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The relationship between the neighborhood built environment and physical activity

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Chapter 8

Conclusions

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On 12th July 2022, an impressive image of galaxy cluster SMACS 0723 was released by NASA (Figure 8-1, right), as one of the very first full-color images from the James Webb Space Telescope (NASA, 2022). Compared to the left image, people finally can see what is in the dark: many galaxies and even some never observed objects. Quoting from the NASA website (Tavernier, 2022), by utilizing the most updated knowledge, technology and equipment, *Webb Telescope sees the universe like we have never seen it before.*

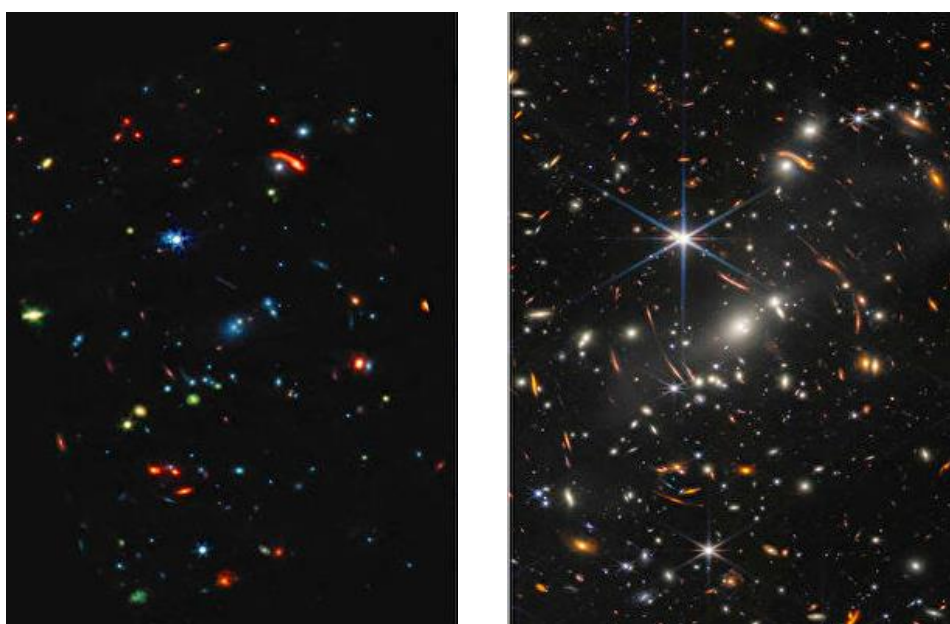


Figure 8-1 Mid-infrared and near-infrared images of Galaxy cluster SMACS 0723 by NASA's James Webb Space Telescope

(Source: NASA, 2022&Tavernier, 2022)

I am not switching topics but using these images to illustrate a problem existing in studies of the relationship between the built environment and physical activity. In the last decades, the built environment has been intensively studied, and certain aspects, such as street connectivity, have been found positively related to health outcomes and recognized as proven evidence. Despite that, scholars should keep searching for more evidence. Researchers and partitioners should bear in mind that there is more to explore in the unseen. What is happening now is that some research relies too much on existing data, evidence, and models while forgetting to search the parts we have missed so far. This thesis, therefore, aims to dive into the dark and light things up. In other words,

to reveal additional built environment characteristics and to finetune the research methods for enhancing public health, and, in this case, promoting physical activity.

8.1 Revisit the research questions

In the last few decades, health has been in the center area of policies (WHO, 2016a&Chen et al., 2019), showing the global awareness of its importance to both individuals and the whole population. Adequate physical activity has been considered a key component of a healthy lifestyle that contributes to better health (Handy, et al., 2002; Southworth, 2005; Saelens&Handy, 2008; Fonseca et al., 2021; Zhang et al., 2022a). Therefore, the factors that potentially have an impact on people's physical activity deserve comprehensive research.

According to the social ecology model (mentioned in Chapter 2), the built environment, no matter if it is a region, a city, or a neighborhood, is like an ecology system. Many factors work together to impact the people living in it (Whitehead&Dahlgren, 1991; Barton et al., 2006). Arguably, an integrated understanding of the various components and their inherent relationship in this ecological system contributes to a strategic plan that can positively influence people's physical activity. However, existing theories and evidence still left many characteristics under-discovered.

This thesis takes historical and social-ecological perspectives to explore the relationship between neighborhoods' built environment and physical activity. Although the relationship has been widely investigated (Audrey&Batista-Ferrer, 2015; Bird et al., 2018; Bonaccorsi et al., 2020; Stappers et al., 2018; Tcymbal et al., 2020) and several linkages have been identified, there are still many pieces (of possible linkages) missing from the jigsaw puzzle. Specific perspectives, such as urban design (Giles-Corti et al., 2022), are expected to explore the relationship more in depth. In Chapter 2, I presented a causal chain diagram (Figure 2-1) to show how urban design shapes the built environment, and thus has an impact on physical activity and, ultimately, people's health.

To enrich this causal chain, I raised the research questions as follows:

How do the built environments of different neighborhood types relate to the physical activity of individuals? And what changes to the built environment can effectively improve physical activity?

To answer the questions, I conducted literature reviews on this topic and implemented empirical studies in Beijing (China) and Groningen (the Netherlands). In total, the urban forms of five neighborhoods were analyzed, and 656 residents were surveyed (counting the valid surveys) to uncover their physical activity and perceptions of their living neighborhoods.

I first conducted a scoping review on urban green spaces to deeply explore how this built environment dimension impacts people's health. The results revealed the importance of how people see, use, and interact with the environment. Building upon this, I took a people-centered holistic approach to empirical studies. I separately compared different forms of neighborhoods within Beijing city (Chapter 4) and Groningen city (Chapter 5). In each chapter, I separately investigated additional parameters for the built environment and physical activity. Later on, I took a step further. From studying the relationship between the built environment and physical activity, I aimed to examine what changes to the former can improve the latter. A review of effective urban changes (or urban interventions) on physical activity was conducted to summarize the existing evidence (Chapter 6). A comparison of two countries (China and the Netherlands) resulted in hands-on design strategies for creating healthier neighborhoods (Chapter 7). In each chapter, I pushed the knowledge boundary a bit further to better understand the relationship between the built environment and physical activity in urban areas.

The following section revisits the sub-questions in the research.

1) Which built environment parameters have been explored so far, and how do they relate to health-related outcomes?

In *Chapter 2*, we critically reviewed what aspects of the built environment have been studied so far for their impacts on physical activity (see section 2.3). Built environment characteristics that have been often explored were identified, including density, land use mix, street connectivity and walkability. Mixed

findings for major built environment parameters' impact on physical activity suggest that despite a large number of studies, there are still unknown parameters.

To figure out why the relationship has shown such a mixed result, in *Chapter 3*, I focused on one specific built environment aspect, urban green spaces, and explored its relationship with health/health-related outcomes (including physical activity) by conducting a 20-year scoping review. 189 reviewed papers showed that different measurements have been adopted for assessing green spaces. On the one hand, the abundance and proximity to green spaces (material aspects) have been researched much more often compared to the quality and characteristics of green spaces (relational aspects). On the other hand, relational aspects showed statistically greater positive impacts on health than material ones.

The findings suggest the relational aspects of the built environment should be valued together with the material aspects in health-related studies. If focusing on the mere presence of the physical environment without taking people's unique individual experiences and practices within the settings into account, the results might be misleading and no concrete and consistent conclusions can be drawn. Fortunately, some work has been done, such as assessing the quality aspect of green spaces through using a questionnaire, developing an evaluation tools, and by conducting a site survey. We call for greater attention to the relational measures of the built environment. Without looking at the environment from an integrated perspective, useful information can be neglected, thus leading to misinterpretations or false conclusions.

Existing evidence should be the base, not handcuffs, as I have discussed the pitfalls of big data (in Chapter 4). In the context of evidence-based and data-driven research, the measurements of both ends of the relations (built environment and physical activity) usually use the existing data registered as datasets (GIS and census data), such as the information on land use and street network. Findings based on big data can reveal relationships on a large scale. Nonetheless, numerous design details have been neglected, which could directly or indirectly impact people's behaviors and health. 'Water can carry a boat, and can also sink it', as an old Chinese saying addressed. Studies based on

big data have greatly advanced our understanding of the relationship, while in the meantime, researchers need to remember that we should not get our hands tied by it. Furthermore, we should never stop looking for possibilities that are not seen yet but do have an impact on health or health-related outcomes. In our case, for example, built environment characteristics that have been seldomly studied, such as the green space quality and sidewalk context, are found to be influential.

2) Which aspects of the built environment have been insufficiently studied and measured in terms of their impact on physical activity?

Once influential health determinants have been identified, the next step is to measure them properly. For healthy urban planning, the well-known ‘what gets measured, gets done’ also applies. This viewpoint has been stated by Giles-Corti et al. (2022a) in the second series of the Lancet Series on urban design, transport, and health.

Both the “what to” and “how to” questions are important. In the research on the relationship between the built environment and health-related outcomes (physical activity), “what to” focuses on the built environment aspects that are influential, and “how to” raises in which way it works. For example, is the reason green spaces are health-promoting that good quality green spaces attract people to use and enjoy them? If yes, the quality aspects of green spaces are supposed to be valued and measured.

Professionals from many disciplines have made efforts to create healthy places for people to live, work and play in. In recent decades, evidence has emerged on how to design the built environment for people to conduct more physical activity for better health. Based on the literature, I developed a hypothesis that the built environment should be measured in a deeply holistic, nuanced way to reflect its impact on physical activity properly.

I tested the hypothesis in three typical Beijing (China) neighborhoods in *Chapter 4* by adopting an urban-analysis method to assess the three neighborhoods. The results showed that the highest physical activity occurred

in the neighborhood with the lowest density, not much green space and street connectivity, aspects which are often seen as lowering physical activity. Apparently, the shortages were compensated by its low-rise housing type and higher quality of sidewalks and street safety. This indicates that often used indicators such as 3D (Density, Diversity and Design) need to be supplemented by other measurable parameters. Furthermore, characteristics impacting physical activity have to be considered in their context, and people's perceptions of the built environment should be valued. Moreover, it proves that combined measurements can better capture built environment features that determine individuals' physical activity behaviors.

The other aspect in this relationship, physical activity, has been measured mainly in terms of duration, while the frequency of physical activity has also been found essential for health (Lustyk et al., 2004; Jeong et al., 2017; Kim et al., 2020), but so far remained understudied. To add to the knowledge of how physical activity can be understood as a result of the built environment, in *Chapter 5*, we took two Dutch neighborhoods in Groningen as case studies, which are similar in social-economic status. However, one is healthier than the other regarding the built environment. Which physical activity factor may explain the health difference, the frequency of or the duration of physical activity? The frequency of physical activity was consistently higher in the healthier neighborhood for all kinds of motives but not the duration, indicating that frequency might be a crucial indicator of physical activity relating to the built environment.

The relationship between the built environment and people's health is complex. Therefore, researchers should make attempts to discover what is missing in the causal chain (Figure 8-2).

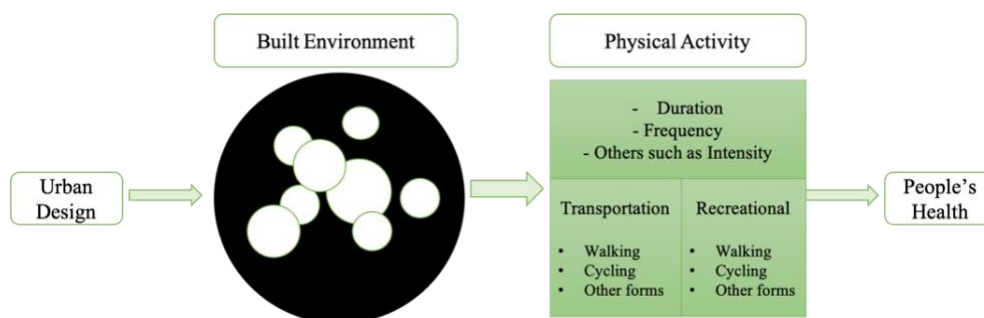


Figure 8-2 the causal chain in healthy urban planning (by author)

3) Which specific urban interventions promote physical activity (evidence from the existing literature)?

Knowledge of the built environment parameters that relate to physical activity is essential. However, it does not answer the question of how can we design or redesign the built environment to improve physical activity level. To actually make changes in people's life and enhance public health, effective urban interventions that can promote physical activity need to be explored.

“First we shape cities, then they shape us” (Gehl, 2013). To understand what specific urban interventions work in promoting physical activity, an umbrella review was conducted to synthesize the evidence (*chapter 6*), which was accompanied by a pre- and post-effect measurement. Seven review papers were included. Based on them, I found that the urban interventions in three categories (park and playground interventions, interventions aimed at walking and cycling, and community-based interventions) have the potential to promote physical activity. To name some specific urban interventions: park renovations, adding exercise equipment, introducing a (new) pocket park, improvement of cycling environments, improvement of walking and cycling environments, multi-component initiatives for active travel and enhancing the availability and accessibility of destinations.

These findings suggest that specific urban interventions can promote physical activity by adding (various) facilities and destinations and enhancing the environment to accommodate active travel (walking, cycling). Moreover, these effective interventions echo the (re)designing suggestions for a healthier Chinese neighborhood in the previous Chapter.

In the following chapter I looked into what does the comparison between Chinese and Dutch practices in creating health-promoting neighborhoods add to our general understanding.

There are similarities and differences between Chinese and Dutch neighborhoods. Historically, neighborhood planning followed different theories in China and the Netherlands. Dutch neighborhoods were based on theories from Europe and America. China, on the other hand, first used the traditional Chinese planning philosophy, and after the Second World War was

influenced by planning ideas from the Soviet Union. Some concepts from western countries were also introduced. Therefore, the form of neighborhoods varied a lot between the two countries. The issue of exploding numbers of cars also happened earlier in the Netherlands than in China, where it only began to cause parking problems the last two decades. Both countries are involved in the WHO Healthy Cities project, although China joined later. The two countries both designated health as a priority, but they focus on different policy areas. Despite many differences, in the Netherlands there is a wealth of experience in healthy city construction, thus it is important and necessary for China to learn from it. However, the differences in geography, culture, and social-economic status should not be neglected.

Chapter 7 exhibits a comparative study between China and the Netherlands. Most existing evidence on a healthy environment was based on the European context, therefore, I conducted this research to explore which urban interventions in Europe are expected to improve health at the neighborhood level, and which can guide the urban renewal practices in Chinese neighborhoods. I found that attractive and safe residential environments, local facilities such as shops and bus stops within walking distances, safe and nice pedestrian and cycling environments with good connectivity, and well-designed and managed open spaces are essential for promoting physical activity and thus improving health conditions. Nevertheless, the use of public space differs. For example, in our study cases, residents enjoy playing flying disc and grilling in Dutch neighborhoods while table tennis and Chinese chess are popular in Chinese neighborhoods. Finally, learning from the Dutch experience, six suggestions for (re)designing healthier neighborhoods in China and a broader context were proposed, including 1) Prioritize walking and cycling, 2) Enhance the micro-environment, 3) Remove obstacles/barriers, 4) Planning and also managing, 5) Design for different groups, and 6) Tailor to the local context.

8.2 Discussion and recommendations

8.2.1 The neighborhood definition from a historical perspective

This thesis took a historical perspective to select the study cases and analyze their neighborhood forms. Some spatial aspects of neighborhoods have changed since they were built, and often these changes were prompted by urban regeneration or urban renewal projects. Even so the original urban model is always remains the starting point for later modifications.

- *Neighborhood* definition in this thesis:

a separate urban module with distinct design characteristics in its built environment; it contains an urban community that shares the facilities and services in the neighborhood.

I therefore, suggest future research about the healthy neighborhood can take a historical perspective when selecting neighborhoods or broader areas. First, the historical boundary (buildings that were built in similar years) of a neighborhood usually matches the administrative boundary (Figure 8-3); by implication all kinds of data can be linked to the scale level of the neighborhood. Second, there is consistency in the spatial form since it was built in similar years and followed the same planning strategy; almost without exception, planning strategies were inspired by health motives. By analyzing whether these motives have been achieved over time, contributions can be made to the planning theory and the healthy environment model.

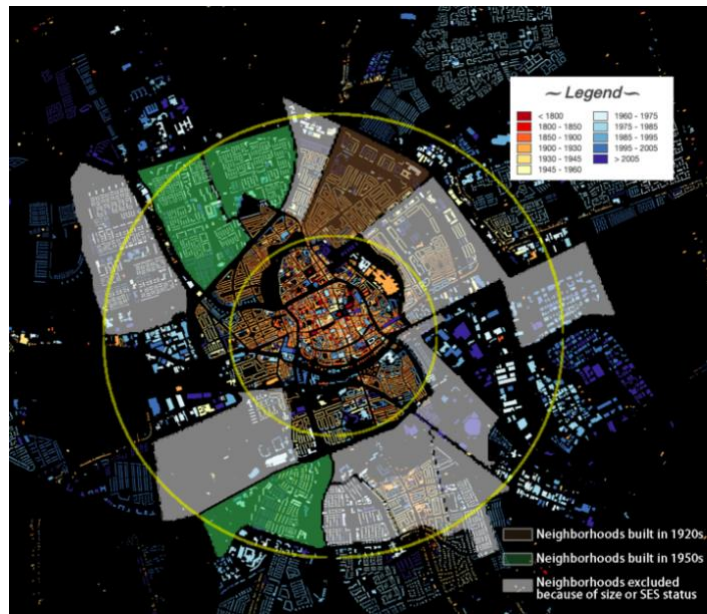


Figure 8-3 Building years and neighborhoods' boundaries matched well in Groningen, NL (by author)

8.2.2 Disconnection of different research disciplines

The built environment impacts health and health-related outcomes (such as physical activity). This has been proven in many studies, including this one. Transportation researchers have accumulated evidence on the 3D (density, diversity and design) model and developed further models (5Ds and 6Ds), which have been applied to analyze their impacts on people's active travel modes (walking and cycling). Academics from environmental research have done many studies about green spaces and found that they are essential for promoting health. Interestingly, green spaces (regardless of quantity or quality) have seldomly been included in health research in the transportation field. Even though they represent a large part of the built environment but also are closely related to health (Zhang et al., 2022b). For example, the walkability index which transportation experts developed is usually made up of the 3Ds as mentioned above but, but do not incorporate green spaces ratios. Thus, their scope is somewhat limited.

The disconnection in research perspectives is probably a result of the separation of different disciplines (environmental research and transportation/urban

planning); it might frustrate scientific progress. In 2016, the 9th Global Conference on Health Promotion was held in Shanghai (WHO, 2016b), entitled 'health for all, and all for health'. One aim of the conference was to address the importance of involving all parties, organizations and disciplines in health promotion. To better understand what is influential to health, various disciplines, including transportation, environment research, urban planning and design, public health and many more fields, should work together and make joint efforts to understand, communicate and learn from others. In an era in which complexity and uncertainty are becoming more and more common, future research is needed to break down the walls between the different disciplines.

8.2.3 Attention for the vulnerable groups

I call for more attention for vulnerable groups. There are two meanings of vulnerable groups here. First, people living in low-income countries are more susceptible for diseases related to inadequate physical activity (WHO, 2018b). However, most existing experience and evidence are based on research in high-income countries. Agendas such as SDGs of the UN and Healthy Cities of WHO aim to improve the well-being of people all over the world, thus the development of vulnerable countries also needs attention. Second, vulnerable populations, such as children and the elderly, get less attention in the existing literature. At the same time, they are more likely to be negatively affected by the poorly-designed built environments (Chen&Vanclay, 2021). They are less likely to have sufficient physical activity. The design and plan of a neighborhood should consider the needs of all inhabitants, including the vulnerable.

8.2.4 Consideration of COVID-19 and others

The fieldwork of this research was conducted during COVID-19 (March and April 2021 in Beijing and March 2022 in Groningen). As a result, the pandemic inevitably influenced the collected data, especially the physical activity data. Moreover, people's physical activity can change in different circumstances, such as seasons, weather, and temperature, and it can also be influenced by holidays and vacation times. Some measures were taken to control those factors

(details actions see Chapters 4&5). In future research, especially in international comparative studies, these aspects should be taken into account.

In the social-ecological model, health and its related behaviors are influenced by many aspects, including personal factors, built environment, social environment. Neighborhoods have many qualities that can have impacts on physical activity and health. One of the limitations of this thesis is that I focused on only some of the built environment factors and left out others, among them air quality and noise. Another limitation is that I focused on the neighborhood; how the neighborhood interacts with the city and how it affects people's behaviors should be further explored in future research. Moreover, the micro-environment of the neighborhoods also matters, but has been widely ignored. Therefore, research from the perspective of urban planning and design is recommended. Further research is also suggested to include more recent neighborhood types.

8.3 Final words

We are living in a time of continuing urbanization and increasing health challenges in urban areas. Creating a healthy environment for urban living is crucial for tackling health problems, both in developed and developing countries.

In the near future, certain goals (Box 8-1) for creating health-promoting cities are expected to be achieved within the framework of the 2030 Agenda for Sustainable Development (SDGs by UN, 2015). 'Healthy China 2030' has proclaimed the ambition of making Chinese cities healthier before 2030.

Box 8-1 Goals of the 2030 Agenda for Sustainable Development (SDGs)

Two Goals of the 17 SDGs are closely related to creating healthy cities, which are:

- **Goal 3.** Ensure healthy lives and promote well-being for all at all ages.
- **Goal 11.** Make cities and human settlements inclusive, safe, resilient and sustainable.

(Source: UN, 2015)

In this context, this thesis is timely, which contributes to creating health-promoting environments both theoretically and practically.

Theoretically, first, this thesis adds evidence in green spaces literature. Based on 189 papers published over the first two decades of this century, we find that green spaces' material dimensions (abundance and proximity) are both essential for better health outcomes. This indicates that incorporating a relational perspective of green place-thinking into the existing literature on green spaces and health could contribute to optimizing the positive effects of green spaces. Second, I add the urban design point of view and the term "neighborhood type" in studying the relationship between the neighborhood environment and physical activity, and found that these are vital in studying the neighborhood and health. The built environment needs to be considered in context and accessed precisely. Third, regarding physical activity in the neighborhoods, we find that the frequency might be a better indicator of a healthy neighborhood than the duration. Fourth, this thesis also fills in the gap of lacking evidence on specific urban interventions (with a pre- and post-effect measurement) that promote physical activity. Finally, the case study in China complements the research deficiencies in Asian countries in this field.

Practically, the findings and conclusions this thesis has arrived at can be applied to neighborhood planning and design practice. For example, urban interventions can promote physical activity in terms of park renovations, adding exercise equipment, introducing pocket parks, improving walking and cycling environments, etc. These findings can guide urban planners and policy-makers to create physical activity-enabling environments in the Chinese and broader context.

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