of the residential neighbourhood environment. Moreover, the geographical scope primarily centres on Precincts 9 and 11 within Putrajaya due to their high residential density and equitable distribution of facilities within a five to ten-minute walk (Azmi et al., 2012). This makes the findings potentially more relevant to this specific area. Furthermore, the study does not distinguish between residents and visitors, and it does not differentiate between various types of walking activities during the counting data process. Consequently, the findings necessitate careful consideration, particularly for researchers focusing on walkability and specific walking activities such as leisure, transport, and commuting.

Methodologically, this study operationalizes syntactic metrics only through angular analysis, providing a more comprehensive understanding of pedestrian movement. This approach ensures that the results accurately reflect how the built environment influences walking behaviour. Moreover, an important aspect of the study is the investigation of how different definitions of a neighbourhood in terms of geographical scale influence; however, despite the attempt to cover a wide range of walkable buffers within residential neighbourhoods, the maximum scale did not exceed 1000m. Researchers interested in macro-scale walkability based on administrative boundaries or entire city should carefully interpret the findings, acknowledging the limitations of the chosen scale. Their investigations might benefit from complementary data sources or future research exploring walkability at various scales to build a comprehensive understanding of how the built environment affects walking across different contexts.

1.6 Research significant

Despite the established link between 5ds and walking across varied city layouts, merging it with syntactic metrics holds significant potential for researchers seeking to decipher the effectiveness of dendritic layout, exemplified by Putrajaya, in fostering walkability within neighbourhood level. Furthermore, this study empowers Malaysian researchers with operational guidance for measuring key walkability factors, enabling more robust and standardized assessments. This research is also theoretically relevant because its findings provide new information on the use of syntactic properties in neighbourhood walkability studies. While current frameworks frequently necessitate complex database creation, rely on inaccurate data, and involve costly fieldwork, our resulting framework provide a good avenue for developing new measures for neighbourhood walkability based on syntactic properties of its street network; these measures may be useful in situations where data are not readily available. Such tool would be useful for urban planning as well as improving and targeting interventions to promote walking. Finally, the geographical definition of a neighbourhood remains an enigmatic problem within the objective assessment framework of walkability. However, the findings of this study, using syntactic metrics, offer a breakthrough for both researchers and practitioners by providing guidance on determining appropriate neighbourhood size for neighbourhood walkability research and interventions. Notably, this perspective presents an intriguing inquiry in the context of Malaysia, where unfavourable weather conditions often lead to shorter walking distances and, consequently, smaller investigation buffers. Studying the relationship between the built environment and walking within these smaller buffers would be a significant contribution to the field, aiding researchers, and practitioners in promoting walkability in similar weather conditions.

1.7 Research Structure

To address the previously mentioned research issue of objective walkability, this study used a quantitative research method to compare and combine measurements of both 5Ds assessment methods and syntactic metrics of urban form in relation to walking volume through an observational study at multi-level neighbourhood definitions. Therefore, the research was structured into four stages. Accordingly, stage 1 is designed as a phase of literature study, investigating the concept of walkability and its measures, reviewing

Malaysian walkability studies, and examining two fields of objective measures—5Ds of urban form and syntactic measures—and their potential to explain walking behaviour in a combined model. Furthermore, it explores the impact of neighbourhood definition in terms of geographical scale on the built environment-walking relationship. Stage 2: This stage focused on operationalizing the variables for fieldwork, acquiring data, and preparing it for GIS analysis. Stage 3: This stage consisted of two parts: (1) analysing the built environment using GIS and space syntax methods, and (2) examining the relationships between variables using statistical analyses (nonparametric correlation, linear regression, and negative binomial regression). Stage 4: This final stage involved developing a neighbourhood walkability assessment tool based on the empirical findings.

1.8 Thesis outlines

The thesis comprises seven chapters and is outlined as follows:

Chapter I: Introduction

This chapter discusses the research background, the problem description, the research questions, objectives, and hypotheses, as well as the methods and steps of this study. It also discusses the study's significance and introduces the scope and limitations of the study.

Chapter II: Neighbourhood Built Environment and Walking Behaviour

This chapter explores the concept of walkability, discussing the association between the built environment and walking behaviour. It then covers walkability measurements by comparing objective versus perceived-based approaches, as well as the agreement between them, Furthermore, it investigates the impact of neighbourhood definition in terms of geographical units on the built environment-walking relationship.

Chapter III: Objective Walkability Approaches

This chapter explores combining the 5Ds with syntactic measures, detailing their theoretical connection. It reviews empirical findings on the 5Ds and walking behaviour, synthesizing studies on objective neighbourhood walkability. The conclusion presents a theoretical framework for assessing neighbourhood walkability using syntactic measures and the 5Ds.

Chapter IV: Methodology

This chapter describes how the research was designed by providing a detailed overview of the discussion regarding the study's research methodology. It outlines the strategies for developing research methods, presents the setting and context of the investigated areas, and introduces data collection methods before providing an overview of the statistical analysis performed.

Chapter V: Results

This chapter presents the findings of the statistical analysis conducted to address the research questions. Additionally, it visualizes the results of GIS and syntactic analysis in the form of maps to facilitate comparison.

Chapter VI: Discussion

This section discusses the findings on neighbourhood walkability assessment based on 5Ds and syntactic metrics. It also discusses their compatibility to predict walking in the context of Putrajaya.

Chapter VII: Conclusion and Recommendations

The final chapter summarizes the overall outputs of this study and concludes the findings related to the objective of the research. This chapter is divided into four main sections, discussing the conclusion of the study, the practical and theoretical implications, policy recommendations, strengths and limitations of the study, and suggestions for future work.

REFERENCES

Abdulah, A., Mirzaei, N. F., & Haron, S. H. (2016). Perception of Neighbourhood-Level Built Environment in Relation to Youth Physical Activity in Malaysia. World Academy of Science, Engineering and Technology International Journal of Humanities and Social Sciences, 1(11), 3596–3601.

Abu-Ghazzeh, T. M. (1994). Built Form and Religion: Underlying Structures of Jeddah Al-Qademah. Traditional Dwellings and Settlements Review, 5(2), 49–59. http://www.jstor.org/stable/41757170

Alalouch, C., Al-Hajri, S., Naser, A., & Al Hinai, A. (n.d.). The impact of space syntax spatial attributes on urban land use in Muscat: Implications for urban sustainability. Sustainable Cities and Society, 46, 101417. https://doi.org/https://doi.org/10.1016/j.scs.2019.01.002

Alawadi, K., Khanal, A., Doudin, A., & Abdelghani, R. (2021). Revisiting transit-oriented development: Alleys as critical walking infrastructure. Transport Policy, 100(August 2020), 187–202. https://doi.org/10.1016/j.tranpol.2020.11.007

Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., & Shlomo, A. (1977). A pattern language : towns, buildings, construction.

Appleyard, D. (1980). Livable Streets: Protected Neighborhoods? The Annals of the American Academy of Political and Social Science, 451, 106–117. http://www.jstor.org/stable/1043165

Arellana, J., Saltarín, M., Larrañaga, A. M., Alvarez, V., & Henao, C. A. (2020). Urban walkability considering pedestrians' perceptions of the built environment: a 10-year review and a case study in a medium-sized city in Latin America. Transport Reviews, 40(2), 183–203. https://doi.org/10.1080/01441647.2019.1703842

Ariffin, R. N. R., & Zahari, R. K. (2013). Perceptions of the Urban Walking Environments. Procedia - Social and Behavioral Sciences, 105, 589–597. https://doi.org/10.1016/j.sbspro.2013.11.062

Ariza-Álvarez, A., Arranz-López, A., & Soria-Lara, J. A. (2019). Comparing walking accessibility variations between groceries and other retail activities for seniors. Research in Transportation Economics, September, 100745. https://doi.org/10.1016/j.retrec.2019.100745

Arranz-López, A., Soria-Lara, J. A., Witlox, F., & Páez, A. (2019). Measuring relative non-motorized accessibility to retail activities. International Journal of Sustainable Transportation, 13(9), 639–651. https://doi.org/10.1080/15568318.2018.1498563

Arshad, A. K., Bahari, N. I., Hashim, W., & Halim, A. G. A. (2016). Gender differences in pedestrian perception and satisfaction on the walkability of Kuala Lumpur City Center. MATEC Web of Conferences, 47, 3–8. https://doi.org/10.1051/matecconf/20164703003

Asadi-shekari, Z., Moeinaddini, M., Aghaabbasi, M., Cools, M., & Zali Shah, M. (2019). Exploring effective micro-level items for evaluating inclusive walking facilities on urban streets (applied in Johor Bahru , Malaysia). Sustainable Cities and Society, 49(April), 101563. https://doi.org/10.1016/j.scs.2019.101563

Asia World Population Review. (2022). World Population Prospects.

Audrey, S., Procter, S., & Cooper, A. R. (2014). The contribution of walking to work to adult physical activity levels: A cross sectional study. International Journal of Behavioral Nutrition and Physical Activity, 11(1), 1–8. https://doi.org/10.1186/1479-5868-11-37

Azari, M., Billa, L., & Chan, A. (2022). Multi-temporal analysis of past and future land cover change in the highly urbanized state of Selangor, Malaysia. Ecological Processes, 11(1), 2. https://doi.org/10.1186/s13717-021-00350-0

Azmi, D. I., Abdul Karim, H., & Ahmad, P. (2013). Comparative Study of Neighbourhood Walkability to Community Facilities between Two Precincts in Putrajaya. Procedia - Social and Behavioral Sciences, 105, 513–524. https://doi.org/10.1016/j.sbspro.2013.11.055

Azmi, D. I., & Ahmad, P. (2015). A GIS Approach: Determinant of Neighbourhood Environment Indices in Influencing Walkability between Two Precincts in Putrajaya. Procedia - Social and Behavioral Sciences, 170, 557–566. https://doi.org/10.1016/j.sbspro.2015.01.057

Azmi, D. I., & Karim, H. A. (2011). A Comparative Study of Walking Behaviour to Community Facilities in Low-Cost and Medium Cost Housing. Procedia - Social and Behavioral Sciences, 35(December 2011), 619–628. https://doi.org/10.1016/j.sbspro.2012.02.129

Azmi, D. I., & Karim, H. A. (2012). Implications of Walkability Towards Promoting Sustainable Urban Neighbourhood. Procedia - Social and Behavioral Sciences, 50(July), 204–213. https://doi.org/10.1016/j.sbspro.2012.08.028

Azmi, D. I., Karim, H. A., & Amin, M. Z. M. (2012). Comparing the Walking Behaviour between Urban and Rural Residents. Procedia - Social and Behavioral Sciences, 68(7), 406–416. https://doi.org/10.1016/j.sbspro.2012.12.237

Baran, P. K., Rodríed;guez, D. A., & Khattak, A. J. (2008). Space syntax and walking in a New Urbanist and suburban neighbourhoods. Journal of Urban Design, 13(1), 5–28. https://doi.org/10.1080/13574800701803498

Bardet, G. (1951). Social Topography: An Analytico-Synthetic Understanding of the Urban Texture. The Town Planning Review, 22(3), 237–260. http://www.jstor.org/stable/40102188

Barr, A., Simons, K., Mavoa, S., Badland, H., Giles-Corti, B., Scheurer, J., Korevaar, E., Stewart, J., & Bentley, R. (2019). Daily walking among commuters: A cross-sectional study of associations with residential, work, and regional accessibility in Melbourne, Australia (2012–2014). Environmental Health Perspectives, 127(9), 1–12. https://doi.org/10.1289/EHP3395

Barros, A. P., Martínez, L. M., & Viegas, J. M. (2017). How urban form promotes walkability? Transportation Research Procedia, 27, 133–140. https://doi.org/10.1016/j.trpro.2017.12.039

Battista, G. A., & Manaugh, K. (2019). Generating walkability from pedestrians' perspectives using a qualitative GIS method. Travel Behaviour and Society, 17, 1–7. https://doi.org/https://doi.org/10.1016/j.tbs.2019.05.009

Batty, M. (2022). Integrating space syntax with spatial interaction. Urban Informatics, 1(1), 4. https://doi.org/10.1007/s44212-022-00004-2

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J. F., & Martin, B. W. (2012). Correlates of physical activity: why are some people physically active and others not? Lancet (London, England), 380(9838), 258–271. https://doi.org/10.1016/S0140-6736(12)60735-1

Baxter, S. L. K., Jackson, E., Onufrak, S., Parisi, M. A., & Griffin, S. F. (2022). Differences in Rural Built Environment Perceptions Across Demographic and Social Environment Characteristics. Health Promotion Practice, 23(1_suppl), 44S-54S.

Berhie, G., & Haq, S. (2015). The effect of spatial configuration on propensity for non--motorised journey to work. The 10th International Space Syntax Symposium, 62, 1–17.

Berhie, G. K. (2016). The Effect of Spatial Configuration on Land Use and Transport Mode Choices: Space Syntax Exploration on Gridded and Non-Gridded American Cities (Issue August 2016).

Berrigan, D., Pickle, L. W., & Dill, J. (2010). Associations between street connectivity and active transportation. International Journal of Health Geographics, 9, 1–18. https://doi.org/10.1186/1476-072X-9-20

Bielik, M., König, R., Schneider, S., & Varoudis, T. (2018). Measuring the Impact of Street Network Configuration on the Accessibility to People and Walking Attractors. Networks and Spatial Economics, 18(3), 657–676. https://doi.org/10.1007/s11067-018-9426-x

Bleich, S. N., Ku, R., & Wang, Y. C. (2011). Relative contribution of energy intake and energy expenditure to childhood obesity: a review of the literature and directions for future research. International Journal of Obesity, 35(1), 1–15. https://doi.org/10.1038/ijo.2010.252

Bloem, B. A., Van Tilburg, T. G., & Thomése, F. (2013). Starting Relationships with Neighbors After a Move Later in Life: An Exploratory Study. Journal of Housing For the Elderly, 27(1–2), 28–47. https://doi.org/10.1080/02763893.2012.724374

Boarnet, M. G., Greenwald, M., & Mcmillan, T. E. (2008). Walking , Urban Design , and Health. https://doi.org/10.1177/0739456X07311073

Boarnet, M. G., Joh, K., Siembab, W., Fulton, W., & Nguyen, M. T. (2011). Retrofitting the Suburbs to Increase Walking : Evidence from a Land-use – Travel Study. 48(January), 129–159. https://doi.org/10.1177/0042098010364859

Boeing, G. (2019). Urban spatial order: street network orientation, configuration, and entropy. Applied Network Science, 4(1), 67. https://doi.org/10.1007/s41109-019-0189-1

Boeing, G. (2021). Off the Grid…and Back Again? Journal of the American Planning Association, 87(1), 123–137. https://doi.org/10.1080/01944363.2020.1819382

Booth, G. L., Creatore, M. I., Luo, J., Fazli, G. S., Johns, A., Rosella, L. C., Glazier, R. H., Moineddin, R., Gozdyra, P., & Austin, P. C. (2019). Neighbourhood walkability and the incidence of diabetes: an inverse probability of treatment weighting analysis. Journal of Epidemiology and Community Health, 73(4), 287–294. https://doi.org/10.1136/jech-2018-210510

Boozani, H. A. (2013). Walkable Design Neighborhood A sustainable Urban Form.

Brad, E. (2009). The Rise of the Network Society. The Information Age: Economy, Society and Culture, Vol. 1, 2nd ed. In The Bottom Line (Vol. 14, Issue 3). Emerald Group Publishing Limited. https://doi.org/10.1108/bl.2001.17014cae.003

Brown, B. B., Yamada, I., Smith, K. R., Zick, C. D., Kowaleski-Jones, L., & Fan, J. X. (2009). Mixed land use and walkability: Variations in land use measures and relationships with BMI, overweight, and obesity. Health & Place, 15(4), 1130–1141. https://doi.org/https://doi.org/10.1016/j.healthplace.2009.06.008

Brownson, R. C., Hoehner, C. M., Day, K., Forsyth, A., & Sallis, J. F. (2009). State of the Science. AMEPRE, 36(4), S99-S123.e12. https://doi.org/10.1016/j.amepre.2009.01.005

Burke, M., Sipe, N., Evans, R., & Mellifont, D. (2005). sabeen. 1–17.

Campbell, E., Henly, J. R., & Elliott, D. S. (2009). Subjective Constructions of Neighborhood Boundaries : Lessons From A Qualitative Study Of Four University of Chicago University of Chicago University of Colorado University of Hawaii. 31(4), 461–490. https://doi.org/10.1111/j.1467-9906.2009.00450.x

Carlson, J. A., Frank, L. D., Ulmer, J., Conway, T. L., Saelens, B. E., Cain, K. L., & Sallis, J. F. (2018). Work and Home Neighborhood Design and Physical Activity. American Journal of Health Promotion, 32(8), 1723–1729. https://doi.org/10.1177/0890117118768767

Carlson, J. A., Saelens, B. E., Kerr, J., Schipperijn, J., Conway, T. L., Frank, L. D., Chapman, J. E., Glanz, K., Cain, K. L., & Sallis, J. F. (2015). Association between neighborhood walkability and GPS-measured walking, bicycling and vehicle time in adolescents. Health and Place, 32, 1–7. https://doi.org/10.1016/j.healthplace.2014.12.008

Carpio-Pinedo, J. (2014). Urban bus demand forecast at stop level: Space Syntax and other built environment factors. Evidence from Madrid. Procedia-Social and Behavioral Sciences, 160, 205–214.

Carr, L. J., Dunsiger, S. I., & Marcus, B. H. (2010). Walk ScoreTM As a Global Estimate of Neighborhood Walkability. American Journal of Preventive Medicine, 39(5), 460–463. https://doi.org/https://doi.org/10.1016/j.amepre.2010.07.007

Cauwenberg, J. Van, Cerin, E., Timperio, A., Salmon, J., Deforche, B., & Veitch, J. (2015). Park proximity , quality and recreational physical activity among mid-older aged adults : moderating effects of individual factors and area of residence. 1–8. https://doi.org/10.1186/s12966-015-0205-5

Cerin, E., Barnett, A., Zhang, C. J. P., Lai, P., Sit, C. H. P., & Lee, R. S. Y. (2020). How urban densification shapes walking behaviours in older community dwellers: a cross-sectional analysis of potential pathways of influence. International Journal of Health Geographics, 19(1), 14. https://doi.org/10.1186/s12942-020-00210-8

Cerin, E., Conway, T. L., Adams, M. A., Barnett, A., Cain, K. L., Owen, N., Christiansen, L. B., van Dyck, D., Mitáš, J., Sarmiento, O. L., Davey, R. C., Reis, R., Salvo, D., Schofield, G., & Sallis, J. F. (2018). Objectively-assessed neighbourhood destination accessibility and physical activity in adults from 10 countries: An analysis of moderators and perceptions as mediators. Social Science and Medicine, 211(June), 282–293. https://doi.org/10.1016/j.socscimed.2018.06.034

Cerin, E., Lee, K. yiu, Barnett, A., Sit, C. H. P., Cheung, M. chin, Chan, W. man, & Johnston, J. M. (2013). Walking for transportation in Hong Kong Chinese urban elders: A cross-sectional study on what destinations matter and when. International Journal of Behavioral Nutrition and Physical Activity, 10, 1–10. https://doi.org/10.1186/1479-5868-10-78

Cervero, R., & Duncan, M. (2003). Walking , Bicycling , and Urban Landscapes : Evidence From the San Francisco Bay Area. 93(9), 1478–1483.

Cervero, R., & Kockelman, K. (1997). Travel Demand And The 3Ds : Density , Design Diversity , And. 2(3), 199–219.

Cervero, R., Sarmiento, O. L., Jacoby, E., Gomez, L. F., & Neiman, A. (2009). Influences of built environments on walking and cycling: Lessons from Bogotá. International Journal of Sustainable Transportation, 3(4), 203–226. https://doi.org/10.1080/15568310802178314

Chaix, B., Kestens, Y., Duncan, S., Merrien, C., Thierry, B., Pannier, B., Brondeel, R., Lewin, A., Karusisi, N., Perchoux, C., Thomas, F., & Méline, J. (2014). Active transportation and public transportation use to achieve physical activity recommendations ? A combined GPS , accelerometer , and mobility survey study. 1–11.

Chan, Y. Y., Lim, K. K. H., Lim, K. K. H., Teh, C. H., Kee, C. C., Cheong, S. M., Khoo, Y. Y., Baharudin, A., Ling, M. Y., Omar, M. A., & Ahmad, N. A. (2017). Physical activity and overweight/obesity among Malaysian adults: findings from the 2015 National Health and morbidity survey (NHMS). BMC Public Health, 17(1), 733. https://doi.org/10.1186/s12889-017-4772-z

Chatman, D. G. (2009). Residential choice , the built environment , and nonwork travel : evidence using new data and methods. 41, 1072–1090. https://doi.org/10.1068/a4114

Cheah, W. L., Chang, C. T., & Saimon, R. (2012). Environment factors associated with adolescents' body mass index, physical activity and physical fitness in Kuching south city, Sarawak: A cross-sectional study. International Journal of Adolescent Medicine and Health, 24(4), 331–337. https://doi.org/10.1515/ijamh.2012.048

Chen, Y. (2019). Neighborhood form and residents ' walking and biking distance to food markets : Evidence from Beijing , China. Transport Policy, 81(November 2016), 340–349. https://doi.org/10.1016/j.tranpol.2017.09.015

Chiang, Y.-C., & Li, D. (2019). Metric or topological proximity? The associations among proximity to parks, the frequency of residents' visits to parks, and perceived stress. Urban Forestry & Urban Greening, 38, 205–214. https://doi.org/https://doi.org/10.1016/j.ufug.2018.12.011

Chin, G. K. W., Niel, K. P. Van, Giles-corti, B., & Knuiman, M. (2008). Accessibility and connectivity in physical activity studies : The impact of missing pedestrian data. 46, 41–45. https://doi.org/10.1016/j.ypmed.2007.08.004

Chiu Chuen, O., Karim, M. R., & Yusoff, S. (2014). Mode choice between private and public transport in Klang Valley, Malaysia. The Scientific World Journal, 2014.

Christian, H. E., Bull, F. C., Middleton, N. J., Knuiman, M. W., Divitini, M. L., Hooper, P., Amarasinghe, A., & Giles-Corti, B. (2011). How important is the land use mix measure in understanding walking behaviour? Results from the RESIDE study. International Journal of Behavioral Nutrition and Physical Activity, 8. https://doi.org/10.1186/1479-5868-8-55

Clark, A. F., Scott, D. M., & Yiannakoulias, N. (2014). Examining the relationship between active travel, weather, and the built environment: a multilevel approach using a GPS-enhanced dataset. Transportation, 41(2), 325–338. https://doi.org/10.1007/s11116-013-9476-3

Clark, A., & Scott, D. (2014). Understanding the Impact of the Modifiable Areal Unit Problem on the Relationship between Active Travel and the Built Environment. Urban Studies, 51(2), 284–299. https://doi.org/10.1177/0042098013489742

Cole, R., Koohsari, M. J., Carver, A., Owen, N., & SUGIYAMA, T. (2018). Are neighborhood environmental attributes more important for older than for younger adults' walking? Testing effect modification by age. Neighborhood Environments, Walking, and Age, August, 1–18.

Cooley, C. H. (1909). Social organization: A study of the larger mind. In Social organization: A study of the larger mind. Charles Scribner's Sons. https://doi.org/10.1037/14788-000

Coulton, C. (2012). Defining Neighborhoods for Research and Policy. 14(2), 231–236.

Coulton, C., Chan, T., & Mikelbank, K. (2011). Finding Place in Community Change Initiatives: Using GIS to Uncover Resident Perceptions of their Neighborhoods. Journal of Community Practice, 19(1), 10–28. https://doi.org/10.1080/10705422.2011.550258

Coulton, C. J., Jennings, M. Z., & Chan, T. (2013). How big is my neighborhood? Individual and contextual effects on perceptions of neighborhood scale. American Journal of Community Psychology, 51(1–2), 140–150. https://doi.org/10.1007/s10464-012-9550-6

Cubukcu, E., Hepguzel, B., Onder, Z., & Tumer, B. (2015). Asia Pacific International Conference on Environment-Behaviour Studies Active Living For Sustainable Future : A model to measure " walk scores " via Geographic Information Systems. Procedia - Social and Behavioral Sciences, 168, 229–237. https://doi.org/10.1016/j.sbspro.2014.10.228

Cutumisu, N. (2011). University of Alberta Movement-Attractors and Generic Environment Traits The Association between Urban Form and Physical Activity by Doctor of Philosophy Faculty of Physical Education and Recreation.

Cutumisu, N., & Spence, J. (2009). Exploring associations between urban environments and children ' s ...

Day, K. (2016). Built environmental correlates of physical activity in China: A review. Preventive Medicine Reports, 3, 303–316. https://doi.org/10.1016/j.pmedr.2016.03.007

De Koning, R. E., Van Nes, A., Ye, Y., & Roald, H. J. (2017). Strategies for integrated densification with urban qualities: Combining Space Syntax with building density, land usage, public transport and property rights in Bergen city. XI SSS: 11th International Space Syntax Symposium 2017, 51–56.

De Siqueira, G., Mabry, R., Al Siyabi, H., Adeel, A., Malaj, S., & Oyeyemi, A. (2023). Construct validity of the physical activity neighborhood environment scale-Oman. Frontiers in Public Health, 11, 1007075.

Deng, C., Dong, X., Wang, H., Lin, W., Wen, H., Frazier, J., Ho, H. C., & Holmes, L. (2020). A Data-Driven Framework for Walkability Measurement with Open Data : A Case Study of Triple Cities , New York.

Devarajan, R., Prabhakaran, D., & Goenka, S. (2020). Built environment for physical activity-An urban barometer, surveillance, and monitoring. Obesity Reviews : An Official Journal of the International Association for the Study of Obesity, 21(1), e12938. https://doi.org/10.1111/obr.12938

Diao, M., & Ferreira, J. (2010). Residential property values and the built environment: Empirical study in the Boston, Massachusetts, Metropolitan Area. Transportation Research Record, 2174, 138–147. https://doi.org/10.3141/2174-18

Dill, J. (2004). Measuring network connectivity for bicycling and walking. 83rd Annual Meeting of the Transportation …, 1, 20. http://reconnectingamerica.org/assets/Uploads/TRB2004-001550.pdf

Dollman, J., Okely, A. D., Hardy, L., Timperio, A., Salmon, J., & Hills, A. P. (2009). Measuring the built environment for physical activity: State of the science. In Journal of science and medicine in sport (Vol. 12, Issue 5, pp. 518–525). https://doi.org/10.1016/j.jsams.2008.09.007

Dong, Z. (2021). Epidemiological Features of Cardiovascular Disease in Asia. JACC: Asia, 1(1), 1–13. https://doi.org/10.1016/j.jacasi.2021.04.007

Duncan, M. J., Winkler, E., Sugiyama, T., Cerin, E., Dutoit, L., Leslie, E., & Owen, N. (2010). Relationships of land use mix with walking for transport: Do land uses and geographical scale matter? Journal of Urban Health, 87(5), 782–795. https://doi.org/10.1007/s11524-010-9488-7

Durand, C. P., Andalib, M., Dunton, G. F., Wolch, J., & Pentz, M. A. (2012). NIH Public Access. 12(501), 1–15. https://doi.org/10.1111/j.1467-789X.2010.00826.x.A

Durand, C. P., Tang, X., Gabriel, K. P., Sener, I. N., Oluyomi, A. O., Knell, G., Porter, A. K., Hoelscher, D. M., & Kohl, H. W. (2016). The association of trip distance with walking to reach public transit : Data from the California Household Travel Survey. Journal of Transport & Health, 3(2), 154–160. https://doi.org/10.1016/j.jth.2015.08.007

Dyck, V., Cardon, G., Deforche, B., Sallis, J. F., Owen, N., & Bourdeaudhuij, I. De. (2010). Neighborhood SES and walkability are related to physical activity behavior in Belgian adults. 50, 74–79. https://doi.org/10.1016/j.ypmed.2009.07.027

Dyck, D. Van, Cardon, G., Deforche, B., De Bourdeaudhuij, I., & Bourdeaudhuij, I. De. (2011). Do adults like living in high-walkable neighborhoods? Associations of walkability parameters with neighborhood satisfaction and possible mediators. Health & Place, 17(4), 971–977. https://doi.org/https://doi.org/10.1016/j.healthplace.2011.04.001

El-geneidy, A., Rania, G., & Te, P. (2014). New evidence on walking distances to transit stops : identifying redundancies and gaps using variable service areas. 193–210. https://doi.org/10.1007/s11116-013-9508-z

Ellis, G., Hunter, R., Tully, M. A., Donnelly, M., Kelleher, L., & Kee, F. (2015). Connectivity and physical activity: using footpath networks to measure the walkability of built environments. Environment and Planning B: Planning and Design, 43(1), 130–151. https://doi.org/10.1177/0265813515610672

Ellis, G., Ireland, N., Hunter, R., Tully, M. A., Ireland, N., Donnelly, M., Kelleher, L., Ireland, N., & Kee, F. (2015). Connectivity and physical activity : using footpath networks to measure the walkability of built environments. 42, 1–22. https://doi.org/10.1068/b140039p

Elsawahli, H., Shah Ali, A., Ahmad, F., & M.Al-Obaidi, K. (2017). Evaluating Potential Environmental Variables and Active Aging in Older Adults for Age-Friendly Neighborhoods in Malaysia. Journal of Housing for the Elderly, 31(1), 74–92. https://doi.org/10.1080/02763893.2016.1268560

Eriksson, U., Arvidsson, D., Gebel, K., Ohlsson, H., & Sundquist, K. (2012). Walkability parameters, active transportation and objective physical activity: moderating and mediating effects of motor vehicle ownership in a cross-sectional study. International Journal of Behavioral Nutrition and Physical Activity, 9(1), 123. https://doi.org/10.1186/1479-5868-9-123

Ewing, R., & Cervero, R. (2010). Travel and the built environment: A meta-analysis. Journal of the American Planning Association, 76(3), 265–294. https://doi.org/10.1080/01944361003766766

Ewing, R., & Handy, S. (2010). Measuring the Unmeasurable : Urban Design Qualities Related to Walkability Measuring the Unmeasurable : Urban Design Qualities. 4809(October). https://doi.org/10.1080/13574800802451155

Fan, P., Wan, G., Xu, L., Park, H., Xie, Y., Liu, Y., Yue, W., & Chen, J. (2018). Walkability in urban landscapes: a comparative study of four large cities in China. Landscape Ecology, 33(2), 323–340. https://doi.org/10.1007/s10980-017-0602-z

Fareh, F., & Alkama, D. (2022). The Effect of Spatial Configuration on the Movement Distribution Behavior: The Case Study of Constantine Old Town (Algeria). Engineering, Technology & Applied Science Research, 12(5), 9136–9141.

Feng, C., & Peponis, J. (2021). Pathways to creating differentiated grids: Types, benefits and costs. Environment and Planning B: Urban Analytics and City Science, 49(2), 535–548. https://doi.org/10.1177/23998083211013818

Feng, J., Glass, T. A., Curriero, F. C., Stewart, W. F., & Schwartz, B. S. (2010). The built environment and obesity: A systematic review of the epidemiologic evidence. Health and Place, 16(2), 175–190. https://doi.org/10.1016/j.healthplace.2009.09.008

Field, A., Miles, J., & Field, Z. (2012). Discovering statistics using R. Sage publications.

Fishman, E., Böcker, L., & Helbich, M. (2015). Adult Active Transport in the Netherlands : An Analysis of Its Contribution to Physical Activity Requirements. 1–14. https://doi.org/10.1371/journal.pone.0121871

Fonseca, F., Ribeiro, P. J. G., Conticelli, E., Jabbari, M., Papageorgiou, G., Tondelli, S., & Ramos, R. A. R. (2022). Built environment attributes and their influence on walkability. International Journal of Sustainable Transportation, 16(7), 660–679. https://doi.org/10.1080/15568318.2021.1914793

Forsyth, A. (2015). What is a Walkable Place ? The Walkability Debate in Urban Design.

Forsyth, A., Hearst, M., Oakes, J. M., & Schmitz, K. H. (2008). Design and destinations: Factors influencing walking and total physical activity. Urban Studies, 45(9), 1973–1996. https://doi.org/10.1177/0042098008093386

Forsyth, A., Oakes, J. M., Schmitz, K. H., & Hearst, M. (2007). Does residential density increase walking and other physical activity? Urban Studies, 44(4), 679–697. https://doi.org/10.1080/00420980601184729

Foster, K. A., & Aaron Hipp, J. (2011). Defining neighborhood boundaries for social measurement: Advancing social work research. Social Work Research, 35(1), 25–35. https://doi.org/10.1093/swr/35.1.25

Foster, S., & Giles-Corti, B. (2008). The built environment, neighborhood crime and constrained physical activity: An exploration of inconsistent findings. Preventive Medicine, 47(3), 241–251. https://doi.org/10.1016/j.ypmed.2008.03.017

Foster, S., Hooper, P., Knuiman, M., Bull, F., & Giles-Corti, B. (2016). Are liveable neighbourhoods safer neighbourhoods? Testing the rhetoric on new urbanism and safety from crime in Perth, Western Australia. Social Science and Medicine, 164, 150–157. https://doi.org/10.1016/j.socscimed.2015.04.013

Frank, L. D., Sallis, J. F., Saelens, B. E., Leary, L., Cain, K., Conway, T. L., & Hess, P. M. (2010). The development of a walkability index : application to the Neighborhood Quality of Life Study. 924–933. https://doi.org/10.1136/bjsm.2009.058701

Frank, L. D., Schmid, T. L., Sallis, J. F., Chapman, J., & Saelens, B. E. (2005). Objectively Measured Urban Form Findings from SMARTRAQ. 28, 117–125. https://doi.org/10.1016/j.amepre.2004.11.001

Gao, J., Kamphuis, C. B. M., Helbich, M., & Ettema, D. (2020). What is ' neighborhood walkability '? How the built environment differently correlates with walking for different purposes and with walking on weekdays and weekends. Journal of Transport Geography, 88(March), 102860. https://doi.org/10.1016/j.jtrangeo.2020.102860

Garau, C., Annunziata, A., & Yamu, C. (2020). A walkability assessment tool coupling multi-criteria analysis and space syntax: the case study of Iglesias, Italy. European Planning Studies, 0(0), 1–23. https://doi.org/10.1080/09654313.2020.1761947

Gebel, K., Bauman, A. E., Sugiyama, T., & Owen, N. (2011). Health & Place Mismatch between perceived and objectively assessed neighborhood walkability attributes : Prospective relationships with walking and weight gain. Health & Place, 17(2), 519–524. https://doi.org/10.1016/j.healthplace.2010.12.008

Gehrke, S. R., & Clifton, K. J. (2014). Operationalizing Land Use Diversity at Varying Geographic Scales and Its Connection to Mode Choice: Evidence from Portland, oregon. Transportation Research Record, 2453(1), 128–136. https://doi.org/10.3141/2453-16

Gehrke, S. R., & Clifton, K. J. (2016). Toward a spatial-temporal measure of land-use mix. Journal of Transport and Land Use, 9(1), 171–186. https://doi.org/10.5198/jtlu.2015.725

Gehrke, S. R., & Wang, L. (2020). Operationalizing the neighborhood effects of the built environment on travel behavior. Journal of Transport Geography, 82(October 2019), 102561. https://doi.org/10.1016/j.jtrangeo.2019.102561

Giles-corti, B., Vernez-moudon, A., Reis, R., Turrell, G., Dannenberg, A. L., Badland, H., Foster, S., Lowe, M., Sallis, J. F., Stevenson, M., & Owen, N. (2016). Urban design , transport , and health 1 City planning and population health : a global challenge. The Lancet, 388(10062), 2912–2924. https://doi.org/10.1016/S0140-6736(16)30066-6

Giles-Corti, B., Wood, G., Pikora, T., Learnihan, V., Bulsara, M., Van Niel, K., Timperio, A., McCormack, G., & Villanueva, K. (2011). School site and the potential to walk to school: The impact of street connectivity and traffic exposure in school neighborhoods. Health and Place, 17(2), 545–550. https://doi.org/10.1016/j.healthplace.2010.12.011

Giles-Corti, B., Macaulay, G., Middleton, N., Boruff, B., Bull, F., Butterworth, I., Badland, H., Mavoa, S., Roberts, R., & Christian, H. (2014). Developing a research and practice tool to measure walkability: A demonstration project. Health Promotion Journal of Australia, 25(3), 160–166.

Glazier, R. H., Weyman, J. T., Creatore, M. I., Gozdyra, P., Moineddin, R., Matheson, F. I., & Booth, G. L. (2012). Development and validation of an urban walkability index for Toronto, Canada. Toronto Community Health Profiles Partnership, 1–21.

Gori, S., Nigro, M., & Petrelli, M. (2014). Walkability Indicators for Pedestrian-Friendly Design. Transportation Research Record, 2464(1), 38–45. https://doi.org/10.3141/2464-05

Gotham, K. F., & Brumley, K. (2002). Using Space : Agency and Identity in a Public-Housing. September, 267–289.

Gotham, K. F. O. X. (2003). Toward an Understanding of the Spatiality of Urban Poverty : The Urban Poor as Spatial Actors. 27(September), 723–737.

Grasser, G., & Dyck, D. Van. (2013). Objectively measured walkability and active transport and weight-related outcomes in adults : a systematic review. 615–625. https://doi.org/10.1007/s00038-012-0435-0

Grasser, G., van Dyck, D., Titze, S., & Stronegger, W. J. (2017). A European perspective on GIS-based walkability and active modes of transport. European Journal of Public Health, 27(1), 145–151. https://doi.org/10.1093/eurpub/ckw118

Guo, Y., & Peeta, S. (2020). Impacts of personalized accessibility information on residential location choice and travel behavior. Travel Behaviour and Society, 19(January), 99–111. https://doi.org/10.1016/j.tbs.2019.12.007

Guo, Y., Peeta, S., & Somenahalli, S. (2017). The impact of walkable environment on single-family residential property values. Journal of Transport and Land Use, 10(1), 241–261. https://doi.org/10.5198/jtlu.2017.824

Habibian, M., & Hosseinzadeh, A. (2018). Walkability index across trip purposes. Sustainable Cities and Society, 42(December 2017), 216–225. https://doi.org/10.1016/j.scs.2018.07.005

Hahm, Y., Yoon, H., Jung, D., & Kwon, H. (2017). Do built environments affect pedestrians' choices of walking routes in retail districts? A study with GPS experiments in Hongdae retail district in Seoul, South Korea. Habitat International, 70(September), 50–60. https://doi.org/10.1016/j.habitatint.2017.10.002

Hajna, S., Dasgupta, K., Halparin, M., & Ross, N. A. (2013). Neighborhood Walkability: Field Validation of Geographic Information System Measures. American Journal of Preventive Medicine, 44(6), e55–e59. https://doi.org/https://doi.org/10.1016/j.amepre.2013.01.033

Hajna, S., Ross, N. A., Brazeau, A., Bélisle, P., Joseph, L., & Dasgupta, K. (2015). Associations between neighbourhood walkability and daily steps in adults: a systematic review and meta-analysis. BMC Public Health, 15(1), 768. https://doi.org/10.1186/s12889-015-2082-x

Hajrasouliha, A., & Yin, L. (2015). The impact of street network connectivity on pedestrian volume. Urban Studies, 52(13), 2483–2497. https://doi.org/10.1177/0042098014544763

Harumain, Y. A. S., Azmi, N. F., & Yusoff, S. M. (2017). Assessing Elements of Walkability in Women ' s Mobility. Journal of the Society of Automotive Engineers Malaysia, 1(3), 208–215.

Harumain, Y. A. S., Koting, Suhana, Rosni, N. A., & Ibrahim, N. (2022). The Influence of Sociodemographic Background on Active Transportation: A Case Study of Bangsar and Shah Alam, Malaysia . In Frontiers in Built Environment (Vol. 8). https://www.frontiersin.org/articles/10.3389/fbuil.2022.925956

Harun, N. Z., & Nashar, A. (2017). Developing a Framework for Streetscape Design to Promote Walkability in Malaysian Campus. Journal of Computational and Theoretical Nanoscience, 23(April). https://doi.org/10.1166/asl.2017.7616

Hasan, A. R., & Nair, P. L. (2022). Urbanisation and growth of metropolitan centres in Malaysia. Malaysian Journal of Economic Studies. https://doi.org/10.3316/informit.554433876393606

Hayley, C., Matthew, K., Mark, D., Sarah, F., Paula, H., Bryan, B., Fiona, B., & Billie, G.-C. (2017). A Longitudinal Analysis of the Influence of the Neighborhood Environment on Recreational Walking within the Neighborhood: Results from RESIDE. Environmental Health Perspectives, 125(7), 77009. https://doi.org/10.1289/EHP823

Hess, D. B. (2012). Walking to the bus : perceived versus actual walking distance to bus stops for older adults. 247–266. https://doi.org/10.1007/s11116-011-9341-1

Hidayati, I., Yamu, C., & Tan, W. (2021). You have to drive: Impacts of planning policies on urban form and mobility behavior in Kuala Lumpur, Malaysia. Journal of Urban Management, 10(1), 69–83. https://doi.org/https://doi.org/10.1016/j.jum.2020.12.004

Hillier, B. (1996). Cities as movement economies. In Urban Design International (Vol. 1, Issue 1, pp. 41–60). https://doi.org/10.1057/udi.1996.5

Hillier, B. (1999). The hidden geometry of deformed grids: Or, why space syntax works, when it looks as though it shouldn't. Environment and Planning B: Planning and Design, 26(2), 169–191. https://doi.org/10.1068/b4125

Hillier, B. (2007). Space is the machine.

Hillier, B., Burdett, R., Peponis, J., & Penn, A. (1987). Creating life: or, does architecture determine anything? Arch.&Comort./Arch.Behav, 3(3), 233–250.

Hillier, B., & Hanson, J. (1984). The Social Logic of Space. Cambridge University Press. https://doi.org/10.1017/CBO9780511597237

Hillier, B., & Iida, S. (2005). Network and Psychological Effects in Urban Movement. 1987, 475–490.

Hillier, B., Penn, A., & Xu, J. (1993). Natural Movement : Or , Configuration and Attraction in Urban Pedestrian Movement. UCL, August. https://doi.org/10.1068/b200029

Hillier, B., Turner, A., Yang, T., & Park, H. (2007). Metric and topo-geometric properties of urban street networks. Proceedings, 6th International Space Syntax Symposium, İstanbul, January 2007.

Hinckson, E., Cerin, E., Mavoa, S., Smith, M., Badland, H., Stewart, T., Duncan, S., & Schofield, G. (2017). Associations of the perceived and objective neighborhood environment with physical activity and sedentary time in New Zealand adolescents. International Journal of Behavioral Nutrition and Physical Activity, 14(1), 145. https://doi.org/10.1186/s12966-017-0597-5

Hino, A. A. F., Reis, R. S., Sarmiento, O. L., Parra, D. C., & Brownson, R. C. (2013). Built Environment and Physical Activity for Transportation in Adults from Curitiba , Brazil. 91(3), 446–462. https://doi.org/10.1007/s11524-013-9831-x

Hogendorf, M., Oude Groeniger, J., Noordzij, J. M., Beenackers, M. A., & van Lenthe, F. J. (2020). Longitudinal effects of urban green space on walking and cycling: A fixed effects analysis. Health and Place, 61(November 2019). https://doi.org/10.1016/j.healthplace.2019.102264

Holliday, K. M., Howard, A. G., Emch, M., Rodríguez, D. A., & Evenson, K. R. (2017). Are buffers around home representative of physical activity spaces among adults? Health & Place, 45, 181–188.

Hou, Y., & Chua, R. (2020). The associations between older adults ' daily travel pattern and objective and perceived built environment : A study of three neighbourhoods in Singapore The associations between older adults ' daily travel pattern and objective and perceived built enviro. July. https://doi.org/10.1016/j.tranpol.2020.06.017

Huang, R., Moudon, A. V., Zhou, C., & Saelens, B. E. (2019). Higher residential and employment densities are associated with more objectively measured walking in the home neighborhood. Journal of Transport and Health, 12(December 2018), 142–151. https://doi.org/10.1016/j.jth.2018.12.002

Im, H. N., & Choi, C. G. (2019). The hidden side of the entropy-based land-use mix index: Clarifying the relationship between pedestrian volume and land-use mix. Urban Studies, 56(9), 1865–1881. https://doi.org/10.1177/0042098018763319

Inoue, S., Ohya, Y., Odagiri, Y., Takamiya, T., Ishii, K., Kitabayashi, M., Suijo, K., Sallis, J. F., & Shimomitsu, T. (2010). Association between Perceived Neighborhood Environment and Walking among Adults in 4 Cities in Japan. 20(4), 277–286. https://doi.org/10.2188/jea.JE20090120

Ja'afar, N. H., & Harun, N. Z. (2018). Building opening design contributing to traditional streets' walkability character in Melaka historic city. Planning Malaysia, 16(4), 188–198. https://doi.org/10.21837/pmjournal.v16.i8.549

Javad, M., Badland, H., & Giles-corti, B. (2013). (Re) Designing the built environment to support physical activity : Bringing public health back into urban design and planning. Cities, 35, 294–298. https://doi.org/10.1016/j.cities.2013.07.001

Jia, Y., Usagawa, T., & Fu, H. (2014). The Association between Walking and Perceived Environment in Chinese Community Residents : A Cross- Sectional Study. 9(2). https://doi.org/10.1371/journal.pone.0090078

Jun, C., Kwon, J. H., Choi, Y., & Lee, I. (2006). An alternative measure of public transport accessibility based on space syntax. International Conference on Hybrid Information Technology, 281–291.

Kaczynski, A. T., & Glover, T. D. (2012). Talking the talk, walking the walk: examining the effect of neighbourhood walkability and social connectedness on physical activity. Journal of Public Health, 34(3), 382–389.

Kaczynski, A. T., & Henderson, K. A. (2007). Environmental correlates of physical activity: A review of evidence about parks and recreation. Leisure Sciences, 29(4), 315–354. https://doi.org/10.1080/01490400701394865

Kamruzzaman, M., Washington, S., Baker, D., Brown, W., Giles-Corti, B., & Turrell, G. (2016). Built environment impacts on walking for transport in Brisbane, Australia. Transportation, 43(1), 53–77. https://doi.org/10.1007/s11116-014-9563-0

Kang, hang D. (2017). Measuring the effects of street network configurations on walking in Seoul, Korea. Cities, 71(July), 30–40. https://doi.org/10.1016/j.cities.2017.07.005

Kang, C. D. (2015). The effects of spatial accessibility and centrality to land use on walking in Seoul, Korea. Cities, 46, 94–103. https://doi.org/10.1016/j.cities.2015.05.006

Kang, C. D. (2016). Spatial access to pedestrians and retail sales in Seoul, Korea. Habitat International, 57, 110–120. https://doi.org/10.1016/j.habitatint.2016.07.006

Kang, C. D. (2018). The S + 5Ds: Spatial access to pedestrian environments and walking in Seoul, Korea. Cities, 77(January), 130–141. https://doi.org/10.1016/j.cities.2018.01.019

Karim, H. A., & Azmi, D. I. (2013). Convenience and Safety of Walking Experience in Putrajaya Neighbourhood Area. Procedia - Social and Behavioral Sciences, 101, 318–327. https://doi.org/10.1016/j.sbspro.2013.07.206

Karjalainen, L. E., & Juhola, S. (2019). Framework for Assessing Public Transportation Sustainability in Planning and Policy-Making. Sustainability, 11(4). https://doi.org/10.3390/su11041028

Keat, L. K., Yaacob, N. M., & Hashim, N. R. (2016). Campus walkability in Malaysian public universities: A case-study of universiti malaya. Planning Malaysia, 5, 101–114.

Keller, S. (1966). NEIGHBOURHOOD CONCEPTS IN SOCIOLOGICAL PERSPECTIVE. Athens Center of Ekistics, 22(128), 67–76.

Kelly, C. M., Lian, M., Struthers, J., & Kammrath, A. (2015). Walking to Work: The Roles of Neighborhood Walkability and Socioeconomic Deprivation. Journal of Physical Activity & Health, 12(Suppl 1), S70–S75. https://doi.org/10.1123/jpah.2012-0359

Kelly, J. A., & Fu, M. (2014). Sustainable school commuting - understanding choices and identifying opportunities. A case study in Dublin, Ireland. Journal of Transport Geography, 34, 221–230. https://doi.org/10.1016/j.jtrangeo.2013.12.010

Kerr, J., Emond, J. A., Badland, H., Reis, R., Sarmiento, O., Carlson, J., Sallis, J. F., Cerin, E., Cain, K., Conway, T., Schofield, G., & Macfarlane, D. J. (2016). Perceived Neighborhood Environmental Attributes Associated with Walking and Cycling for Transport among Adult Residents of 17 Cities in 12 Countries : The IPEN Study. 290(3), 290–298.

Kerr, J., Sallis, J. F., Owen, N., De Bourdeaudhuij, I., Cerin, E., Sugiyama, T., Reis, R., Sarmiento, O., Frömel, K., & Mitáš, J. (2013). Advancing science and policy through a coordinated international study of physical activity and built environments: IPEN adult methods. Journal of Physical Activity and Health, 10(4), 581–601.

Keyvanfar, A., Ferwati, M. S., Shafaghat, A., & Lamit, H. (2018). A path walkability assessment index model for evaluating and facilitating retail walking using decision-tree-making (DTM) method. Sustainability (Switzerland), 10(4), 1–33. https://doi.org/10.3390/su10041035

Kiang, H. C. (2014). A Categorization System for Residential Wards in Tang Chang’an. Journal of the Society of Architectural Historians, 73(1), 91–117. https://doi.org/10.1525/jsah.2014.73.1.91

Kim, H. J., & Heinrich, K. M. (2016). Built environment Factors influencing Walking to school Behaviors : a comparison between a small and large Us city. 4(April), 17–23. https://doi.org/10.3389/fpubh.2016.00077

Kim, H., & Jun, C. (2013). Spatial analysis of the relationship between space syntax and land use density. Proceedings of the 9th International Space Syntax Symposium.

Koohsari, M. J., Badland, H., Sugiyama, T., Mavoa, S., Christian, H., & Giles-corti, B. (2014). Mismatch between Perceived and Objectively Measured Land Use Mix and Street Connectivity : Associations with Neighborhood Walking. 92(2), 242–252. https://doi.org/10.1007/s11524-014-9928-x

Koohsari, M. J., Kaczynski, A. T., Giles-Corti, B., & Karakiewicz, J. A. (2013). Effects of access to public open spaces on walking: Is proximity enough? Landscape and Urban Planning, 117, 92–99. https://doi.org/10.1016/j.landurbplan.2013.04.020

Koohsari, M. J., Kaczynski, A. T., Mcormack, G. R., & Sugiyama, T. (2014). Using Space Syntax to Assess the Built Environment for Physical Activity: Applications to Research on Parks and Public Open Spaces. Leisure Sciences, 36(2), 206–216. https://doi.org/10.1080/01490400.2013.856722

Koohsari, M. J., Karakiewicz, J. A., & Kaczynski, A. T. (2013). Public Open Space and Walking: The Role of Proximity, Perceptual Qualities of the Surrounding Built Environment, and Street Configuration. Environment and Behavior, 45(6), 706–736. https://doi.org/10.1177/0013916512440876

Koohsari, M. J., Oka, K., Owen, N., & Sugiyama, T. (2019). Health & Place Natural movement : A space syntax theory linking urban form and function with walking for transport. Health & Place, July 2018, 0–1. https://doi.org/10.1016/j.healthplace.2019.01.002

Koohsari, M. J., Owen, N., Cerin, E., Giles-corti, B., & Sugiyama, T. (2016). Walkability and walking for transport : characterizing the built environment using space syntax. International Journal of Behavioral Nutrition and Physical Activity, 1–9. https://doi.org/10.1186/s12966-016-0448-9

Koohsari, M. J., Owen, N., Cole, R., Mavoa, S., Oka, K., Hanibuchi, T., & Sugiyama, T. (2017). Built environmental factors and adults ' travel behaviors : Role of street layout and local destinations. Preventive Medicine, 96, 124–128. https://doi.org/10.1016/j.ypmed.2016.12.021

Koohsari, M. J., Sugiyama, T., Lamb, K. E., Villanueva, K., & Owen, N. (2014). Street connectivity and walking for transport : Role of neighborhood destinations. Preventive Medicine, 66, 118–122. https://doi.org/10.1016/j.ypmed.2014.06.019

Koohsari, M. J., Sugiyama, T., & Mavoa, S. (2016). Health & Place Street network measures and adults ' walking for transport : Application of space syntax. Health & Place, 38, 89–95. https://doi.org/10.1016/j.healthplace.2015.12.009

Kwan, M.-P., Wang, J., Tyburski, M., Epstein, D. H., Kowalczyk, W. J., & Preston, K. L. (2019). Uncertainties in the geographic context of health behaviors: A study of substance users' exposure to psychosocial stress using GPS data. International Journal of Geographical Information Science, 33(6), 1176–1195.

Kwan, S. C., Ismail, R., Ismail, N. H., & Mohamed, N. (2021). An ecological study of the relationship between urban built environment and cardiovascular hospital admissions (2004–2016) in an Asian developing country. Social Science and Medicine, 276(January), 113868. https://doi.org/10.1016/j.socscimed.2021.113868

Kyaw, T. M., Ismail, Z., Selamat, M. I., & Nawawi, H. (2022). Obesity and its associated factors among older adults: MyHEBAT (Malaysian HEalth and Well-Being AssessmenT) study. Health Science Reports, 5(4), e668. https://doi.org/10.1002/hsr2.668

Lachapelle, U., & Pinto, D. G. (2016). Longer or more frequent walks : Examining the relationship between transit use and active transportation in Canada. Journal of Transport & Health, 1–8. https://doi.org/10.1016/j.jth.2016.02.005

Lakdawalla, D., & Philipson, T. (2009). The growth of obesity and technological change. Economics and Human Biology, 7(3), 283–293. https://doi.org/10.1016/j.ehb.2009.08.001

Lamíquiz, P. J., & López-Domínguez, J. (2015). Effects of built environment on walking at the neighbourhood scale. A new role for street networks by modelling their configurational accessibility? Transportation Research Part A: Policy and Practice, 74, 148–163. https://doi.org/10.1016/j.tra.2015.02.003

Larrañaga, A. M., Arellana, J., Rizzi, L. I., Strambi, O., & Cybis, H. B. B. (2018). Using best–worst scaling to identify barriers to walkability: a study of Porto Alegre, Brazil. Transportation, 1–33.

Leão, A. L. F., Abonizio, H. Q., Reis, R. S., & Kanashiro, M. (2020). Walkability variables: an empirical study in Rolândia – PR, Brazil. 475–488.

Learnihan, V., Van Niel, K. P., Giles-Corti, B., & Knuiman, M. (2011). Effect of Scale on the Links between Walking and Urban Design. Geographical Research, 49(2), 183–191. https://doi.org/10.1111/j.1745-5871.2011.00689.x

Lebendiger, Y., & Lerman, Y. (2019). Applying space syntax for surface rapid transit planning. Transportation Research Part A: Policy and Practice, 128, 59–72. https://doi.org/https://doi.org/10.1016/j.tra.2019.07.016

Lee, B. A., & Kanan, J. W. (1994). Neighborhood Context and Residential Mobility *. 31(2), 249–270.

Lee, C., & Moudon, A. V. (2006). THE 3Ds+R: Quantifying Land Use and Urban Form Correlates of Walking (Vol. 4057).

Lee, I.-M., & Buchner, D. M. (2008). The importance of walking to public health. Medicine and Science in Sports and Exercise, 40(7 Suppl), S512-8. https://doi.org/10.1249/MSS.0b013e31817c65d0

Lee, S. (2013). Combining Space Syntax With Gis-Based Built Environment Measures in Pedestrian Walking Activity.

Lee, S. M., Conway, T. L., Frank, L. D., Saelens, B. E., Cain, K. L., & Sallis, J. F. (2016). The Relation of Perceived and Objective Environment Attributes to Neighborhood Satisfaction. https://doi.org/10.1177/0013916515623823

Lee, S., Yoo, C., & Seo, K. W. (2020a). Determinant factors of pedestrian volume in different land-use zones: Combining space syntax metrics with GIS-based built-environment measures. Sustainability (Switzerland), 12(20). https://doi.org/10.3390/su12208647

Lee, S., Yoo, C., & Seo, K. W. K. W. (2020b). Determinant factors of pedestrian volume in different land-use zones: Combining space syntax metrics with GIS-based built-environment measures. Sustainability, 12(20), 8647. https://doi.org/10.3390/su12208647

Lerman, Y., Rofè, Y., & Omer, I. (2014). Using space syntax to model pedestrian movement in urban transportation planning. Geographical Analysis, 46(4), 392–410. https://doi.org/10.1111/gean.12063

Leslie, E., Coffee, N., Frank, L., Owen, N., Bauman, A., & Hugo, G. (2007). Walkability of local communities : Using geographic information systems to objectively assess relevant environmental attributes. 13, 111–122. https://doi.org/10.1016/j.healthplace.2005.11.001

Lewis, S., & Grande del Valle, E. (2019). San Francisco's neighborhoods and auto dependency. Cities, 86, 11–24. https://doi.org/https://doi.org/10.1016/j.cities.2018.12.017

Li, J., Peterson, A., Auchincloss, A. H., Hirsch, J. A., Rodriguez, D. A., Melly, S. J., Moore, K. A., Diez-Roux, A. V, & Sánchez, B. N. (2022). Comparing effects of Euclidean buffers and network buffers on associations between built environment and transport walking: the Multi-Ethnic Study of Atherosclerosis. International Journal of Health Geographics, 21(1), 1–12.

Liao, B., van den Berg, P. E. W., van Wesemael, P. J. V., & Arentze, T. A. (2020). Empirical analysis of walkability using data from the Netherlands. Transportation Research Part D: Transport and Environment, 85(June), 102390. https://doi.org/10.1016/j.trd.2020.102390

Liao, B., Xu, Y., Li, X., & Li, J. (2022). Association between Campus Walkability and Affective Walking Experience, and the Mediating Role of Walking Attitude. International Journal of Environmental Research and Public Health, 19(21). https://doi.org/10.3390/ijerph192114519

Lima, F., Brown, N., & Duarte, J. (2022). A Grammar-Based Optimization Approach for Designing. August. https://doi.org/10.3390/buildings12081157

Lin, L., & Moudon, A. V. (2010). Health & Place Objective versus subjective measures of the built environment , which are most effective in capturing associations with walking ? Health & Place, 16(2), 339–348. https://doi.org/10.1016/j.healthplace.2009.11.002

Liu, Y., Wei, X., Jiao, L., & Wang, H. (2016). Relationships between street centrality and land use intensity in Wuhan, China. Journal of Urban Planning and Development, 142(1), 5015001.

Lohmann, A., & McMurran, G. (2009). Resident-defined neighborhood mapping: using GIS to analyze phenomenological neighborhoods. Journal of Prevention & Intervention in the Community, 37(1), 66–81. https://doi.org/10.1080/10852350802498714

Lotfi, S., & Javad, M. (2009). Measuring objective accessibility to neighborhood facilities in the city (A case study : Zone 6 in Tehran , Iran). 26, 133–140. https://doi.org/10.1016/j.cities.2009.02.006

Loucks, D. (2005). Model Sensitivity and Uncertainty Analysis.

Low, S. M., & Altman, I. (1992). 1 Place Attachment. 1–2.

Lu, Y. (2019). Using Google Street View to investigate the association between street greenery and physical activity. Landscape and Urban Planning, 191(July 2017). https://doi.org/10.1016/j.landurbplan.2018.08.029

Lu, Y., Sarkar, C., & Xiao, Y. (2018). The effect of street-level greenery on walking behavior: Evidence from Hong Kong. Social Science & Medicine, 208(December 2017), 41–49. https://doi.org/https://doi.org/10.1016/j.socscimed.2018.05.022

Lu, Y., Xiao, Y., & Ye, Y. (2017). Urban density, diversity and design: Is more always better for walking? A study from Hong Kong. Preventive Medicine, 103, S99–S103. https://doi.org/10.1016/j.ypmed.2016.08.042

Ma, L. (2014). The Objective vs . the Perceived Environment : What Matters for Active Travel. Portland State University.

Mahmoud, Z. A., Ahmad, Y., Manyam Keumala, N. I., & Mahmoud, E. A. (2016). Examining the Walkability of Planned Neighbourhood in Malaysia: Outcome of a Pilot Study. OIDA International Journal of Sustainable Development, Ontario International Development Agency, Canada, 2000.

Mahmoudi, M., Ahmad, F., & Abbasi, B. (2015). Livable streets: The effects of physical problems on the quality and livability of Kuala Lumpur streets. Cities, 43, 104–114.

Majid, M. R., Lim, N. H. H., Zaman, M., & Ruslik, N. (2021). Exploring The Link Between Bmi, Perceived Neighbourhood Environment And Health Behaviours In Malaysia. Journal of Sustainability Science and Management, 16(7), 190–208. https://doi.org/10.46754/jssm.2021.10.015

Malambo, P., Kengne, A. P., Lambert, E. V, Villers, A. De, & Puoane, T. (2017). Association between perceived built environmental attributes and physical activity among adults in South Africa. https://doi.org/10.1186/s12889-017-4128-8

Maleki, M. Z., & Zain, M. F. M. (2011). Factors that influence distance to facilities in a sustainable efficient residential site design. Sustainable Cities and Society, 1(4), 236–243. https://doi.org/10.1016/j.scs.2011.07.008

Mansouri, M., & Ujang, N. (2016a). Journal of Urbanism : International Research on Space syntax analysis of tourists ' movement patterns in the historical district of Kuala Lumpur , Malaysia. Journal of Urbanism International Research on Placemaking and Urban Sustainability, July. https://doi.org/10.1080/17549175.2016.1213309

Mansouri, M., & Ujang, N. (2016b). Tourist' expectation and satisfaction towards pedestrian networks in the historical district of Kuala Lumpur, Malaysia. Asian Geographer, 33(1), 35–55. https://doi.org/10.1080/10225706.2016.1185639

Mansouri, M., & Ujang, N. (2017). Space syntax analysis of tourists' movement patterns in the historical district of Kuala Lumpur, Malaysia. Journal of Urbanism, 10(2), 163–180. https://doi.org/10.1080/17549175.2016.1213309

Marshall, J. D., Brauer, M., & Frank, L. D. (2009). Healthy Neighborhoods : Walkability and Air Pollution. 11, 1752–1760. https://doi.org/10.1289/ehp.0900595

Marshall, W. E., & Garrick, N. W. (2010). Effect of street network design on walking and biking. Transportation Research Record, 2198, 103–115. https://doi.org/10.3141/2198-12

Martin, D. G. (2003). Enacting Neighborhood1. Urban Geography, 24(5), 361–385. https://doi.org/10.2747/0272-3638.24.5.361

Mateo-Babiano, I. (2016). Pedestrian's needs matter: Examining Manila's walking environment. Transport Policy, 45, 107–115. https://doi.org/https://doi.org/10.1016/j.tranpol.2015.09.008

Mathis, B. J., Tanaka, K., & Hiramatsu, Y. (2023). Obesity vs. Metabolically Healthy Obesity in East Asia. In Encyclopedia (Vol. 3, Issue 2, pp. 730–745). https://doi.org/10.3390/encyclopedia3020053

Matthews, S. A. (2008). The salience of neighborhood: some lessons from sociology. In American journal of preventive medicine (Vol. 34, Issue 3, pp. 257–259). https://doi.org/10.1016/j.amepre.2007.12.001

Mavoa, S., Bagheri, N., Kaczynski, Koohsari, M. J., T, A., Lamb, K. E., Oka, K., O'Sullivan, D., & Witten, K. (2019). How Do Neighbourhood Definitions Influence the Associations between Built Environment and Physical Activity? In Walkable Neighborhoods. https://doi.org/10.3390/books978-3-03921-931-5

Mavoa, S., Boulangé, C., Stewart, J., & Giles-corti, B. (2018). Identifying appropriate land-use mix measures for use in a national walkability index. 681–700.

Mayne, D. J., Morgan, G. G., Jalaludin, B. B., & Bauman, A. E. (2019). Area-level walkability and the geographic distribution of high body mass in Sydney, Australia: a spatial analysis using the 45 and up study. International Journal of Environmental Research and Public Health, 16(4), 664.

Mayne, D. J., Morgan, G. G., Willmore, A., Rose, N., Jalaludin, B., Bambrick, H., & Bauman, A. (2013). An objective index of walkability for research and planning in the Sydney Metropolitan Region of New South Wales, Australia: An ecological study. International Journal of Health Geographics, 12(1), 8–10. https://doi.org/10.1186/1476-072x-12-61

Mccormack, G. R., Javad, M., Turley, L., Nakaya, T., Shibata, A., Ishii, K., Yasunaga, A., & Oka, K. (2019). Health and Place Evidence for urban design and public health policy and practice : Space syntax metrics and neighborhood walking. Health and Place, December, 102277. https://doi.org/10.1016/j.healthplace.2019.102277

Mccormack, G. R., Koohsari, M. J., Turley, L., Nakaya, T., Shibata, A., Ishii, K., Yasunaga, A., Oka, K., Javad, M., Turley, L., Nakaya, T., Shibata, A., Ishii, K., Yasunaga, A., & Oka, K. (2021). Evidence for urban design and public health policy and practice: Space syntax metrics and neighborhood walking. Health & Place, 67(December), 102277. https://doi.org/https://doi.org/10.1016/j.healthplace.2019.102277

Meng, L., & Ishida, T. (2022). Analysis of the Relationship between Beijing Rail Transit and Urban Planning Based on Space Syntax. Sustainability, 14(14), 8744.

Milgram, S. (1977). The individual in a social world : essays and experiments. Addison-Wesley Pub. Co.

Min, K. M., Moon, J. M., & Kim, Y. O. (2007). The Effect Of Spatial Configuration On Land Use And Land Value In Seoul. Proceedings, 6th International Space Syntax Symposium, İstanbul, 2007, 80.1-80.16.

Mitra, R., & Buliung, R. N. (2012). Built environment correlates of active school transportation: Neighborhood and the modifiable areal unit problem. Journal of Transport Geography, 20(1), 51–61. https://doi.org/10.1016/j.jtrangeo.2011.07.009

Mitra, R., Buliung, R. N., & Roorda, M. J. (2010). Built environment and school travel mode choice in Toronto, Canada. Transportation Research Record, 2156, 150–159. https://doi.org/10.3141/2156-17

Mokhlas, H., Hamid, N. A., Mustafa, M., & Sham, R. (2015). Measuring Walkability Attributes of Pedestrians Rail Commuter: A Pilot Study. Proceedings of the 1st AAGBS International Conference on Business Management 2014 (AiCoBM 2014), January 2016. https://doi.org/10.1007/978-981-287-426-9

Molaei, P., Tang, L., & Hardie, M. (2021). Measuring Walkability with Street Connectivity and Physical Activity: A Case Study in Iran. In World (Vol. 2, Issue 1, pp. 49–61). https://doi.org/10.3390/world2010004

Monyeki, M. A., Moss, S. J., Kemper, H. C. G., & Twisk, J. W. R. (2018). Self-Reported Physical Activity is Not a Valid Method for Measuring Physical Activity in 15-Year-Old South African Boys and Girls. Children (Basel, Switzerland), 5(6), 71. https://doi.org/10.3390/children5060071

Moudon, A. V., Lee, C., Cheadle, A. D., Garvin, C., Johnson, D., Schmid, T. L., Weathers, R. D., & Lin, L. (2006). Operational Definitions of Walkable Neighborhood: Theoretical and Empirical Insights. Journal of Physical Activity & Health, 3(s1), S99–S117. https://doi.org/10.1123/jpah.3.s1.s99

Mph, C. X., Goryakin, Y., & Cecchini, M. (2018). Physical Activity Levels and New Public Transit: A Systematic Review and Meta-analysis. https://doi.org/10.1016/j.amepre.2018.10.022

N. Cutumisu1, 2,∗, C. Blanchard3, R. Plotnikoff4, T. Berry5, J. S. (2012). Effect ofneighbourhood space syntax on the frequency ofwalk- ing in Edmonton, Canada. Journal OfScience and Medicine in Sport, 15(1), 1–14. http://www.ramr.org/articulos/volumen_8_numero_2/casuistica/casuisticas_emangioendotelioma_epitelioide_de_pleura.pdf%0Ahttps://www.hindawi.com/journals/crira/2017/5972940/%0Ahttp://www.echeat.com/free-essay/Understanding-the-Basics-of-American-Football-31

Nag, D., Sen, J., & Kishore, A. (2022). Measuring Connectivity of Pedestrian Street Networks in the Built Environment for Walking : A Space - Syntax Approach. Transportation in Developing Economies. https://doi.org/10.1007/s40890-022-00170-7

Nasrudin, N., Sarimin, M., & Ibrahim, N. (2018). Assessing a walkable environment in Jalan Tuanku Abdul Rahman, Kuala Lumpur, Malaysia. Planning Malaysia, 16(3), 261–273. https://doi.org/10.21837/pmjournal.v16.i7.516

Neatt, K., Millward, H., & Spinney, J. (2017). Neighborhood walking densities: A multivariate analysis in Halifax, Canada. Journal of Transport Geography, 61(April), 9–16. https://doi.org/10.1016/j.jtrangeo.2017.04.005

Netto, V. M. (2016). ' What is space syntax not ? ' Re fl ections on space syntax as sociospatial theory. 21, 25–40. https://doi.org/10.1057/udi.2015.21

NHMS. (2019). National Health and Morbidity Survey (Vol. 20). https://doi.org/10.18356/be4d1601-en

Nik-Nasir, N. M., Md-Yasin, M., Ariffin, F., Mat-Nasir, N., Miskan, M., Abu-Bakar, N., & Yusoff, K. (2022). Physical Activity in Malaysia: Are We Doing Enough? Findings from the REDISCOVER Study. International Journal of Environmental Research and Public Health, 19(24). https://doi.org/10.3390/ijerph192416888

Nordin, N., & Nakamura, H. (2019). The Relation between Objective and Perceived Physical Characteristics of a Neighbourhood Environment for Older People. 9th Asia Pacific International Conference on Environment-Behaviour Studies, Faculty of Architecture, Ulisboa, Lisbon, Portugal, 03-04 Jul 2019. https://doi.org/10.21834/e-bpj.v4i11.1732

Nyagah, P. (2015). A Multi-Procedural Approach to Evaluating Walkability and Pedestrian Safety (Issue December).

Oliver, L. N., Schuurman, N., & Hall, A. W. (2007). Comparing circular and network buffers to examine the influence of land use on walking for leisure and errands. International Journal of Health Geographics, 6(1), 41. https://doi.org/10.1186/1476-072X-6-41

Olszewski, P. S., & Wibowo, S. (2005). Using Equivalent Walking Distance to Assess Pedestrian Accessibility to Transit Stations in Singapore. January 2005. https://doi.org/10.3141/1927-05

Omar, D., Omar, K. A., Othman, S., & Yusoff, Z. M. (2016). Walkability Design for Urban Public Housing Park. 7th Asian Conference on Environment-Behaviour Studies National Taiwan University, Taipei, Taiwan, 1(April), 9–10. https://doi.org/10.21834/e-bpj.v1i3.375

Openshaw, S. (1984). Ecological Fallacies and the Analysis of Areal Census Data. Environment and Planning A: Economy and Space, 16(1), 17–31. https://doi.org/10.1068/a160017

Orstad, S. L., Mcdonough, M. H., Stapleton, S., Altincekic, C., & Troped, P. J. (2016). Review of Agreement Between Perceived and Objective Neighborhood Environment Measures and Associations With Physical Activity Outcomes. 1–29. https://doi.org/10.1177/0013916516670982

Ortiz-chao, C. (2007). in Mexico City Using.

Owen, N., Cerin, E., Leslie, E., Coffee, N., Frank, L. D., Bauman, A. E., Hugo, G., Saelens, B. E., Sallis, J. F., Bs, M. B., Hugo, G., Saelens, B. E., & Sallis, J. F. (2007). Neighborhood walkability and the walking behavior of Australian adults. American Journal of Preventive Medicine, 33(5), 387–395. https://doi.org/10.1016/j.amepre.2007.07.025

Oyeyemi, A. L., Adegoke, B. O., Sallis, J. F., Oyeyemi, A. Y., & Bourdeaudhuij, I. De. (2012). Perceived crime and traffic safety is related to physical activity among adults in Nigeria.

Ozbil, A., Gurleyen, T., Yesiltepe, D., & Zunbuloglu, E. (2019). Comparative associations of street network design, streetscape attributes and land-use characteristics on pedestrian flows in peripheral neighbourhoods. International Journal of Environmental Research and Public Health, 16(10). https://doi.org/10.3390/ijerph16101846

Ozbil, A., & Peponis, J. (2012). The effects of urban form on walking to transit. Proceedings of the Eigth International Space Syntax Symposium, Santiago, Chile, 1–15.

Ozbil, A., Peponis, J., & Stone, B. (2011). Understanding the link between street connectivity , land use and pedestrian flows. URBAN DESIGN International, 16(2), 17–76. https://doi.org/10.1057/udi.2011.2

Özbil Torun, A., Göçer, K., Yeşiltepe, D., & Argın, G. (2020). Understanding the role of urban form in explaining transportation and recreational walking among children in a logistic GWR model: A spatial analysis in Istanbul, Turkey. Journal of Transport Geography, 82(November 2019). https://doi.org/10.1016/j.jtrangeo.2019.102617

Ozer, O., & Kubat, A. S. (2007). Walkability: Perceived and measured qualities in action. 2007 International Space Syntax Symposium, 101–117. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006267585&partnerID=40&md5=6db170b1ff29564f0ee32aabd7066bf4

Pafka, E. (2017). Integration Is Not Walkability. Proceedings of the 11th Space Syntax Symposium, 102.1-102.10. http://www.11ssslisbon.pt/docs/proceedings/papers/102.pdf

Park, S., Choi, K., & Lee, J. S. (2014). To Walk or Not to Walk : Testing the Effect of Path Walkability on Transit Users ' Access Mode Choices to the Station. December, 37–41. https://doi.org/10.1080/15568318.2013.825036

Park, Y., & Rogers, G. O. (2015). Neighborhood Planning Theory, Guidelines, and Research: Can Area, Population, and Boundary Guide Conceptual Framing? Journal of Planning Literature, 30(1), 18–36. https://doi.org/10.1177/0885412214549422

Paydar, M., & Kamani Fard, A. (2022). Walking behavior of older adults in Temuco, Chile: the contribution of the built environment and socio-demographic factors. International Journal of Environmental Research and Public Health, 19(22), 14625.

Pebley, A. R. (2009). Our Place : Perceived Neighborhood Size and Names in Los Angeles. December.

PECAR, M. (1999). Bosnian Dwelling Tradition: Continuity and Transformation in the Reconstruction of Sarajevo. Traditional Dwellings and Settlements Review, 11(1), 49–55. http://www.jstor.org/stable/41757731

Penn, A. (2003). Space syntax and spatial cognition: Or why the axial line? Environment and Behavior, 35(1), 30–65. https://doi.org/10.1177/0013916502238864

Penn, A., Hillier, B., Banister, D., & Xu, J. (1998). Configurational modelling of urban movement networks. Environment and Planning B: Planning and Design, 25(1), 59–84.

Peponis, J., Bafna, S., & Zhang, Z. (2008). The connectivity of streets : reach and directional distance. 35, 881–902. https://doi.org/10.1068/b33088

Peters, M., Muellmann, S., Christianson, L., Stalling, I., Bammann, K., Drell, C., & Forberger, S. (2020). Measuring the association of objective and perceived neighborhood environment with physical activity in older adults: challenges and implications from a systematic review. International Journal of Health Geographics, 19(1), 47. https://doi.org/10.1186/s12942-020-00243-z

Porta, S., Latora, V., Wang, F., Rueda, S., Strano, E., Scellato, S., Cardillo, A., Belli, E., Cardenas, F., & Cormenzana, B. (2012). Street centrality and the location of economic activities in Barcelona. Urban Studies, 49(7), 1471–1488.

Porta, S., Strano, E., Iacoviello, V., Messora, R., Latora, V., Cardillo, A., Wang, F., & Scellato, S. (2009). Street centrality and densities of retail and services in Bologna, Italy. Environment and Planning B: Planning and Design, 36(3), 450–465.

Qin, Z., Wang, Z., Ye, Q., Jia, P., Xiong, Y., & Xu, F. (2020). Relation between residential density and walking time among urban adults in Nanjing, China. Public Health, 181, 34–39. https://doi.org/10.1016/j.puhe.2019.12.002

Qureshi, S. (2016). ASSESSING BUILT ENVIRONMENT ATTRIBUTES OF WALKABLITY (Issue November). University Technology Malaysia.

Qureshi, S., Shaikh, J. M., & Memon, S. A. (2018). Residents's Subjective Assessment of Walkability Attributes in Objectively Assessed Neighbourhoods. Mehran University Research Journal of Engineering and Technology, 37(3), 673–680. https://doi.org/10.22581/muet1982.1803.20

Qureshi, S., & Siong, H. C. (2011). TOWARDS PUTRAJAYA GREEN CITY 2025 Planning Strategy for Sustainability. APSA Congress, 409–420.

Rahman, N. A., Shamsuddin, S., & Ghani, I. (2015). What makes people use the street?: Towards a liveable urban environment in Kuala Lumpur city centre. Procedia-Social and Behavioral Sciences, 170, 624–632.

Ramakreshnan, L., & Aghamohammadi, N. (2020). A comprehensive bibliometrics of ' walkability ' research landscape : visualization of the scientific progress and future prospects.

Ramakreshnan, L., Fong, C. S., Sulaiman, N. M., & Aghamohammadi, N. (2020). Motivations and built environment factors associated with campus walkability in the tropical settings. Science of The Total Environment, 749, 141457. https://doi.org/https://doi.org/10.1016/j.scitotenv.2020.141457

Ratti, C. (2004). Space syntax : some inconsistencies. 31(1994), 487–499. https://doi.org/10.1068/b3019

Reyer, M., Fina, S., Siedentop, S., & Schlicht, W. (2014). Walkability is only part of the story: Walking for transportation in Stuttgart, Germany. International Journal of Environmental Research and Public Health, 11(6), 5849–5865. https://doi.org/10.3390/ijerph110605849

Road, P., Student, D., & Road, P. (2007). TRANSIT STATION ACCESS TRIPS AND FACTORS AFFECTING PROPENSITY TO WALK TO TRANSIT STATIONS IN BANGKOK ,. 6.

Robitatille, É. (2009). Indicateurs géographiques de l'environnement bâti et de l'environnement des services influant sur l'activité physique, l'alimentation et le poids corporel. In Www.Inspq.Qc.Ca.

Rodrigue, L., Manaugh, K., El-Geneidy, A., Daley, J., Wasfi, R., Ravensbergen, L., & Butler, G. (2022). Factors influencing subjective walkability. Journal of Transport and Land Use, 15(1), 709–727.

Rodríguez, A., & Vogt, C. A. (2009). Demographic, environmental, access, and attitude factors that influence walking to school by elementary school-aged children. Journal of School Health, 79(6), 255–261. https://doi.org/10.1111/j.1746-1561.2009.00407.x

Rodríguez, D. A., Evenson, K. R., Diez Roux, A. V., & Brines, S. J. (2009). Land Use, Residential Density, and Walking. The Multi-Ethnic Study of Atherosclerosis. American Journal of Preventive Medicine, 37(5), 397–404. https://doi.org/10.1016/j.amepre.2009.07.008

Rui, Y., & Ban, Y. (2014). Exploring the relationship between street centrality and land use in Stockholm. International Journal of Geographical Information Science, 28(7), 1425–1438.

Saari, N. S. (2019). Planning For Integrated Bus Stop Using Space Syntax Analysis. In Faculty of Built Enviroment and Surveying, Universiti Teknologi Malaysia. Universiti Teknologi Malaysia.

Saeidi Hosseini, S. A. R., & Hatamzadeh, Y. (2020). Walking duration in daily travel: an analysis among males and females using a hazard-based model. Transportmetrica A: Transport Science, 0(0), 1–37. https://doi.org/10.1080/23249935.2020.1840655

Saelens, B. E., & Handy, S. (2008). Built Environment Correlates of Walking : A Review. Med. Sci. Sports Exerc., 550–566. https://doi.org/10.1249/MSS.0b013e31817c67a4

Saelens, B. E., Ph, D., Frank, L. D., Ph, D., & Med, A. B. (2003). Environmental Correlates of Walking and Cycling : Findings From the Transportation , Urban Design , and Planning Literatures. c, 80–91.

Saelens, B. E., Sallis, J. F., Frank, L. D., Cain, K. L., Conway, T. L., Chapman, J. E., Slymen, D. J., & Kerr, J. (2012). Neighborhood environment and psychosocial correlates of adults' physical activity. Medicine and Science in Sports and Exercise, 44(4), 637–646. https://doi.org/10.1249/MSS.0b013e318237fe18

Sallis, J. F. (2011). Environmental and Policy Research on Physical Activity is Going Global. 13, 111–117.

Sallis, J. F., Cerin, E., Conway, T. L., Adams, M. A., Frank, L. D., Pratt, M., Salvo, D., Schipperijn, J., Smith, G., Cain, K. L., Davey, R., Kerr, J., Lai, P., Mitáš, J., Reis, R., Sarmiento, O. L., Schofi, G., Troelsen, J., Dyck, D. Van, … Owen, N. (n.d.). Physical activity in relation to urban environments in 14 cities worldwide : a cross-sectional study. 2207–2217. https://doi.org/10.1016/S0140-6736(15)01284-2

Sallis, J. F., Saelens, B. E., Frank, L. D., Conway, T. L., Slymen, D. J., Cain, K. L., Chapman, J. E., & Kerr, J. (2009). Neighborhood built environment and income: Examining multiple health outcomes. Social Science and Medicine, 68(7), 1285–1293. https://doi.org/10.1016/j.socscimed.2009.01.017

Salvo, D., Reis, R. S., Sarmiento, O. L., & Pratt, M. (2014). Overcoming the challenges of conducting physical activity and built environment research in Latin America : IPEN Latin America. Preventive Medicine, 69, S86–S92. https://doi.org/10.1016/j.ypmed.2014.10.014

Salvo, D., Reis, R. S., Stein, A. D., Rivera, J., Martorell, R., & Pratt, M. (2014). Characteristics of the Built Environment in Relation to Objectively Measured Physical Activity Among Mexican Adults , 2011. 1–16.

Sarkar, C., Webster, C., & Gallacher, J. (2015). UK Biobank Urban Morphometric Platform (UKBUMP)–a nationwide resource for evidence-based healthy city planning and public health interventions. Annals of GIS, 21(2), 135–148.

Sarkar, C., Webster, C., & Gallacher, J. (2017). Association between adiposity outcomes and residential density: a full-data, cross-sectional analysis of 419 562 UK Biobank adult participants. The Lancet Planetary Health, 1(7), e277–e288.

Sayed, K. Al, Turner, A., & Hanna, S. (2009). Cities as Emergent Models The Morphological Logic of Manhattan and Barcelona. UCL, 2009, 1–12.

Schlossberg, M., & Brown, N. (2004). Comparing transit-oriented development sites by walkability indicators. Transportation Research Record, 1887, 34–42. https://doi.org/10.3141/1887-05

Scoppa, M. D., & Peponis, J. (2015). Distributed Attraction: The Effects of Street Network Connectivity upon the Distribution of Retail Frontage in the City of Buenos Aires. Environment and Planning B: Planning and Design, 42(2), 354–378. https://doi.org/10.1068/b130051p

Sevtsuk, A., Kalvo, R., & Ekmekci, O. (2016a). Pedestrian accessibility in grid layouts : the role of block , plot and street dimensions. 20, 89–106.

Sevtsuk, A., Kalvo, R., & Ekmekci, O. (2016b). Pedestrian accessibility in grid layouts : The role of block , plot and street dimensions Pedestrian accessibility in grid layouts : the role of block , plot and street dimensions. October. https://doi.org/10.51347/jum.v20i2.4056

Shah, M. Z. (2010). Rating Pedestrian Facility With P-Index And The Application of Google®Map. https://api.semanticscholar.org/CorpusID:115773898

Shamsuddin, S., Abu Hassan, N. R., & Ilani Bilyamin, S. F. (2012). Walkable Environment in Increasing the Liveability of a City. Procedia - Social and Behavioral Sciences, 50(July), 167–178. https://doi.org/10.1016/j.sbspro.2012.08.025

Sharmin, S., & Kamruzzaman, M. (2018). Meta-analysis of the relationships between space syntax measures and pedestrian movement. Transport Reviews, 38(4), 524–550. https://doi.org/10.1080/01441647.2017.1365101

Sheng, Q., Jiao, J., & Pang, T. (2021). Understanding the Impact of Street Patterns on Pedestrian Distribution: A Case Study in Tianjin, China. Urban Rail Transit, 7(3), 209–225. https://doi.org/10.1007/s40864-021-00152-9

Sherman, J. E., Spencer, J., Preisser, J. S., Gesler, W. M., & Arcury, T. A. (2005). A suite of methods for representing activity space in a healthcare accessibility study. 21, 1–21. https://doi.org/10.1186/1476-072X-4-24

Shojaei, S., & M.S, M. K. (2012). Preferences for Pedestrian Walkways in Tropical Urban Neighbourhoods of Kuala Lumpur , Malaysia. Journal of Environmental Research And Development, 6(3), 477–486.

Singh, R. (2016). Factors affecting walkability of neighborhoods. 216(October 2015), 643–654. https://doi.org/10.1016/j.sbspro.2015.12.048

Siqueira Reis, R., Hino, A. A. F., Ricardo Rech, C., Kerr, J., & Curi Hallal, P. (2013). Walkability and Physical Activity: Findings from Curitiba, Brazil. American Journal of Preventive Medicine, 45(3), 269–275. https://doi.org/https://doi.org/10.1016/j.amepre.2013.04.020

Soltani, A., Javadpoor, M., Shams, F., & Mehdizadeh, M. (2022). Street network morphology and active mobility to school: Applying space syntax methodology in Shiraz, Iran. Journal of Transport & Health, 27, 101493. https://doi.org/https://doi.org/10.1016/j.jth.2022.101493

Soltero, E. G. (2017). Associations Between Objective and Self-Report Measures of Traffic and Crime Safety in Latino Parents of Preschool Children. 19(4), 1109–1120. https://doi.org/10.1007/s10903-016-0498-8

Sorkin, M. (2014). Love thy neighbor. The Cities Papers, 303(9–10), 1–4. https://doi.org/10.2307/j.ctt20p5753.7

Stangl, P., & Guinn, J. M. (2011). Neighborhood design , connectivity assessment and obstruction. 16, 285–296. https://doi.org/10.1057/udi.2011.14

Suarez-balcazar, Y., Early, A. R., Otr, L., Garcia, C., Balcazar, D., Arias, D. L., Otr, L., & Morales, M. (2020). Walkability Safety and Walkability Participation : A Health Concern. https://doi.org/10.1177/1090198120903256

Sugiyama, T., Cerin, E., Owen, N., Oyeyemi, A. L., Conway, T. L., Dyck, V., Schipperijn, J., Macfarlane, D. J., Salvo, D., Reis, R. S., Mitá, J., Sarmiento, O. L., Davey, R., Scho, G., Orzanco-garralda, R., & Sallis, J. F. (2014). Health & Place Perceived neighbourhood environmental attributes associated with adults ' recreational walking : IPEN Adult study in 12 countries. 28, 22–30. https://doi.org/10.1016/j.healthplace.2014.03.003

Sugiyama, T., Maike, N., Cole, R., Giles-corti, B., & Owen, N. (2012). Destination and Route Attributes Associated with Adults' Walking: A Review. May 2006, 1275–1286. https://doi.org/10.1249/MSS.0b013e318247d286

SUGIYAMA, T., MAIKE NEUHAUS, Cole, R., Giles-corti, B., & Owen, N. (2012). Destination and Route Attributes Associated. May 2006, 1275–1286. https://doi.org/10.1249/MSS.0b013e318247d286

Sugiyama, T., Rachele, J. N., Gunn, L. D., Burton, N. W., Brown, W. J., & Turrell, G. (2019). Health & Place Land use proportion and walking : Application of isometric substitution analysis. Health & Place, 57(September 2018), 352–357. https://doi.org/10.1016/j.healthplace.2018.12.004

Sundquist, K., Eriksson, U., Mezuk, B., & Ohlsson, H. (2015). Neighborhood walkability, deprivation and incidence of type 2 diabetes: A population-based study on 512,061 Swedish adults. Health & Place, 31, 24–30. https://doi.org/https://doi.org/10.1016/j.healthplace.2014.10.011

Suttles, G. D. (1973). The Social Construction of Communities. The ANNALS of the American Academy of Political and Social Science, 407(1), 245–246. https://doi.org/10.1177/000271627340700181

Sylvers, D. L., Hicken, M., Esposito, M., Manly, J., Judd, S., & Clarke, P. (2022). Walkable neighborhoods and cognition: implications for the design of health promoting communities. Journal of Aging and Health, 34(6–8), 893–904.

Talen, E. (2018). In support of the unambiguous neighborhood: A proposed size typology. Journal of Urbanism, 11(4), 480–502. https://doi.org/10.1080/17549175.2018.1484794

Tao, T., Wang, J., & Cao, X. (2020). Exploring the non-linear associations between spatial attributes and walking distance to transit. Journal of Transport Geography, 82(October 2018), 102560. https://doi.org/10.1016/j.jtrangeo.2019.102560

Targa, F., Clifton, K., Park, C., & Park, C. (2005). Built environment and nonmotorized travel: Evidence from Baltimore City using the NHTS. 301.

Taylor, R. B. (1988). Human Territorial Functioning. Cambridge University Press. https://doi.org/10.1017/CBO9780511571237

Taylor, R. B. (1997). Social Order and Disorder of Street Blocks and Neighborhoods: Ecology, Microecology, and the Systemic Model of Social Disorganization. Journal of Research in Crime and Delinquency, 34(1), 113–155. https://doi.org/10.1177/0022427897034001006

Tewahade, S., Li, K., Goldstein, R. B., Haynie, D., Iannotti, R. J., & Simons-Morton, B. (2019). Association between the built environment and active transportation among U.S. adolescents. Journal of Transport and Health, 15(August), 100629. https://doi.org/10.1016/j.jth.2019.100629

Thornton, L. E., Pearce, J. R., & Kavanagh, A. M. (2011). Using Geographic Information Systems (GIS) to assess the role of the built environment in influencing obesity: a glossary. The International Journal of Behavioral Nutrition and Physical Activity, 8, 71. https://doi.org/10.1186/1479-5868-8-71

Thornton, L. E., Pearce, J. R., Macdonald, L., Lamb, K. E., & Ellaway, A. (2012). Does the choice of neighbourhood supermarket access measure influence associations with individual-level fruit and vegetable consumption? A case study from Glasgow. International Journal of Health Geographics, 11, 29. https://doi.org/10.1186/1476-072X-11-29

Tilahun, N., & Li, M. (2015). Walking Access to Transit Stations. https://doi.org/10.3141/2534-03

Tiznado-aitken, I., Hurtubia, R., & Mun, J. C. (2018). The Role of Accessibility to Public Transport and Quality of Walking Environment on Urban Equity : The Case of Santiago de Chile. https://doi.org/10.1177/0361198118782036

Townshend, T., & Lake, A. (2017). Obesogenic environments: current evidence of the built and food environments. Perspectives in Public Health, 137(1), 38–44. https://doi.org/10.1177/1757913916679860

Tsiompras, A. B., & Photis, Y. N. (2017). What matters when it comes to "Walk and the city"? Defining a weighted GIS-based walkability index. Transportation Research Procedia, 24, 523–530. https://doi.org/https://doi.org/10.1016/j.trpro.2017.06.001

Tsou, K.-W., & Cheng, H.-T. (2013). The effect of multiple urban network structures on retail patterns–A case study in Taipei, Taiwan. Cities, 32, 13–23.

Tung, S. E. H., Ng, X. H., Chin, Y. S., & Mohd Taib, M. N. (2016). Associations between parents' perception of neighbourhood environments and safety with physical activity of primary school children in Klang, Selangor, Malaysia. Child: Care, Health and Development, 478–485. https://doi.org/10.1111/cch.12355

Turner, A. (2007). From axial to road-centre lines : a new representation for space syntax and a new model of route choice for transport network analysis. 34, 539–556. https://doi.org/10.1068/b32067

Ujang, N., & Muslim, Z. (2014). Walkability and Attachment to Tourism Places in the City of Kuala Lumpur,Malaysia. Athens Journal of Tourism, 2(1), 55–67. https://doi.org/10.30958/ajt.2-1-4

van Loon, J., Frank, L. D., Nettlefold, L., & Naylor, P.-J. J. (2014). Youth physical activity and the neighbourhood environment: Examining correlates and the role of neighbourhood definition. Social Science and Medicine, 104, 107–115. https://doi.org/10.1016/j.socscimed.2013.12.013

Vargo, J., Stone, B., & Glanz, K. (2012). Google walkability: a new tool for local planning and public health research? Journal of Physical Activity & Health, 9(5), 689–697. https://doi.org/10.1123/jpah.9.5.689

Villanueva, K., Knuiman, M., Nathan, A., Giles-Corti, B., Christian, H., Foster, S., & Bull, F. (2014). The impact of neighborhood walkability on walking: Does it differ across adult life stage and does neighborhood buffer size matter? Health and Place, 25, 43–46. https://doi.org/10.1016/j.healthplace.2013.10.005

Völker, S., Heiler, A., Pollmann, T., Claßen, T., Hornberg, C., & Kistemann, T. (2018). Urban Forestry & Urban Greening Do perceived walking distance to and use of urban blue spaces a ff ect self-reported physical and mental health ? Urban Forestry & Urban Greening, 29(October 2017), 1–9. https://doi.org/10.1016/j.ufug.2017.10.014

Wagner, R. (2008). On the metric , topological and functional structures of urban networks. 387, 2120–2132. https://doi.org/10.1016/j.physa.2007.11.019

Wang, F., Chen, C., Xiu, C., & Zhang, P. (2014). Location analysis of retail stores in Changchun, China: A street centrality perspective. Cities, 41, 54–63.

Wang, H., & Yang, Y. (2019). Neighbourhood walkability: A review and bibliometric analysis. Cities, 93, 43–61. https://doi.org/https://doi.org/10.1016/j.cities.2019.04.015

Wang, J., & Cao, X. (2017). Exploring built environment correlates of walking distance of transit egress in the Twin Cities. Journal of Transport Geography, 64(September), 132–138. https://doi.org/10.1016/j.jtrangeo.2017.08.013

Wang, K., Xu, L., & Jiang, H. (2022). Analysis of the effect of human-machine co-driving vehicle on pedestrian crossing speed at uncontrolled mid-block road sections: a VR-based case study. International Journal of Environmental Research and Public Health, 19(12), 7208.

Wei, Y. D., Xiao, W., Wen, M., & Wei, R. (2016). Walkability , Land Use and Physical Activity. January, 1–16. https://doi.org/10.3390/su8010065

World Health Organisation. (2015). Pacific Physical Activity Guidelines for Adults. Frameworkd for Accelerating the COmmunication of Physical Activity Guidelines, 1, 1–34.

Xintao, L., & Bin, J. (2011). Defining and Generating Axial Lines from Street Center Lines for better Understanding of Urban Morphologies.

Yagi, T. (2022). Impact of Street Layout on Dutch Walking Behaviour using Space Syntax. Radboud University.

Yamu, C., de Roo, G., & Frankhauser, P. (2015). Assuming it is all about conditions. Framing a simulation model for complex, adaptive urban space. Environment and Planning B: Planning and Design, 43(6), 1019–1039. https://doi.org/10.1177/0265813515607858

Yamu, C., & Frankhauser, P. (2015). Spatial accessibility to amenities, natural areas and urban green spaces: using a multiscale, multifractal simulation model for managing urban sprawl. Environment and Planning B: Planning and Design, 42(6), 1054–1078. https://doi.org/10.1068/b130171p

Yamu, C., & Van Nes, A. (2017). An Integrated Modeling Approach Combining Multifractal Urban Planning with a Space Syntax Perspective. In Urban Science (Vol. 1, Issue 4). https://doi.org/10.3390/urbansci1040037

Yamu, C., van Nes, A., & Garau, C. (2021). Bill Hillier's Legacy: Space Syntax—A Synopsis of Basic Concepts, Measures, and Empirical Application. In Sustainability (Vol. 13, Issue 6). https://doi.org/10.3390/su13063394

Yang, L., Hipp, J. A., Adlakha, D., Marx, C. M., Tabak, R. G., & Brownson, R. C. (2014). Choice of commuting mode among employees: Do home neighborhood environment, worksite neighborhood environment, and worksite policy and supports matter? Journal of Transport and Health, 2(2), 212–218. https://doi.org/10.1016/j.jth.2015.02.003

Yazid, H., Hasibuan, H. S., & Koestoer, R. H. (2023). Walkability Concept Toward Sustainable City: Comparative Insights of Brisbane and Bogor Urban Areas. Indonesian Journal of Environmental Management and Sustainability, 7(1), 20–26.

Yi, L. Y., Samat, N., & Wan Muda, W. M. (2017). Accelerometer-measured physical activity and its relationship with Body Mass Index (BMI) and Waist Circumference (WC) measurements: A cross-sectional study on Malaysian adults. Malaysian Journal of Nutrition, 23(3), 397–408.

Yigitcanlar, T., Kamruzzaman, M., & Teriman, S. (2015). Neighborhood sustainability assessment: Evaluating residential development sustainability in a developing country context. Sustainability (Switzerland), 7(3), 2570–2602. https://doi.org/10.3390/su7032570

You, H., There, G., Lachapelle, U., Frank, L., Saelens, B. E., Sallis, J. F., & Conway, T. L. (2011). Commuting by Public Transit and Physical Activity : Where You Live , Where You Commuting by Public Transit and Physical Activity : Where You Live , Where You Work , and How You Get There. January. https://doi.org/10.1123/jpah.8.s1.s72

Zakaria, J., & Ujang, N. (2015). Comfort of walking in the city center of Kuala Lumpur. Procedia-Social and Behavioral Sciences, 170, 642–652. https://doi.org/10.1016/j.sbspro.2015.01.066

Zang, P., Liu, X., Zhao, Y., Guo, H., Lu, Y., & Xue, C. Q. L. (2020). Eye-Level Street Greenery and Walking Behaviors of Older Adults. International Journal of Environmental Research and Public Health, 17(17). https://doi.org/10.3390/ijerph17176130

Zhang, M., & Kukadia, N. (2005). Metrics of urban form and the modifiable areal unit problem. Transportation Research Record, 1902, 71–79. https://doi.org/10.3141/1902-09

Zhang, R., Yao, E., & Liu, Z. (2017). School travel mode choice in Beijing, China. Journal of Transport Geography, 62(August 2016), 98–110. https://doi.org/10.1016/j.jtrangeo.2017.06.001

Zhang, Z., Fisher, T., & Feng, G. (2020). Assessing the Rationality and Walkability of Campus Layouts. 1–21.

Zhao, F., Chow, L., Li, M., Ubaka, I., & Gan, A. (2003). Forecasting Transit Walk Accessibility Regression Model Alternative to Buffer Method. 03, 34–41.

Zhou, Q., Lin, H., & Bao, J. (2021). Spatial autoregressive analysis of nationwide street network patterns with global open data. Environment and Planning B: Urban Analytics and City Science, 48(9), 2743–2760. https://doi.org/10.1177/2399808320987846

Zuefle, M. (1999). Jackson, E. L., & Burton, T. L. (1999). Leisure studies: Prospects for the twenty-first century. SCHOLE: A Journal of Leisure Studies and Recreation Education, 15(1), 137–139. https://doi.org/10.1080/1937156x.2000.11949464