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Can We Build Walkable Environments to Support Social Capital? Towards a Spatial Understanding of Social Capital; a Scoping Review

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Abstract: Empirical evidence suggests that it is possible to socially renew neighbourhoods through the formation of social capital (SC) as an effect of walking. The characteristics of the built environment that influence walkability and SC have been relatively well established by previous research, but contrasts remain. Therefore, this document seeks to investigate the relationship between SC and walkability, through a Scoping Review of empirical studies published in indexed journals in the Web of Science and Scopus. The findings indicate that the formation of SC as an effect of walking is associated with land use and the design of neighbourhood facilities; the provision of urban furniture (benches) and green spaces; and that the design and configuration of the neighbourhoods affects SC even more than the excess density. In addition, the methodological strategies used to arrive at these results were reviewed. The conclusions suggest the need to study this issue from an updated perspective, where new neighbourhood interaction systems can be tracked (that provide new indicators), using advanced tools and technologies that help streamline and make measurements more objective.

Keywords: social capital; walkability; pedestrian environment



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1. Introduction

According to the OECD [1], one of the factors that contribute to the increase in people's wellbeing is the quality of the relationships they have with other people, better expressed as social capital (SC). This is a polysemic concept that implies, among other things, the collective construction of trust, as well as the level of associativity and social integration through the formation or membership of social networks or organisations.

Various authors have pointed out that the implications of SC transcend into multiple areas. For Putnam [2], SC reserves of a society have a strong impact on economic and democratic development and even on people's happiness and health. Also, Helliwell and Putnam [3], indicated that ties with friends and neighbours, civic engagement, as well as trust between neighbours seem to be independently and solidly related to happiness and satisfaction with life, both directly and through its impact on health. Likewise, Umberson et al. [4], highlighted the close association that exists between social support and social integration with psychological health, even recent studies show the benefits of social interactions in public health, especially about mental health [5,6].

On the other hand, SC theory suggests that SC can grow over time and that those factors such as stability of residence and opportunities for social encounters in the neighbourhood facilitate the building of trust and participation. This infers that certain characteristics of the built environment could affect the generation of SC. Hence, authors such as Carmona et al. [7], have proposed that through urban design it is possible to influence the patterns of

human activity and, therefore, the nature of the social life that a place has. This coincides with research by Leyden [8], who indicated that how communities and neighbourhoods are designed and built affects SC.

In response to this, urban planners, through empirical evidence, have investigated the design aspects of the built environment that positively influence the formation of SC. This search has shown that those neighbourhoods (compact and mixed) that provide structures for walking mobility and spaces for coexistence are significant for promoting SC. Glanz [9], mentioned that a neighbourhood that promotes walkability improves health conditions and increases the number of social interactions between residents. These observations are related to what is stated by Leyden [8], who pointed out that residents who live in mixed-use walkable neighbourhoods are more likely to know their neighbours, participate politically, trust others and become socially involved, which link to good physical and mental health.

Thus, pedestrian mobility makes residents feel connected to each other and the local area, whilst making use of its streets, public spaces, and facilities. Simultaneously, this promotes physical and social health by encouraging residents to use the outdoor spaces of their neighbourhoods, whilst developing bonds of trust and improving their health by walking. This alerts city planners to the need to shift the neighbourhood approach towards a pedestrian-friendly scheme, in favour of healthier cities both physically and socially.

In this sense, due to the limited research on studies examining the act of walking and its connection with the development of SC, the general objective of this document is: (1) to investigate the relationship between SC and walkability to understand its spatial dynamics through the analysis of the latest technology. For this, a Scoping Review was carried out on empirical studies published in journals indexed in the Web of Science and Scopus in the last 15 years, which is explained in detail in the methodology section. The remainder of this document is structured as follows: (1) the general concepts of SC and walkability are reviewed; (2) a practical-empirical dimension is established on the relationships between SC and walkability, exposing the significant findings around the urban form (land use, municipal infrastructure, urban furniture, green spaces, and density) and the strategies in methodologies used for its measurement; (3) the results obtained are presented; and finally (4) the discussion of the results is presented and possible future lines of research are formulated.

2. Methodology

The methodology used is a Scoping Review based on the methodological framework of Arksey and O'Malley [10]. The research question was identified: What is the relationship between SC and walkability? Subsequently, empirical studies published in journals indexed in the Web of Science and Scopus were searched. Through an advanced search, the following keywords were included together:

- (“*Social capital*” OR “*Social interactions*” OR “*Sense of community*” OR “*Sociability*” OR “*Microsociology*”) + (“*Walkable city*” OR “*Walkability*” OR “*Pedestrian mobility*” OR “*Walk friendly*”) + (“*Happy city*” OR “*Healthy city*” OR “*Smart urbanism*” OR “*Compact city*”).

A total of 285 articles resulted from these searches, framing a 15-year time scale (2007–2021). The articles were exported to the Rayyan-QCRI systematic reviews web application, whereafter deleting duplicates, 207 articles remained. Subsequently, the first stage of review of titles and abstracts was carried out using an inclusion and exclusion labelling system (with Rayyan-QCRI); 126 articles were eliminated, leaving 81 articles for the second round of review. In this second review, 50 papers were eliminated; the reasons for exclusion have been diverse (foreign language, article not accessible, a social factor not included). As a result, 31 articles were selected that were processed in a “data charting form” [10] using the Excel database. The information was then classified by: title; authorship, year of publication; place of study; main concepts; type of study (theoretical, descriptive statistics, or statistical model); study population; study objectives; methodology;

important results and conclusions. Together, these data formed the basis of the analysis. Finally, the information was synthesised.

In this section, it is important to mention that the concept that governs this research is SC; however, to broaden the search options in the Scoping Review, other keywords were taken into account that are not autonomously SC, but elements or vehicles of it, such as: *social interactions*, *sense of community*, and *local sociability*. Whilst these concepts are not the definition of SC, without them, there is no SC. That is, social interaction is fundamental in the construction of SC. Higher levels of social interaction are more likely to address community issues and actively participate in them, leading to effective community development. For its part, the sense of community is an aspect of community interaction that refers to the sense of belonging to a group. When residents are more emotionally attached to their community, they can socialise and get involved in different neighbourhood activities, thus improving the quality of their relationships with other people, which is one of the premises of SC. That said, some studies that address *social interaction*, *sense of community*, or *local sociability* have taken SC theories as a framework because they consider the implicit value that these have in their construction.

Likewise, for this analysis, analogous concepts such as: *Social Life* [11,12]; *Social Sustainability* [13]; *Sociable Streets* [14]; *Liveability* [15]; *Neighbourhood Safety* [16] y *Healthy communities* [17] were taken into account. Derived from an exhaustive review of the theory, it was considered that these concepts integrate indicators similar to those of SC (see Figure 1).

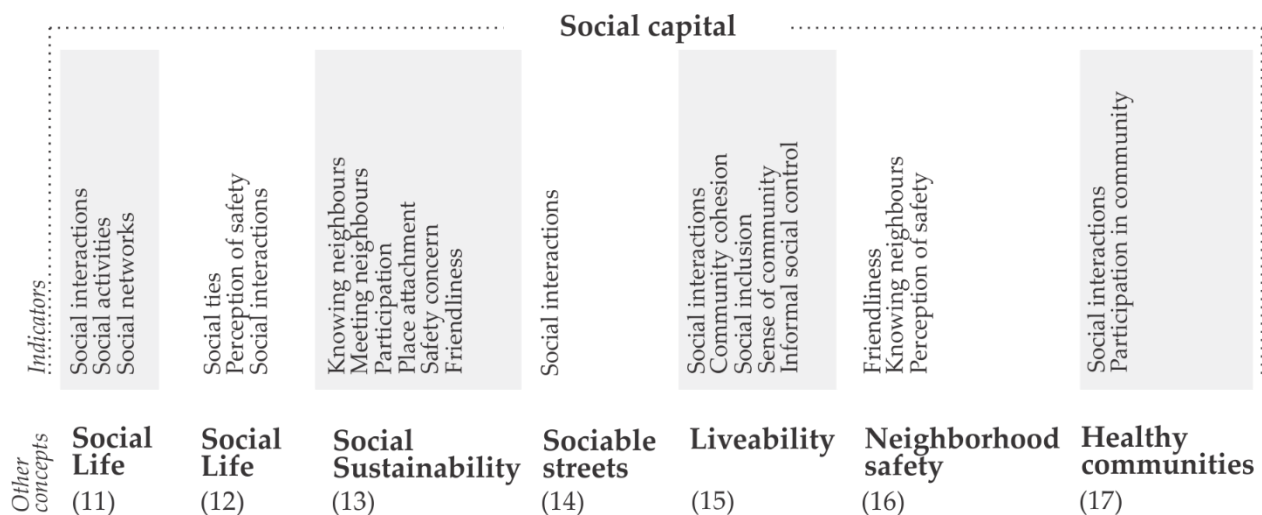


Figure 1. Concepts and indicators similar to social capital. Prepared by the authors.

3. General Concepts: Social Capital and Walkability

3.1. Social Capital

Social capital (SC) is a broad multidimensional concept, that has been widely defined over the years in response to the variety of perspectives and theoretical interpretations from which it has been approached. This has led to conceptual ambiguities.

Hanifan [18] was the first to define the concept of SC defining it as: “those intangible elements that count to a great extent in people’s daily lives, goodwill, camaraderie, understanding and social interaction between individuals and families” (pp. 130–138). Ultimately, Bourdieu [19] will define it as the sum of the real and potential resources accumulated in an individual or group through a continuous network that is formed through mutual relationships between people. After Bourdieu’s definition, other authors will make their definitions, Coleman [20], through a systematic approach, describes it as a complex element that promotes individual behaviour in a social structure, and its specific components are social relations and norms. Putnam [21] describes it as the characteristics of the networks of social life, norms, and trust that allow people to act together more effectively to pursue

shared goals. He also introduced two forms of SC, *bonding*, and *bridging*. According to Putnam [2], *bonding* is more likely characterised as strong ties and connecting people with similar characteristics, while *bridging* connects heterogeneous groups of people and is characterised by weak ties. Later, Szreter and Woolcock [22] proposed *linking* SC to refer to the relationships between people in formal institutions.

Although Putnam's definition is probably the most popular perhaps due to it being the one that provides a suitable overview, it has received criticism due to its lack of rigor and for having a general perspective. This usually generates confusion about the difference between the sources, forms, and consequences of SC. Being able to distinguish between these elements can be difficult since most social phenomena involve complicated cyclic, relational and mutual causality [23].

Added to this, are the complexities that stem from the multiple theoretical perspectives from which SC has been defined and approached. According to Claridge [23], the definition of SC must match the way it is contextualised and operationalised, what is important is the clarity and coherence of the approach and the ability to explain and justify it.

With this in mind, extensive specialised literature has shown that the characteristics of communities with pedestrian-oriented design have been significantly correlated with various indicators of SC.

This is corroborated by authors such as Leyden [8]. The author found that people who lived in walkable neighbourhoods were more likely to know their neighbours, participate politically, trust others, and be socially engaged. This study surveyed SC and the *Neighbour Walkability Measure* of residents living in traditional, mixed-use, pedestrian-oriented, and suburban neighbourhoods. The results found that people who live in mixed-use, walkable neighbourhoods have higher levels of SC compared to those who live in car-facing suburbs.

In turn, Lund [24] found that the factors of the pedestrian environment significantly influence the sense of community. Through surveys in eight neighbourhoods, she analysed the role of the built environment and user perceptions in predicting walkability. Results showed that friendly cityscapes, locating everyday amenities like parks and retail stores within a neighbourhood could increase pedestrian travel and neighbour interaction within a community.

Similarly, Kim and Kaplan [25] found that the physical characteristics of the built environment such as open spaces that promote walkability play an important role in increasing the probability of social interactions and therefore the sense of community. Through surveys and questionnaires to residents of neighbourhoods of the new urbanism and a traditional suburb, they analysed four domains of the sense of community, each in terms of 17 different aspects of the physical environment. Natural features and open spaces played a particularly important role in the sense of community.

Nevertheless, it is necessary to mention that even when positive correlations were found between walkability and SC, they do not indicate causality. In certain cases, the authors agreed that walkability is more complex than is usually defined and that the factors that influence neighbourhood sociability extend beyond issues of urban form. As Field [26] mentioned, in some cases, we can ensure that optimal conditions exist, but we cannot force people to like each other and forge meaningful relationships.

3.2. Walkability

Walkability describes the extent to which cities, neighbourhoods, pedestrian paths, or streets are pleasant and interesting, and therefore invite walking itineraries [27].

For Giles-Corti et al. [28], walking emerges as a multidimensional behavioural category that involves different aspects of urban practices and dimensions. They have described three dimensions: (1) a utilitarian dimension (where walking is a necessary activity); (2) a leisure dimension (where walking is an optional and recreational activity); and (3) a social dimension (where walking is a vector of contact and interaction between individuals). In relation to the social dimension, authors such as Zhu et al. [29], have mentioned that walkable neighbourhoods, social interactions, and neighbourhood cohesion

have synergistic and mutually reinforcing relationships. This implies that planning efforts to promote physical activity could help address important public policy objectives related to social outcomes such as neighbourhood cohesion and social interactions.

In this vein, there is increasing interest in analysing walkability from a broader framework that includes the category of community. Zuniga-Teran et al. [30], in their study on the design of healthy communities, propose a theoretical Walkability Framework in which they showed the interrelation between nine categories of neighbourhood design that, when combined, result in walkability. This classification includes the category of community that was measured through the variables: *presence of spaces that facilitate social interactions* and *spaces that promote community participation* (community centres, squares, churches). Results for this category showed that neighbourhoods with easily accessible and nearby green spaces provide spaces for community activities that can encourage recreational walks.

For their part, Li et al. [6] analysed the association between the ability to walk and mental well-being, for this, they used the Well-Being Index adapted from the World Health Organization (WHO-5), with which they measured the variable of mental well-being and its relationship with walkability. They found that accessibility to walk in the neighbourhood is positively associated with mental well-being, mitigation of environmental stressors, social cohesion, and a sense of community. It should also be said that it has been found that neighbourhoods with heavy traffic, noise, and limited access to urban amenities are associated with low levels of sense of community, which leads to poor mental health [31].

In response, various mobility plans and programmes have been implemented worldwide under the concept called Healthy Cities, which places people at the centre of the planning process and gives rise to cities with inclusive mobility where people choose to walk, bike, and use public transportation. According to the WHO [32]: “A Healthy City is continuously creating and improving physical and social environments and expanding community resources that allow people to support each other to perform all life functions and develop their full potential” (p. 13).

4. Empirical Dimension: Relationships between Social Capital and Walkability

4.1. Mixed Land Use and Municipal Infrastructure

The characteristics of the physical environment that influence the formation of SC have been relatively well established by previous research, however, there are exceptions. On the one hand, studies have been found that provide significant empirical evidence and, on the other, those that consider that these associations between the walkability of a neighbourhood and the sense of community are modest. Each of the findings corresponds to specific sociodemographic and physical environment characteristics that influence SC. The findings differ depending on the housing prototype, urban infrastructure, housing density, neighbourhood configuration and scale, the specific population group, among other factors.

The most outstanding findings are those that highlight that the design of the land use and a neighbourhood's equipment provide the means to allow people to get to know each other, which theoretically impacts SC. In other words, it is more common to find positive manifestations of SC in compact and diverse neighbourhoods, which promote walkability. According to Rogers et al. [33], a neighbourhood that provides residents with easy access to municipal infrastructure such as post offices, parks, playgrounds, coffee shops, restaurants, barbershops, and club hangouts may have higher SC values.

Following this, Cheshmehzangi [15] addresses the idea that walkability can be motivated by better-integrated mobility and land-use patterns that influence the movement of people and its relationship with social land uses. In addition, it has been found that the cumulative presence of characteristics of the physical environment that provide semi-private spaces for informal interaction, such as front porches, continuous sidewalks, and street pacification, promotes neighbourhoods; which is understood as a reciprocal relationship and trust according to Wilkerson et al. [34].

For their part, Karuppannan and Sivam [13], detected that social interactions within communities are greater when the houses are located around the public sphere. Their study demonstrated that the provision of high-quality and well-located open spaces at the district level, mixed land uses, and good pedestrian accessibility to the public realm and social infrastructure play an important role in increasing the social sustainability of the neighbourhood. Social sustainability is a condition that can improve life within communities and that has a series of characteristics such as equity of access to services, equity between generations, political participation of citizens, as well as a sense of community responsibility that allows the awareness of social sustainability to be transmitted [35].

Beyond social factors, the economic values of a neighbourhood can be formed and adapted due to the pedestrian movements that promote mixed and diverse cities. According to Barnett [36], walkable communities are equitable by putting people before cars. When people turn to a motorised form of transport, it is easier to travel longer distances and therefore the viability of local shopping centres is threatened. In contrast, when people walk to their local stores, they tend to develop business loyalty, which promotes local commerce and helps stabilise the local economy. In this regard, authors such as Zordan et al. [37] warn about the valuable social role that spaces dedicated to the sale of food that are found on the ground floor of buildings in residential areas have, which promotes the idea that when people walk to get food, they have the opportunity to interact. This characteristic has more impact even when the shops have frontages to the street instead of parking areas according to Wood et al. [38].

Likewise, given the synergy that exists between leisure walks and commercial practices, it is also necessary to pay attention to the creation of pedestrian-friendly neighbourhood environments that promote leisure. Kim and Yang [39], analysed the relationship between the experience of walking for various purposes and individual perceptions of SC through surveys. The results showed that there are relationships between leisure walks and levels of neighbourhood trust and the creation of social networks.

Another substantial finding in this area is made by Kwon et al. [40], who showed that the characteristics of the neighbourhood that promote walkability were positively related to the use of community currency (CC) and the activities derived from them. A CC is a complementary currency created and marketed by a local community as a means of exchange; in addition, it can be used interchangeably with money. CC users living in walkable neighbourhoods showed significantly higher levels of community attachment compared to their counterparts. The results of this study suggest that neighbourhood physical settings can work to deter or promote CC participation, and that an effective CC promotion strategy is to target CC communities.

4.2. Urban Furniture and Green Spaces

On several occasions, the design of a neighbourhood's built environment has been found to play an important role in creating SC. Rogers et al. [41], from their social sustainability approach, find positive correlations between accessibility for pedestrians and SC. This study shows that sidewalks and lighting were the most frequently mentioned built environment terms that could be improved to encourage more walking.

An age group that has been much analysed lately by SC researchers is older adults, who are prone to sedentary behaviours negatively associated with social interactions according to Van Holle et al. [42]. The findings of these authors show that urban furniture plays a very important role in the development of SC in older adults. According to Ottoni [43], benches specifically contribute positively to the mobility experiences of this group by improving the use and enjoyment of green and blue spaces, as well as serving as an incentive for mobility and favouring social cohesion and SC. Along the same lines, Hong et al. [44] warn that elements of green spaces such as natural views can be beneficial for SC of the neighbourhood of older adults. Likewise, Hwang et al. [45], found that the existence and access to open-air spaces, such as green spaces and places to exercise, are decisive for improving SC indicators in the elderly.

Consequently, Van den Berg [46] indicates that policymakers and urban planners should aim to increase the walkability and social cohesion of the neighbourhood, paying due attention to neighbourhoods with a high percentage of the elderly population.

4.3. Urban Density

Urban density is often a matter of debate when studying walkability and SC. Oidjarv [47], found correlations between walkability in the neighbourhood and informal problem solving; that is, the more residents walk through the neighbourhood, the greater the probability of talking to other neighbours about community problems and offering help or receiving assistance from other neighbours. Although the correlation was only marginally significant, the author suggests that it could be hypothesised that increased walkability in the community, combined with an increase in population density, will promote the formation of close social ties among community residents; this is due to the increase in informal interactions of neighbours.

For its part, the theory suggests that the dense and mixed city is the necessary formula to achieve a vibrant and pedestrian-friendly urban community. In the last three decades, various models of sustainable urban development and growth have prescribed the forms and patterns of urban expansion that can be economically, environmentally, and socially sustainable. These include the Urban Village [48], Transit-Oriented Development [49], New Urbanism [50], Smart Growth [51], and the Compact City [52].

In contrast to what has been exposed by these models, some authors consider that the densest and most vulnerable social neighbourhoods in cities are often considered places where traffic, crime, and less desirable neighbours are concentrated [53,54]. This can cause people to be afraid to walk in the community, so they have limited social interaction and therefore a lesser sense of community.

According to Jun and Hur [55], this inconsistency could be explained by paying attention to the way in which we express and measure walkability, that is to say, physical walkability (objective measures) is not the same as perceived (the method that groups several individuals and builds a theoretical concept). The level of socioeconomic disadvantage is often high in neighbourhoods where physical walkability is high. On the contrary, residents of neighbourhoods with higher perceived walkability could have a higher socioeconomic level; therefore, they are more likely to take leisure walks and interact with their neighbours, which would generate a greater sense of community even when their objective measurements of walkability are lower.

For their part, French et al. [56], find a negative correlation between residential density and the sense of community. They attribute this to the fact that a neighbourhood where land uses attract more “strangers” can detract from the sense of community since it is difficult for residents to distinguish who belongs to the neighbourhood from who does not. Therefore, although the built environment may not directly affect the sense of community, it can influence the perceptions of residents, which in turn affects the sense of community.

Vulnerable groups are commonly excluded from living in well-designed urban areas, which is reflected in neighbourhood problems and a lack of a sense of community. Raman [11], finds that in high-density neighbourhoods, common spaces play a very important role in promoting social interaction. This study shows that social interaction improves positively when living in places that are spatially well integrated with the rest of the neighbourhood. The spatial centrality and accessibility of common spaces are crucial for the success of a neighbourhood as a facilitator of social activities. This is compatible with the finding of Karuppannan and Sivam [13] regarding the increase in social interactions caused by the location of the houses around open public spaces.

In this sense, the design and configuration of neighbourhoods have a greater impact on the construction of SC than excess density. In other words, neighbourhood problems derived from excess density can be reduced by projecting quality common public spaces that promote the creation of social networks and trust between neighbours.

4.4. Methodological Strategies: The Intersection of Variables of Social Capital and Walkability

Most of the reviewed studies rely on methodological strategies that contrast the variables of SC and walkability by means of multivariate statistical models. The variables have been extracted through various measurement instruments such as questionnaires, surveys, audits, scores, observation tools, mapping, and even with the support of spatial syntax software and neo technologies such as Deep Learning and remote sensing.

Researchers agree that due to the multidimensional nature of SC, a wide range of indicators need to be used when measuring it. Indeed, our study shows the use of a plethora of indicators that, beyond clarifying the spatiality of the concept, make it remain ambiguous. Sometimes a simple indicator such as *trust* or *sense of community* was used, and at other times, more robust groups of indicators were used (clustering of indicators). Given the lack of agreed-upon methods for measurements, some cases studies tend to identify important elements or factors that are tailored to their research context. Even in some of the studies that were analysed, the authors use different concepts from SC; however, when examining them, they reveal a close similarity with SC indicators (see Figure 1).

The most recurrent instruments validated by the review authors are: the Social Capital Scale [57]; the Community Index SCI-2 [58]; and the Saguaro Seminar on Civic Engagement in America Survey [59]. Some authors took these instruments in their entirety and others made some adjustments. In addition, given the need for a better understanding of the spatial dynamics of SC, some studies have chosen to include mapping and observation techniques in their methodological strategies that allow measuring social interactions and their relationship with the place. *Behavioural maps* [31,33] (see Figure 2), *Activity mapping* [14], and *Social network maps* [11], are effective and feasible methods to understand the relationships between social dynamics and place, since they provide answers regarding temporality (time of day, season of the year). Each map shows an image of the moment in a specific place in addition to taking into account other causal factors, such as the built environment.

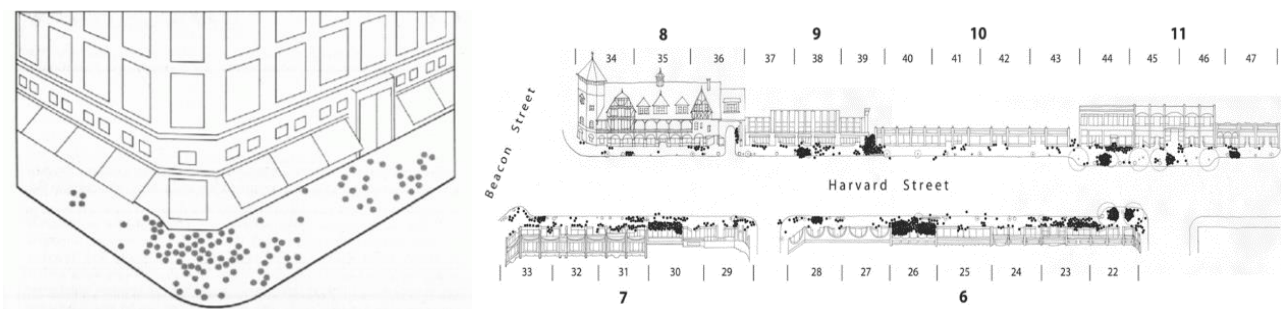


Figure 2. Representation of Behavioural Maps according to Whyte (1980) and Mehta (2007). Each point marks a person in the public space.

It is important to mention that these three observation tools are not capable of directly measuring SC indicators such as *social cohesion* or *sense of community*. However, they can give clues as to where, when, for how long, how, and among whom the social interactions occur, which are the fuel of SC.

All these instruments for measuring the SC indicators are mostly developed in Table 1.

Table 1. Main instruments for measuring social capital indicators. Prepared by the authors.

Type	Measuring Instrument	Definition	Dimensions	References
Questionnaire	Community Index SCI-2	The SCI is based on a theory of the sense of community presented by McMillan and Chavis [60], and measures four aspects of the sense of community using a Likert scale Instrument based on seven aspects	Membership, influence, meeting needs, and a shared emotional connection	Chavis, Lee & Acosta [58]
Questionnaire	Social Capital Scale	of social capital using the Likert scale Is one of the very few social capital scales published to date that reports reliability data	Trust, concern, reciprocity, civic engagement, friendliness, networks	Wood, Gilles-Corti & Bulsara [61]
Survey	Saguaro Seminar on Civic Engagement in America Survey	Phone survey that asked individual respondents questions about 11 facets of social capital	Trust, diversity of friendships, political participation, civic leadership, and associational involvement, informal socialising, giving and volunteering, faith-based engagement, equality of civic engagement across the community	Putnam [59]
Mapping Technique	Behavioural Maps	Method used in the field of urban design to understand how people's behaviour is affected by the physical attributes in public spaces	Types of activities and number of persons engaged in them; socialising activities; social interactions	Whyte [62]; Gehl [63]; Mehta [64]
Mapping Technique	Activity Mapping: Snap Shot static activities observations	Mapping technique where the dependent variables consist of the aggregation of different kinds of social activities	Necessary (N), Optional (O), and Resultant (R) activities. "R" activities consider people chatting, watching, entertaining, street vendors selling goods and people distributing and advertising leaflets, (these activities occur because of the presence of other people).	Whyte [62]; Gehl [63]
Mapping Technique	Social Network Maps	Social network mapping starts with the larger concept of social network theory. Under this theory, you map social networks with nodes and ties. A node is a single point on the network, either an individual or a group. The ties are the connections between the nodes	Associations, social networks, social groups	Granovetter [65]; Coleman [20]

With regard to walkability, measurements have been made through various accessibility indexes for pedestrians constructed from questionnaires, surveys, or walkability audits (Table 2). A reference used in several of the studies is the Leyden Walkability Index [8]. Similarly, behaviour maps have been used since they also have the ability to measure walkability through observation. Historically, walkability has relied on software based on the theory of spatial syntax (space syntax) to analyse the "pedestrian activity" associated with spatial centrality and urban density. Finally, it is worth noting the important theoretical and practical contribution presented by Zhou et al. [66]. From theory, they propose the first conceptual framework to the term "Visual Walkability", understood as an indicator of psychological and subjective comfort of pedestrians. From practice, the authors use Deep Learning technologies to extract characteristics of the built environment from the semantic segmentation of panoramic images uploaded to the web (Baidu Map Street View). This methodological approach accounts for the growing interest in the use of programming tools to achieve greater efficiency in the measurement of walkability. Although the proposed methodology does not imply the measurement of walkability conceived as physical activity, the approach provides a viable alternative for the measurement of elements of the built environment that promote it.

Table 2. Main instruments for measuring walkability. Prepared by the authors.

Type	Measuring Instrument	Definition	Dimensions	References
Survey	Neighbourhood walkability measure	Instrument where survey respondents were asked to rate the degree to which their neighbourhoods were pedestrian-oriented and mixed-use	Nine places in the neighbourhood people walk to	Leyden [8]
Survey	Walk Score	Measures walkability on a scale from 0–100. The points are based on the distance to amenities in each category	Walking routes to destinations such as grocery stores, schools, parks, restaurants, and retail	Walk Score Methodology [67]
Survey	Neighbourhood Environment Walkability Scale (NEWS) Neighbourhood Environment Walkability Survey Abbreviated (NEWS-A)	NEWS is a 98-question instrument that assesses the perception of neighbourhood design features related to physical activity	Residential density; land use mix; street connectivity; infrastructure for walking/cycling; neighbourhood aesthetics; traffic and crime safety; neighbourhood satisfaction	Saelens & Salis [68]
Questionnaire	International Physical Activity Questionnaire (IPAQ)	Instrument designed for use by adults aged 15–69 years and assesses physical activity across a comprehensive set of domains including transport and leisure	Separate domain-specific scores for walking	IPAQ [69]
Questionnaire	Senior Walking Environmental Assessment Tool (SWEAT)	Reliable senior-specific environmental measurement of detailed street-level environmental features that may influence walking among seniors	Functionality; aesthetics; safety; destination	Cunningham et al. [70]
Questionnaire	Walkability Index	Integrated index for operationalising walkability using parcel-level information	Net residential density; retail floor area ratio; intersection density; entropy score	Frank et al. [71]
Observation & mapping technique	Observation Survey of Pedestrian Movements	This mapping exercise included systematically recording all social and pedestrian activity from 8:00 a.m. to 7:00 p.m. on a weekday and at a weekend	Pedestrian and social activity	Raman [11]
Observation & mapping technique	Activity Mapping: People Following	This observation tool analyses the walkability patterns of the people and then traces them on a map	Key pedestrian activities	Syed Mahdzar [14]
Observation & mapping technique	Interaction Mapping Analysis	Method based on a syntagmatic study of one place, its changing activities, and users. It measures the socioeconomic benefits of walkability	Pedestrian movement and interaction	Cheshmehzangi [15]
Digital technique	Visual Walkability & Pixel wise semantic segmentation	This method performs a precise segmentation of different physical characteristics in street view imagery and labels each pixel in the categories (visual walkability framework) to which it belongs	Street features; pedestrian subjective perception	Zhou et al. [66]

4.5. The Asymmetry between the Use of Objective and Perceived Measures

More associations that are positive have been found between perceived measures of walkability and SC. This could be because it is easier for researchers to construct their own, compared to collecting objective measurements that can take more time and cost. Saelens et al. [72], mentioned that perceptions of neighbourhood characteristics play as important a role in shaping behaviour as do real characteristics.

Importantly, we cannot ignore what was previously mentioned regarding the negative relationship between objective walkability (associated with economically disadvantaged neighbourhoods) and SC. Neighbourhoods with a socioeconomic disadvantage tend to be the ones that walk the most (walking as a necessary activity-utilitarian), either due to poor accessibility, poor transport connection, pedestrian design, etc. This does not

contribute to the quality pedestrian experience and much less to the possibility of walking for recreation-leisure.

Now, SC measurements in most cases remain in constant subjectivity, as they do not find new variables that explain their spatiality. However, this research reveals aspects that can contribute to the generation of new strategies for measuring SC phenomena such as specific transactions and activities derived from the use of CC. More variables of this type could emerge when tracking new systems of community interaction that can provide new ways of measuring the social dynamics of neighbourhoods.

5. Discussion and Conclusions: Possible Approaches to Better Understand the Interaction of Social Capital and Walkability

5.1. The Search for the Spatial Dimension of Social Capital

The empirical evidence analysed in this work shows various attempts to elucidate the spatial understanding of SC from the walkability approach. Researchers have proposed descriptive research techniques such as questionnaires and surveys and have later evolved to more complex tools involving mapping strategies and software. However, it is still necessary to show the gaps that these types of instruments have left in the understanding of the urban spatial dynamics of SC.

The questionnaire-survey tools warn about the plethora of SC indicators that have been used in recent years, those beyond clarifying the concept make it remain ambiguous. Ultimately, there is no measure of SC that, according to the researchers, can be completely objective or free of value judgment. Most of the comments that try to discredit the concept of SC mention its intangible and unquantifiable nature.

Nevertheless, this research accounts for aspects that can contribute to the generation of new strategies for measuring the SC phenomenon, such as the specific transactions and activities derived from the use of community currencies considered by some researchers as one of the most effective forms of SC. More variables of this type could emerge when tracking which are the new systems of community interaction and in turn, that could provide new ways of measuring the dynamics of social cooperation in neighbourhoods.

An example of this could be the exploitation of solidarity exchanges of data on different platforms, such as the *Time Bank* (its activity is based on the exchange of time between people in order to help solve problems in daily life), or applications such as *Next Door* (an application in which residents of various neighbourhoods receive reliable information, exchange help and make contact).

Interestingly, the complementary use of observation techniques such as *Behaviour maps* shows the importance of approaching SC studies from the neighbourhood's micro-scale. It will be necessary to approach the observations and measurements from the various scales: neighbourhood—block—street—street segment, in order to find precise causal variables. In other words, it is not the same to assign the role of SC facilitator to a neighbourhood in a generalised way, as it is to understand that an exact street, with a specific design, context and dynamics are the ones that are truly driving SC.

5.2. More Studies Are Needed on the Relationship between Social Capital and Leisure-Recreation Walkability

As mentioned previously, walking emerges as a multidimensional behavioural category. Walking for leisure or recreation is positively correlated with proximity to destinations, the provision of aesthetically attractive areas, and the feeling that residents are safe from crime. It was also indicated that social functions could be regenerated by making streets and urban spaces suitable for leisure activities rather than simply walking as a necessity. At the same time, the levels of neighbourhood trust and networking of people who experienced leisure walking were higher than those of people who did not.

Recreational walking was significantly and strongly associated with neighbourhood interactions. Those who go for walks within their neighbourhood to exercise, walk dogs, or just have fun are more likely to interact with neighbours than those who walk for the purpose of reaching a destination.

All of the above assumes that it is possible to socially regenerate neighbourhoods through the formation of SC as an effect of walking. This could imply an economic regeneration given the synergy that exists between leisure activities and commercial practices. However, it is necessary to take into account that leisure walks are mostly associated with people with a higher socioeconomic income. This is why it is important to create walkable environments that support leisure and pay particular attention to neighbourhoods with a socioeconomic disadvantage; especially since, in most cases pedestrian-friendly interventions are found in tourist areas, or neighbourhoods with a higher socioeconomic level.

It is also necessary to remember that the structure of SC is specific to its context and that, as has been shown throughout this study; it is influenced by a variety of factors such as the built environment, as well as by the history, culture, social structure, economic inequalities, and ethnicity of the people of a certain place. That said, it would be advisable to insert these variables in the measurement methods.

5.3. New Neotechnological Methods as a Proposal for Future Research

Finally, it will be necessary to approach SC and walkability from an updated vision where new systems of neighbourhood community interaction are tracked to provide new indicators, and where updated tools and technologies are used to help streamline and make measurements more objective.

This research has revealed new ways to measure both SC and walkability. A new indicator of community attachment has been found in research on SC and walkability: the use of CC and participation in events involving CC. According to the results, the SC of the neighbourhoods can be generated and regenerated through the implementation and use of this type of currency. It was even shown that the characteristics of walkability in the neighbourhood were positively related to the use of CC and the events derived from CC. This accounts for the urban improvements in charge of promoting walkability, policies, and policymakers must think about comprehensive reactivations that involve the social and the economic.

Interestingly, the examples of solidarity exchanges that have been shown in this study, such as CC, *time bank*, and neighbourhood applications (Next Door) could help to extract concrete and first-hand data. Data such as the location, proximity, frequency, and possible motivation of interactions between neighbours could become concrete indicators that contribute to a better understanding of the spatial dynamics of the SC, whilst reducing costs and times in obtaining data.

About walkability, research has shown us that we can make use of current technologies that help us improve both objective and perception measurements. With the rise of Big Data and the use of technologies such as Deep Learning, it is possible that researchers can find more effective ways to measure in a quantitatively and comprehensively way the role that walkability plays in the construction of SC.

This study has certain limitations. Inherently, the nature of a literature review gives the possibility that the authors have misinterpreted the data and findings of the investigators. In addition to this, limiting the studies to those published in English could have excluded relevant findings.

On the other hand, another limitation could be that we have tried to show a more objective look at SC. This is in response to the recurring criticism about subjectivity in measurement strategies. For this reason, an attempt has been made to take into account those studies that have made an effort to develop tools for the objective measurement of SC. This could have neglected the potential contributions that qualitative studies have made in the area.

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