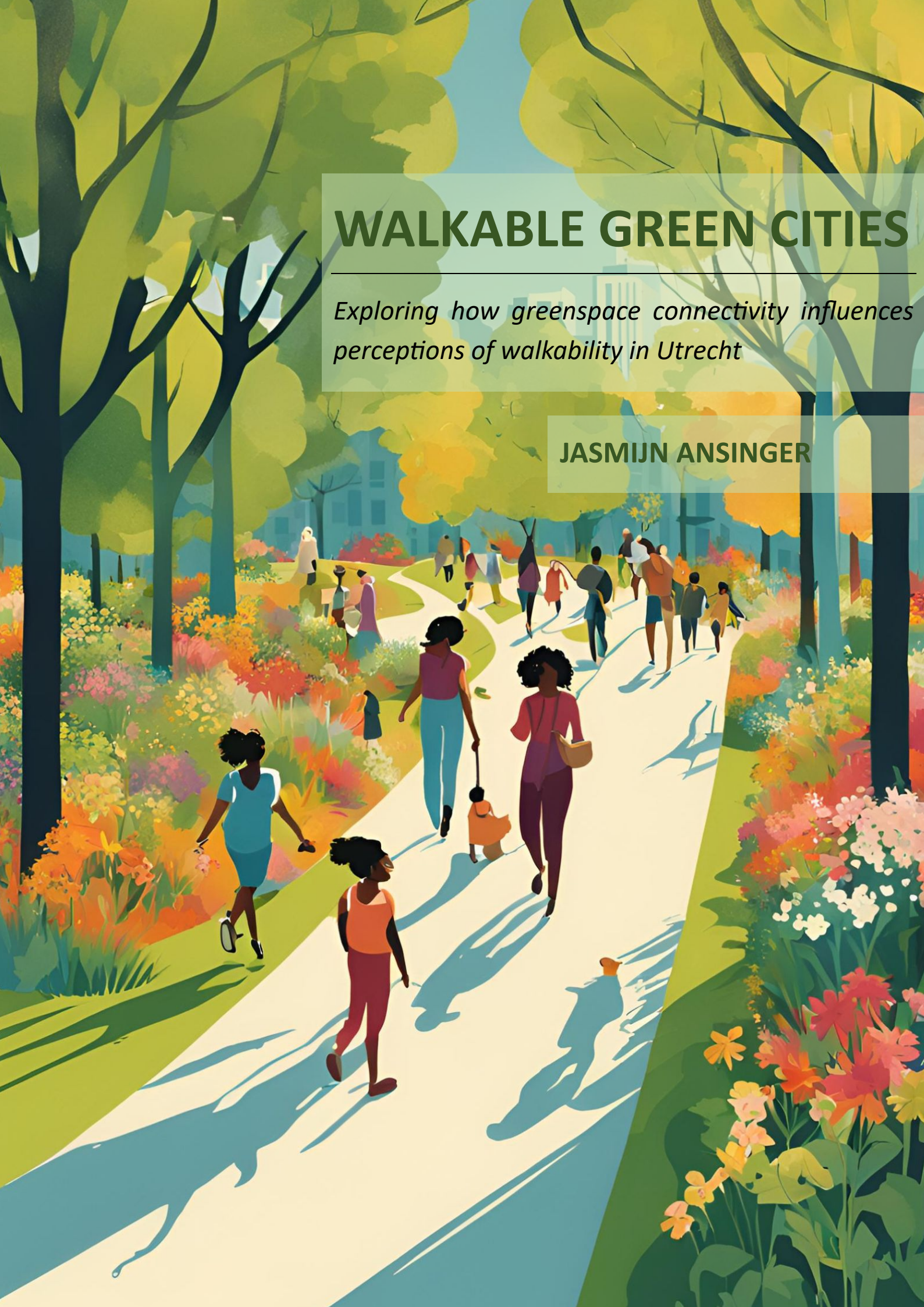

WALKABLE GREEN CITIES

Exploring how greenspace connectivity influences perceptions of walkability in Utrecht

JASMIJN ANSINGER

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Exploring how greenspace connectivity influences perceptions of walkability in Utrecht

This document is a master thesis for the Master of Science Urban Environmental Management with the specialization Land Use Planning at Wageningen University and Research.

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Abstract

INTRODUCTION: In response to increasing urbanization and declining public health, especially in cities, urban planners are increasing the focus on integrating greenspaces and increasing walkability. While the health benefits of greenspace and walkability are well-researched, the influence of *greenspace connectivity* on *perceived walkability* remains unexplored.

THEORETICAL AND CONCEPTUAL MODEL: Based on the walkability model and the graph theory, greenspace connectivity and perceived walkability are researched.

METHODS: This research used a two-phase mixed-methods design. In Phase One, a GIS analysis was used to calculate the gamma-index of different neighborhoods in Utrecht. Two neighborhoods, Overvecht (high greenspace connectivity) and Zuidwest (low greenspace connectivity), were selected for Phase Two. In this second phase, residents participated in a survey or semi-structured interviews.

RESULTS: The results indicate that greenspace connectivity slightly varies between neighborhoods. Although Overvecht had a higher greenspace connectivity, it scored lower on perceived walkability for both utilitarian walking and recreational walking. Survey findings showed that perceived ease of access and self-reported frequency of walking had a significant effect on the perceived walkability. The interviews showed that residents associate walking with safe, continuous, and green environments.

DISCUSSION: Based on the findings, it was noted that walking motivation played an imported role in the perceived walkability. Recreational walking showed a stronger relationship with greenspace quality and aesthetics, while utilitarian walking was more influenced by efficiency of routes. Therefore, greenspace plays a more prominent role in increasing recreational perceived walkability.

CONCLUSION: The results suggest that greenspace connectivity has an indirect influence on perceived walkability. It can influence the perceived walkability especially through the attractiveness and usability of walking routes within the neighborhoods. Urban planners should use both structural and perceptional perspectives, to ensure the best outcome to enhance physical health in urban environments.

KEY WORDS: Greenspace connectivity, perceived walkability, Utrecht, urban green infrastructure, connectivity analysis, walking motivation.

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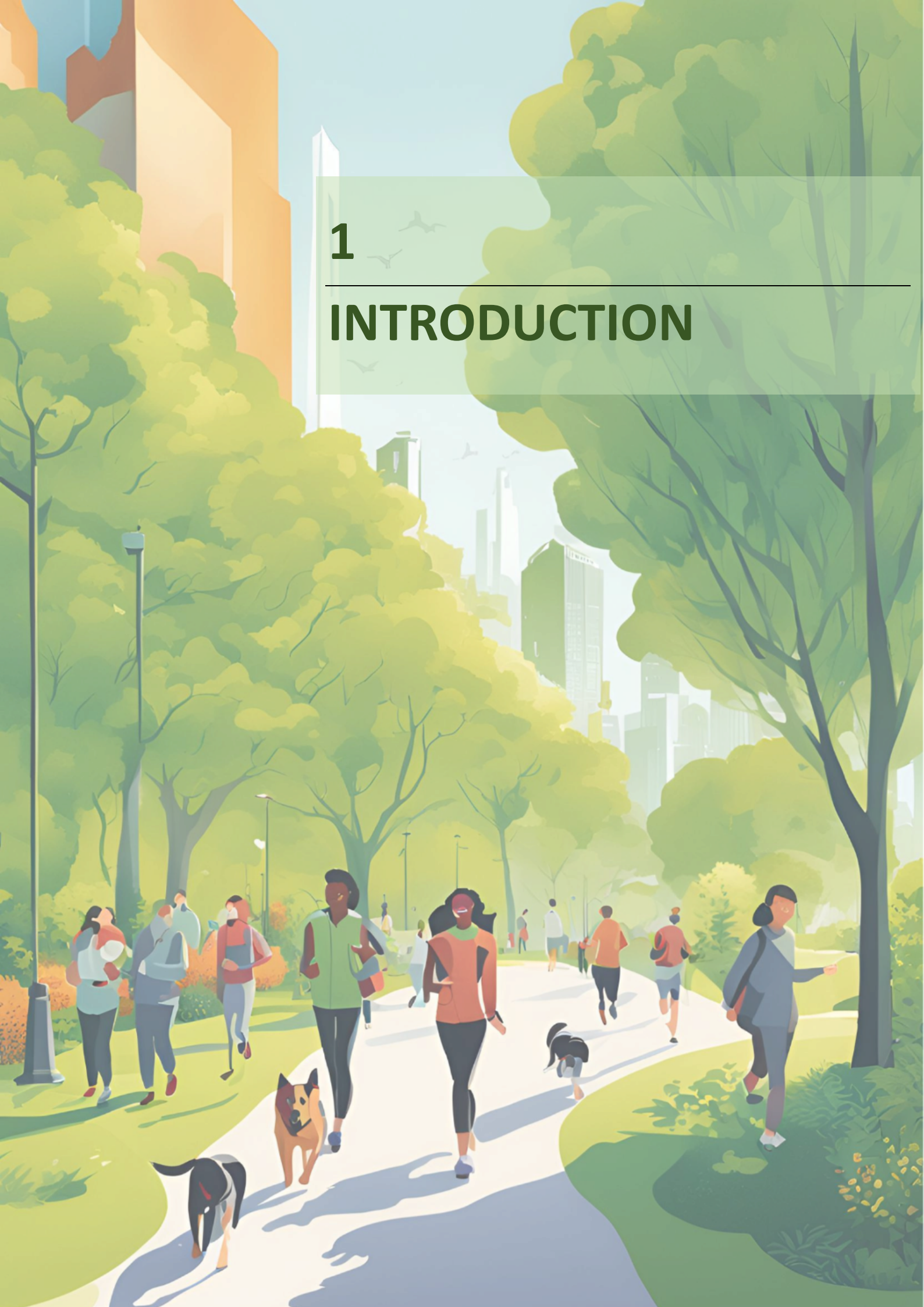


1

INTRODUCTION

1 Introduction

1.1 Background Information

Walking has historically been the primary mode of transportation within urban areas, and until the nineteenth century, most cities were structured in ways that supported walkability (Baobeid et al., 2021; Singh, 2016). However, with the rapid urbanization, population growth, and the introduction of cars that took place in the 1950s, urban lifestyles have shifted toward a more car-dependent lifestyle (Baobeid et al., 2021). Since then, planning has focused more on creating space for motorized transportation and has neglected active transportation modes such as walking and cycling (Baobeid et al., 2021). In current society, walking and walkability are becoming important themes again in urban planning, driven by the growing recognition of their role in sustainable urban development (Baobeid et al., 2021; Singh, 2016). Urban walkability can now be seen as a core design element, offering significant advantages across multiple domains, including public health and environmental sustainability (Baobeid et al., 2021).

Several studies have researched the health benefits of walking and cycling. It has been shown that walking and cycling can help prevent chronic modern diseases like obesity, diabetes, and hypertension but also support physical rehabilitation (Baobeid et al., 2021; Mackenbach et al., 2014). In addition, it also contributes to mental health by reducing depression and stress (Baobeid et al., 2021; Roe & Aspinall, 2011). By promoting active transport and reducing car usage, not only individual health outcomes but also the overall quality of life within urban communities can be improved (Baobeid et al., 2021). Furthermore, urban environments that prioritize walkability often exhibit higher levels of livability. Residents of cities with a higher walkability benefit from reduced traffic congestion, cleaner air and improved opportunities for social interaction, which further contributes to the residents' well-being (Baobeid et al., 2021).

In addition, walkability aligns with the goals of urban sustainable development, it reduces reliance on fossil fuels, mitigates urban heat island effects, and lowers greenhouse gas emissions (The United Nations, 2023). Additionally, walkable cities encourage economic productivity by promoting efficient land use and increasing urban resilience in transportation (Baobeid et al., 2021). This comes together in green infrastructure, which refers to the integration of greenspaces into urban infrastructure and spatial planning, creating interconnected networks that provide ecological, social and economic benefits (Hou et al., 2023). A key characteristic of green infrastructure is connectivity. Well-connected greenspaces strengthen regional ecosystem resilience, enhance biodiversity and support human well-being by offering accessible opportunities for active transport (Hou et al., 2023). These interconnected networks also improve a city's capacity to adapt to environmental challenges, such as climate change and resource scarcity (Hou et al., 2023).

Urban land is a finite and highly contested resource, with competing demands for residential, commercial and recreational uses (University of Arizona, 2019). In The Netherlands this competition is particularly intense due to the ongoing housing shortage (Jansma & Ockhuijsen, 2021). This tension often puts urban greenspace at the risk of marginalization (University of Arizona, 2019). However, the preservation and implementation of urban greenspaces are essential for ensuring sustainable and livable cities (Baobeid et al., 2021). By highlighting the benefits of urban greenspace urban planners

can increase its chances of preservation, additionally increasing opportunities for active transport (University of Arizona, 2019).

1.2 Societal Relevance

From a societal perspective, poorly planned urban areas can cause irreversible damage to the ecosystem services that are both critical to human wellbeing as to biodiversity (Hou et al., 2023). As urbanization increases, the need for sustainable development strategies that balance human activity with ecological preservation also increases (Hu et al., 2023).

Decreased physical health is one of the most pressing concerns in urban environments (Baobeid et al., 2021; Lachowycz & Jones, 2013; Mackenbach et al., 2014). Regular moderate-to-vigorous physical activity has several long- and short-term effects on health, including the prevention of cardiovascular diseases, type 2 diabetes, obesity and certain types of cancer (Dewulf et al., 2012; World Health Organization, 2024). Despite these advantages, physical inactivity is a growing global issue, with 31% of the adult global population currently being inactive, even expecting to rise to 35% by 2030 (World Health Organization, 2024). Encouraging walking, especially through well connected greenspaces might offer an effective solution to reduce this trend and promote healthier lifestyles in urban environments (Hou et al., 2023; University of Arizona, 2019). Walking not only promotes physical activity, but is also considers the sustainability challenges of the future (Kim et al., 2024). In the urban sector, pedestrian-oriented urban planning is considered to be a key element to create sustainable urban environments (Kim et al., 2024).

In addition to health benefits, green infrastructure contributes to biodiversity and sustainability. By preserving and connecting greenspaces, green infrastructure supports protects biodiversity and enhances environmental resilience (Hou et al., 2023). Connectivity is an important aspect, as it can help with the integration of greenspaces into urban planning. While connectivity is often discussed in ecological terms referring to wildlife movement, this thesis focusses on greenspace structural connectivity for people. Which refers to the physical linkages between publicly accessible walking infrastructure as will be further discussed in *2.1.5 2.1.5 Greenspace Connectivity at Landscape Scale.*

This thesis can help contribute to understand the relationship between structural greenspace connectivity and its possible effects on the walkability, to improve the physical health of the urban residents. By focusing on this relationship, this research seeks to provide valuable insights for creating healthier and more sustainable cities.

1.3 Knowledge Gap

Based on an initial literature review there is already much knowledge on the relation between urban greenspace and physical activity, with the main conclusion being increased physical activity levels in areas with more urban greenspaces (Baobeid et al., 2021; Ding et al., 2011; Mackenbach et al., 2014; Roe & Aspinall, 2011; Zuniga-Teran et al., 2017). However, a knowledge gap in the existing literature is a lack of information on the association of greenspace connectivity and the urban walkability to promote walking behavior. Previous research has primarily examined street connectivity and its relationship with the accessibility of greenspaces, such as parks, where greenspace is considered an outcome or a destination (Baobeid et al., 2021; Hou et al., 2023; Kim et al., 2024). In contrast, this

thesis focusses on the connectivity of greenspace itself, looking into street greenery in addition to parks and other urban greenspaces. Unlike previous studies that treat greenspace as stand-alone destinations, this research views greenspace as a resource within the urban environment, exploring the structural connectivity rather than solely the accessibility of greenspace (Chandrabose et al., 2024; Dills et al., 2012; Marquet et al., 2020; Zuniga-Teran et al., 2019).
In addition, before looking into actual walking behavior, it is important to first analyze walking perceptions, as perceptions often mediate actual behavior (Jin & Kim, 2024). When it comes to planning an urban neighborhood, the planner might objectively design a walkable neighborhood, but is it also perceived walkable by the residents? (Zuniga-Teran et al., 2019).

1.4 Research Objective

The purpose of this study it to explore whether greenspace connectivity influences perceptions of walkability of urban neighborhoods in the city of Utrecht, by comparing two neighborhoods with different levels of greenspace connectivity. The hypothesis is that higher levels of greenspace connectivity within a neighborhood will increase the walkability as perceived by the residents of this neighborhood.

1.5 Research Questions

1.5.1 Main research question

How does greenspace connectivity influence walkability in urban neighborhoods in Utrecht as perceived by residents?

1.5.2 Sub research questions

The following sub research questions will be used to help answer the main research question as stated above.

1. What is the current state of greenspace connectivity in different neighborhoods in Utrecht?
2. How does self-reported frequency of walking and alternative transport options influence their perceptions of walkability in urban environments?
3. How do perceived access and perceived barriers to walking, influence perceived walkability of residents in Utrecht?
4. What is the effect of walking motivation, recreational or utilitarian, on the perceived walkability of residents in Utrecht?

1.6 Thesis Structure

The thesis contains nine chapters. The first chapter (current chapter) is the introduction, this chapter presents the outline of the thesis, provide background information and the research questions that guide the study. The second chapter is the theoretical framework, this chapter dives deeper into the main concepts of the research (greenspace connectivity and walkability), and provides theories that explain these concepts. The third chapter is the conceptual framework, this chapter looks into mediating variables that influence the relation between greenspace connectivity and perceived walkability. The fourth chapter focuses on the methods, detailing the approach for neighborhood selection and other methodologies relevant to the study. The fifth chapter provides information on the study area. The sixt chapter is the first chapter with the results, it present the results of the first phase, outlining the findings of the Geo Information System (GIS) analysis. The seventh chapter contains the

results of the second phase, diving deeper into the survey and interview results. After this the eight chapter is the discussion, here the sub research questions will be answered and further points of discussion will be presented. Finally, the nineth chapter (conclusion and recommendation) concludes the thesis by answering the main research question and offering recommendations based on the results.

The results of the study consist of two main phases, phase one is before neighborhood selection, which aligns with sub-research question 1. The focus for this phase is on the variable greenspace connectivity. The second phase, is after neighborhood selection, which starts after the first sub-research question and consists sub-research questions two till four. The focus for this phase is on perceived walkability of the residents. In the discussion the results of the two phases are evaluated in order to answer the main research question. A visual representation of the two research phases can be found in Figure 1.

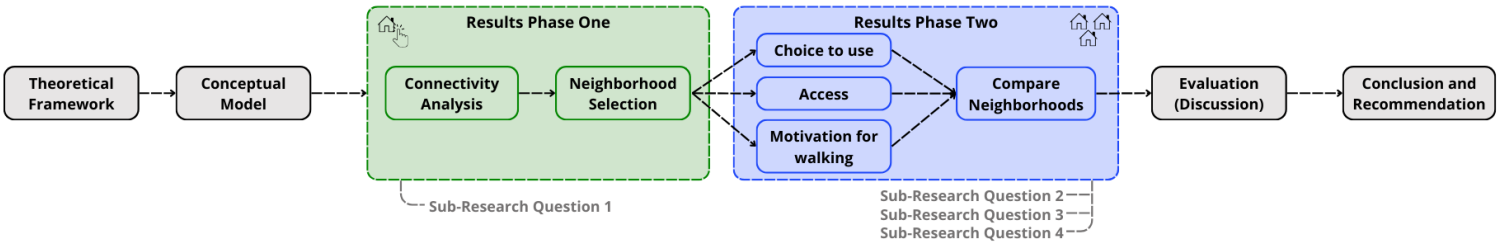
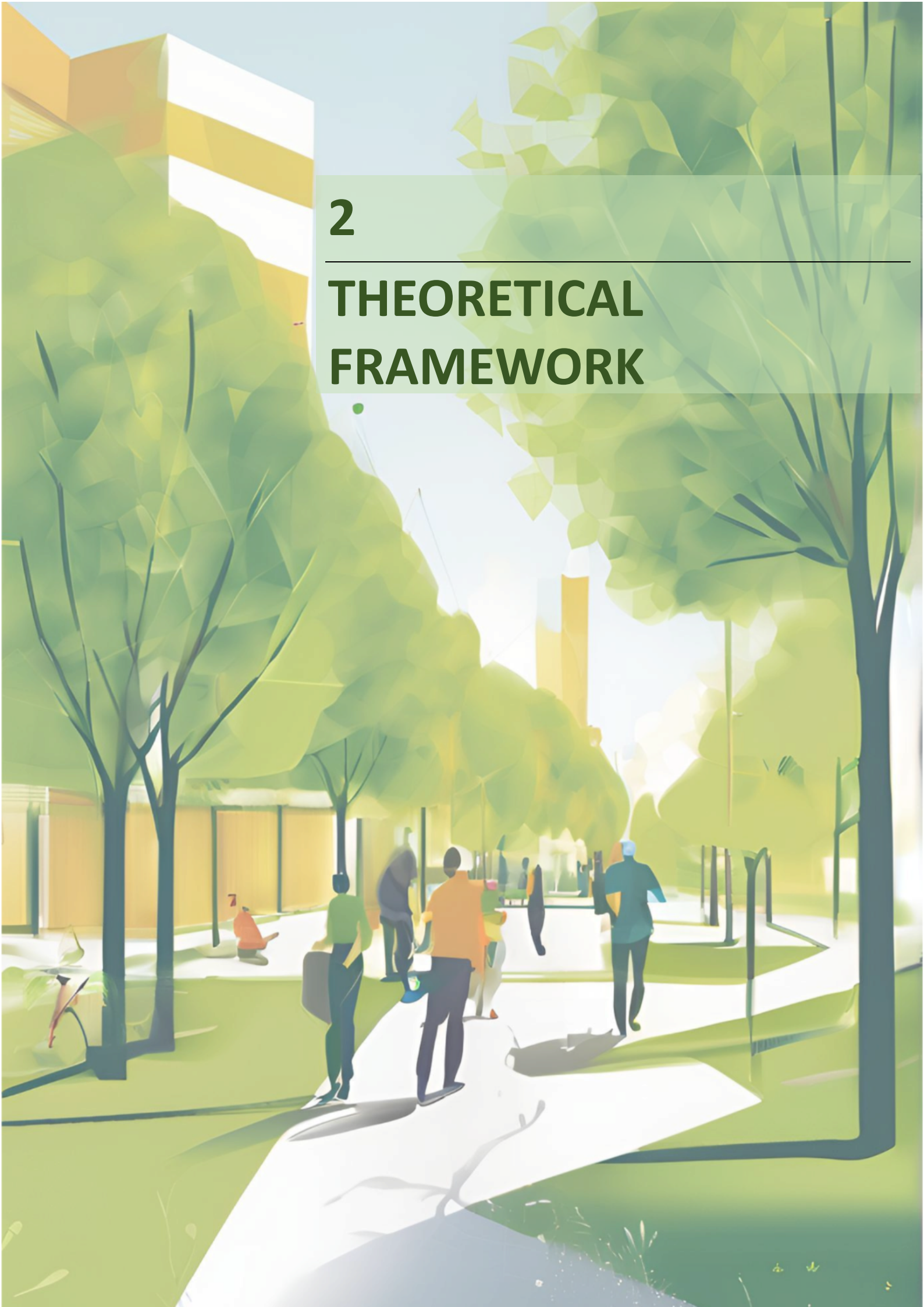


Figure 1: Visual representation of thesis structure



2

THEORETICAL FRAMEWORK

2 Theoretical Framework

Within the main research question, several concepts are introduced. The following section will provide a comprehensive overview of **greenspace connectivity**, its components, and the concept of **perceived walkability**.

Figure 2: Visual representation of possible relation between the two main concepts

2.1 Greenspace Connectivity

In order to determine what greenspace connectivity is, it is important to look into both the concept of (urban) greenspace and the concept of connectivity.

2.1.1 Greenspace

Greenspace is a term that is widely used in various disciplines such as life, physical and social sciences, but often without a clear definition. In addition, the term itself also varies per research, examples are green space, greenery, green area etc. (Taylor & Hochuli, 2017). For this research, the term used is "greenspace" within an urban context, defined as provided by Lachowycz & Jones (2013). Here greenspace broadly includes **publicly accessible areas featuring natural vegetation such as grass, plants or trees including street greenery**, and may also include built environment features such as **urban parks,** and less managed areas, **including forest and nature reserves** within an urban context (Lachowycz & Jones, 2013; L. Taylor & Hochuli, 2017).

Numerous studies have researched and demonstrated positive effects on health of urban greenspace and its relation to health and well-being. These studies have showed that greenspace is associated with reductions of depression, anxiety, stress, anger and aggression (Akpinar et al., 2016; Baobeid et al., 2021; Chandrabose et al., 2024; Mackenbach et al., 2014; Roe & Aspinall, 2011). In addition, greenspace is positively associated with physiological well-being, quality of life and better health outcomes (Akpinar et al., 2016).

2.1.2 Green networks

Blue-green networks, are an urban development concept that integrates existing or restored rivers and their valleys (blue networks) with green spaces, such as parks, old orchards, and wastelands (European Commission, n.d.). This approach serves as a foundation for spatial city planning aimed at promoting sustainable development and adapting to global climate change. Recreating a nature-oriented water cycle and integrating water with green infrastructure through blue-green networks is an effective way to enhance urban ecosystems (European Commission, n.d.). It supports habitats of flora and fauna and improves urban quality, in addition, it mitigates climate change effects, improves air quality and positively influences a city's economic development (European Commission, n.d.). For this research the focus will be on greenspace and therefore blue infrastructure will further be left out.

Environmental benefits of green networks are closely linked to ecosystem services, for example, greenspaces absorb rainfall and therefore decrease the risk of flooding, absorb CO_2 and thus mitigate climate change (European Commission, n.d.). In addition, greenspaces filter particulate matter and therefore improve air quality (European Commission, n.d.).

2.1.3 Greenspaces and health in urban areas

The relation between greenspace and health can be understood by looking at three domains, which emphasize three functions of greenspace: mitigation, restoration, and instoration (Markevych et al., 2017). Mitigation refers to reducing harm by reducing exposures to environmental stressors such as air pollution, noise and heat. Restoration refers to restoring capacities, for example, stress recovery or attention restoration. Finally, instoration refers to building capacities, within this domain greenspace encourages physical activity and facilitates social cohesion. The influence of these three domains tends to matter most in urban areas, which means that in urban areas the impact of greenspace on health is stronger than in less urbanized areas (Markevych et al., 2017). A possible explanation for this is that in urban areas dwellers benefit more from greenspace than people who live in less urban areas, since these urban dwellers experience more factors such as artificial light, air pollution, noise and heat as they are more prevalent, stronger or necessary in urban areas (Browning et al., 2022; Markevych et al., 2017).

2.1.4 Exposure to Urban Greenspace

The first mediating variable is exposure to greenspace, which in this research refers to the extent of contact or interaction that an individual has with urban greenspace (Remme et al., 2021). It consists of two sub-variables: choice to use and access to greenspace. This exposure to the urban greenspace is critical because it enables people to experience the physical, psychological and social benefits of greenspace (Remme et al., 2021). In the scope of this research, exposure to greenspace represents the relationship that depends both on the availability of greenspace and on the individual's capacity to use and access the greenspace.

The first component within exposure to urban greenspace is the **choice to use**. It reflects the individual decision-making process that turns opportunity to access greenspace into actual usage or contact with the urban greenspace (Remme et al., 2021). Within this concept personal and conceptual factors are taken into account whether the greenspace is utilized. Choice to use includes personal and social factors, such as **time availability, transport availability, health and mobility and factors about the perceived walking environment**, such as aesthetic qualities, safety and greenspace amenities (benches, lighting etc.) (Remme et al., 2021). Indicators that are valuable for researching choice to use can be time spent in greenspace and self-reported frequency of use of greenspace visits (Remme et al., 2021). This component brings a behavioral filter that determines whether opportunities provided by access correlate with actual exposure to the greenspace. Even if the greenspace is accessible, exposure will not occur unless individuals are motivated to use it. An example of this could be that a greenspace is well connected, however it might be perceived as unsafe, resulting in less usage of the greenspace (Remme et al., 2021).

The second component for exposure, briefly mentioned above, is **access to greenspace**. Access to greenspace refers to the opportunity an individual has, or perceives to have to physically reach greenspaces (Remme et al., 2021). This component includes physical access, barriers and perceived accessibility (Lachowycz & Jones, 2013; Remme et al., 2021). Access to greenspace is an important

component to consider, as, for example, highly connected greenspaces such as greenways, could not result in high perceived walkability, if access is hindered by socio-economic or physical barriers (Remme et al., 2021).

To conclude, access to greenspace provides physical opportunities for exposure to greenspace, and choice to use determines whether or not individuals take advantage of these opportunities.

2.1.5 Greenspace Connectivity at Landscape Scale

The term landscape connectivity is an ecological term first introduced in 1984 and is defined as the extent to which the landscape facilitates or hinders movement between species (Morin et al., 2024; P. D. Taylor et al., 1993; Tian et al., 2017). Landscape connectivity supports biodiversity and provides services that support human health and well-being (Cornell University, n.d.). The term landscape connectivity includes functional and structural connectivity. Hereby, structural landscape connectivity refers to the physical connectivity, which can be measured by assessing configuration, proximity, or connectivity among landscape elements along with landscape structure (P. D. Taylor et al., 1993; Tian et al., 2017). Functional connectivity refers to the behavioral response to certain landscape elements, in other words, how well a landscape allows for movement of organisms and processes such as genetic exchange or breeding migrations (Cornell University, n.d.; Tian et al., 2017). For this research, the focus lies on structural connectivity as it is assumed to influence the walkability in urban areas.

The connectivity of greenspaces not only provides benefits for biodiversity and ecosystems, but it also directly benefits humans through the creation of connected trails and greenways (Lookingbill et al., 2022). Structural landscape connectivity in urban context not only enhances green cover and improves micro-climate, but it also puts people closer to nature, promoting better physical and mental health (Tian et al., 2017). In addition, well-connected greenspaces at the landscape scale provide a better living environment and increase the economic values of land, such as tourism potential and urban landscape quality (Tian et al., 2017). Due to these benefits and the creation of greenbelts, greenways, and green-blue networks, connectivity is often a desired outcome in urban planning (Lookingbill et al., 2022).

Data on structural landscape connectivity often relies on environmental and land cover data, which refers to data on the Earth's terrestrial surface, such as grass, trees, or human structures (Liccari et al., 2022; Morin et al., 2024). Urban areas pose unique challenges for measuring landscape connectivity, due to the fine-scale heterogeneity, land cover types, and stressors (Lookingbill et al., 2022). Landscape connectivity research is therefore most commonly done in a natural or rural landscape on animal species, but when looking at the built urban environment, the assumption is made for this research that people can be seen as the target species, and that therefore the concept of structural landscape connectivity also applies to humans.

Based on the definitions above of greenspace and landscape connectivity, a definition can be given on the first important concept: greenspace structural connectivity. Greenspace structural connectivity refers in this research to **the structural integration of greenspace within urban environments**. It can be created by placing and linking publicly accessible greenspaces within a city, creating a green network. Examples can be street trees or other forms of greenery, as this is located on the sidewalk, which is closely related to human walking behavior. Key components of greenspace structural connectivity could include continuous greenspace or green corridors (San Francisco Estuary Institute, n.d.).

2.1.6 Graph Theory

The graph theory is a widely used to analyze an urban network, and can be used to assess urban connectivity, for example road connectivity but also greenspace connectivity, it redefines complex urban systems to a finite number of nodes also commonly referred to as vertices and links which are also called edges (Jażdżewska, 2022). Within a network, or graph, nodes represent individual elements within the network, and the edges represent the connectivity between these nodes (Minor & Urban, 2008). A visual representation of the graph theory can be found in Figure 3. For this study, the nodes are the urban public street trees, and the edges are the links between these trees. In this study, it is considered a link when street trees are located within five meters of each other. There are various ways of using graph theory within research, but with the development of GIS tools, the combination of graph theory and GIS analysis has become more common to perform network analysis (Jażdżewska, 2022).

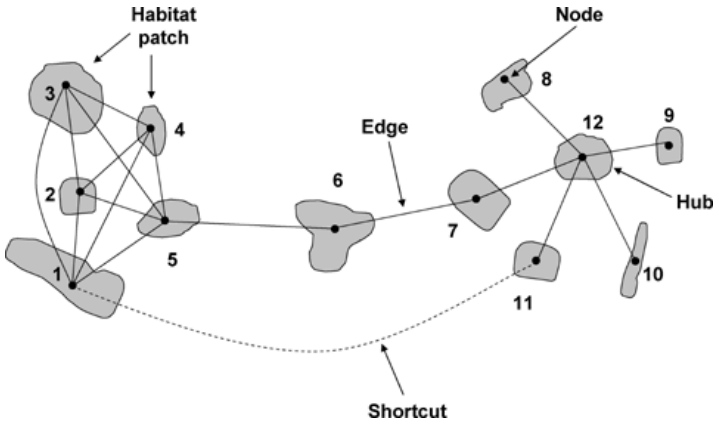


Figure 3: Illustration of graph theory terminology (Minor & Urban, 2008)

2.2 Walkability

The concept of walkability is highly relevant to different disciplinary fields, connecting urban design and planning to broader issues like public health and climate change (Kim et al., 2024). It refers to "**the extent to which the urban environment is pedestrian friendly**" (Moura, Cambra, & Gonçalves, 2017: 282). Walkability concerning greenspace refers to the ease and safety with which individuals can walk from home to a greenspace (Zuniga-Teran et al., 2019). When looking at human motivation for walking, two main reasons have been identified: recreation and utilitarian walking (Remme et al., 2021; Zuniga-Teran et al., 2017).

A term that is widely used when speaking of walkability is pedestrian-friendly, whereby pedestrian-friendly is an urban space that prioritizes walking, cycling, and public transport over car use. Greenspaces are vital for a pedestrian-friendly urban design; parks, gardens, and green corridors provide recreational areas and contribute to the city's ecological health (Coronado, 2024). It also includes prioritizing accessibility and inclusivity by ensuring that sidewalks are wheelchair friendly which makes the city more welcoming for the elderly, disabled, and families with children (Coronado, 2024).

2.2.1 Motivation for Walking

Walking is a complex activity and can have multiple purposes. In general, walking can be defined into utilitarian walking including walking as a form of transport and recreational walking (Kim et al., 2024;

Zuniga-Teran et al., 2017). The characterization of walking is inconsistent across the literature, some studies characterize walking as a form of exercise as recreational, while others refer to it as utilitarian (Agrawal & Schimek, 2007; Kang et al., 2017; Kim et al., 2024; Yang & Diez-Roux, 2012). This is also the case for dog walking, which is characterized as utilitarian in some studies and as recreational walking in other studies (Agrawal & Schimek, 2007; Cutt et al., 2008; Kang et al., 2017). Therefore, in this research an operational definition is given to utilitarian and recreational walking, based on the article of Kang et al. (2017). Hereby, utilitarian walking refers to walking **with a destination**, which can be shops or work etc. and recreational walking is defined as walking **without a destination**, including dog walking or walking as exercise. The two types of walking with examples can be found in Figure 4. Differences in walking can also be found in aspects other than purpose, for instance, utilitarian walking is 45% shorter in duration and 9% faster in speed than recreational walking (Kang et al., 2017).

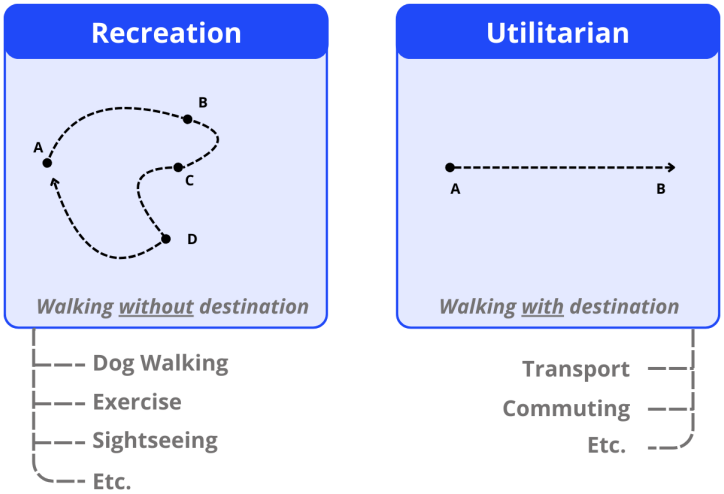


Figure 4: Two types of walking with examples

The built environment is proven to be associated with different walking purposes, areas characterized by a high population density and high distance connectivity are related to increased walking as a form of exercise (recreational walking) (Kim et al., 2024). While utilitarian walking is found to be most common in residential, workplace or mixed-use areas (Kim et al., 2024).

2.2.2 The Walkability Model

Different attributes of the built environment have been identified to influence the mode of transportation, and thus the choice for walking (Zuniga-Teran et al., 2019). A study by Cervero & Kockelman (1997), recognized as one of the most influential studies on walkability, categorizes these attributes as the 3Ds: density, diversity of land use, and design (Zuniga-Teran et al., 2017). Building on this foundation, Zuniga-Teran et al. (2019) propose a more comprehensive Walkability Model (Figure 5). This model measures walkability through three dimensions; physical attributes such as connectivity, land use mix and density. Motivation for walking refers to walking for recreation and utilitarian reasons. The third dimension is human perceptions, such as safety from traffic, surveillance, parking, greenspace, community and overall walking experience. For this research this model will be used to guide the concept of walkability, as it provides a full overview of walkability. Two aspects of this model are particularly interesting for this research: connectivity and greenspace. Within the walkability model, connectivity refers to how well a street network provides multiple, direct and short routes to

reach different destinations, whereas higher connectivity is more desirable to facilitate walking (Zuniga-Teran et al., 2017). In addition, the greenspace category of the model measures the availability of spaces dominated by vegetation, which includes the size, proximity, and ease of access of the greenspace (Zuniga-Teran et al., 2017).

To give an example, a walkable neighborhood, as defined by the walkability model, features pedestrian-friendly infrastructure within a well-connected street network that offers short and direct routes to commercial destinations. These neighborhoods are further characterized by aesthetically pleasing surroundings and homes designed with street-facing windows, which are believed to encourage walking by fostering a sense of openness and safety (Zuniga-Teran et al., 2017).

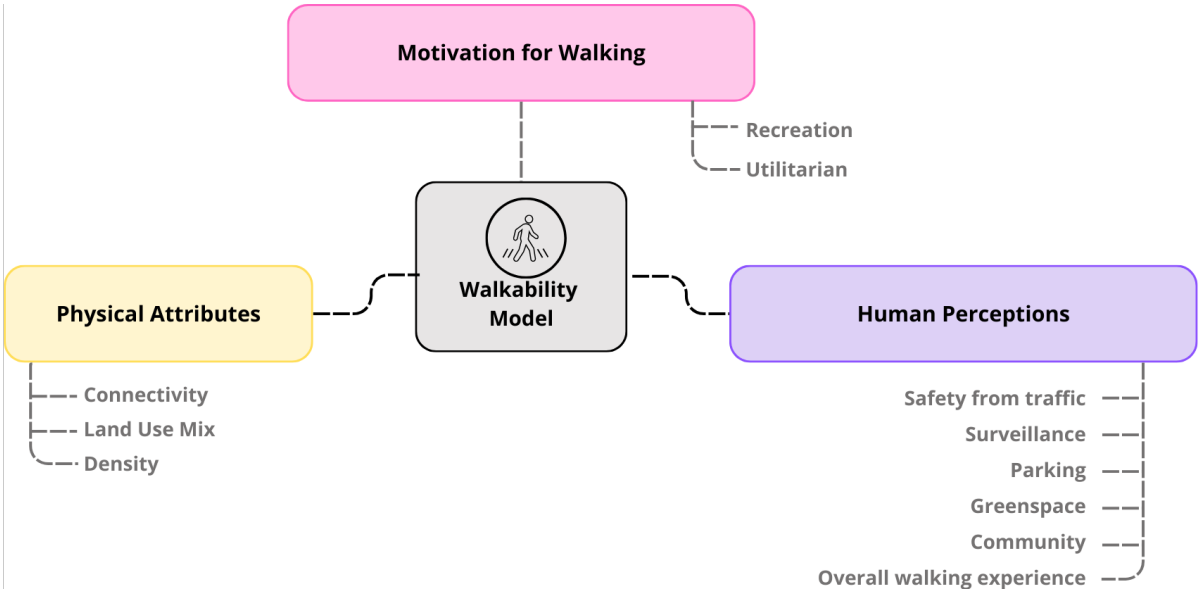
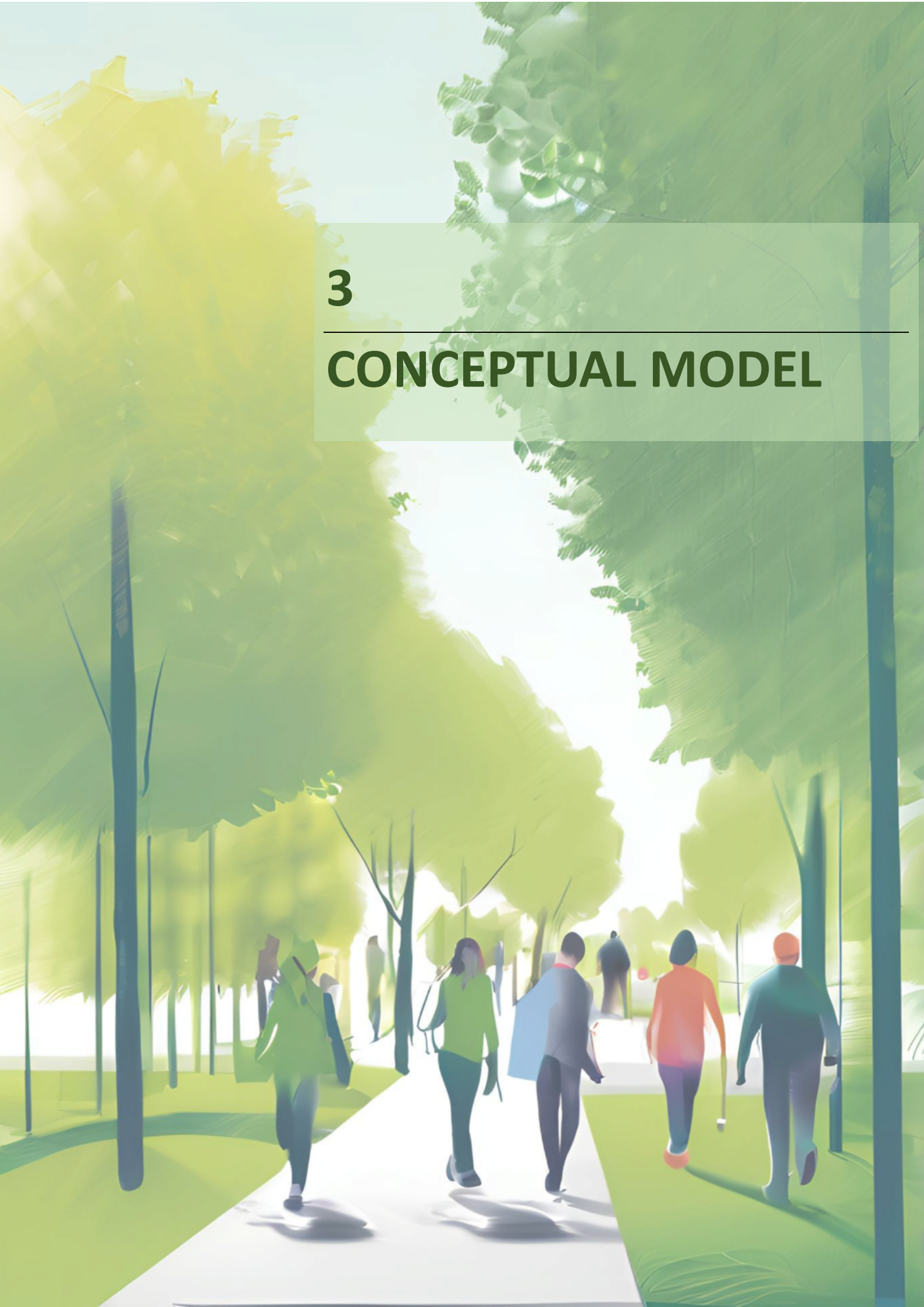


Figure 5: Visualization of the walkability model

2.3 Influence of Socio-demographic Factors

It is expected that the most important socio-demographic factors to include are age, gender, socio-economic status (SES), and car or dog ownership (Baobeid et al., 2021; Dewulf et al., 2012; Kang et al., 2017; Lachowycz & Jones, 2013). Factors such as mobility and perceptions of urban environment are strongly age-related and therefore, the motivations for using greenspace are likely to vary by age (Lachowycz & Jones, 2013). Gender is also important to include as a socio-demographic factor, since gender is known to affect health in relation to greenspace (Lachowycz & Jones, 2013). For example, research suggests that women have a stronger relationship with greenspace access and walking in comparison with men (Lachowycz & Jones, 2013). An example of how SES influences the relationship between urban greenspace and walkability is that people with a lower SES are more reliant on public green since these inhabitants may not have a private garden. The last personal factor to consider is car or dog ownership, as it is expected to influence the motivation for walking. If an individual owns a dog, the need for walking is higher (recreational walking, see motivation for walking), this also goes for owning a car, which influences the motivation for walking as a form of transport (Baobeid et al., 2021; Cutt et al., 2008).



3

CONCEPTUAL MODEL

3 Conceptual Model

The conceptual model for this research is based on the combination of conceptual models as provided by Remme et al. (2021), Liu & Titheridge (2016) and Lachowycz & Jones (2013). The models are used as a guideline to form the conceptual model relevant for this research (Figure 6). Remme et al. (2021) developed a broadly applicable model to contribute to the assessment of the multi-functionality of urban nature and to dive deeper into nature-related health outcomes. The framework focuses on the relationship between urban nature and physical activity with two main mediators, and modified by external moderators (Remme et al., 2021). The model by Liu & Titheridge (2016) focuses on the perceived walkability. Finally, the model by Lachowycz & Jones (2013) is developed as a socio-economic model for the relationship between greenspace access and health. In the following chapter, the concepts will be further explained.

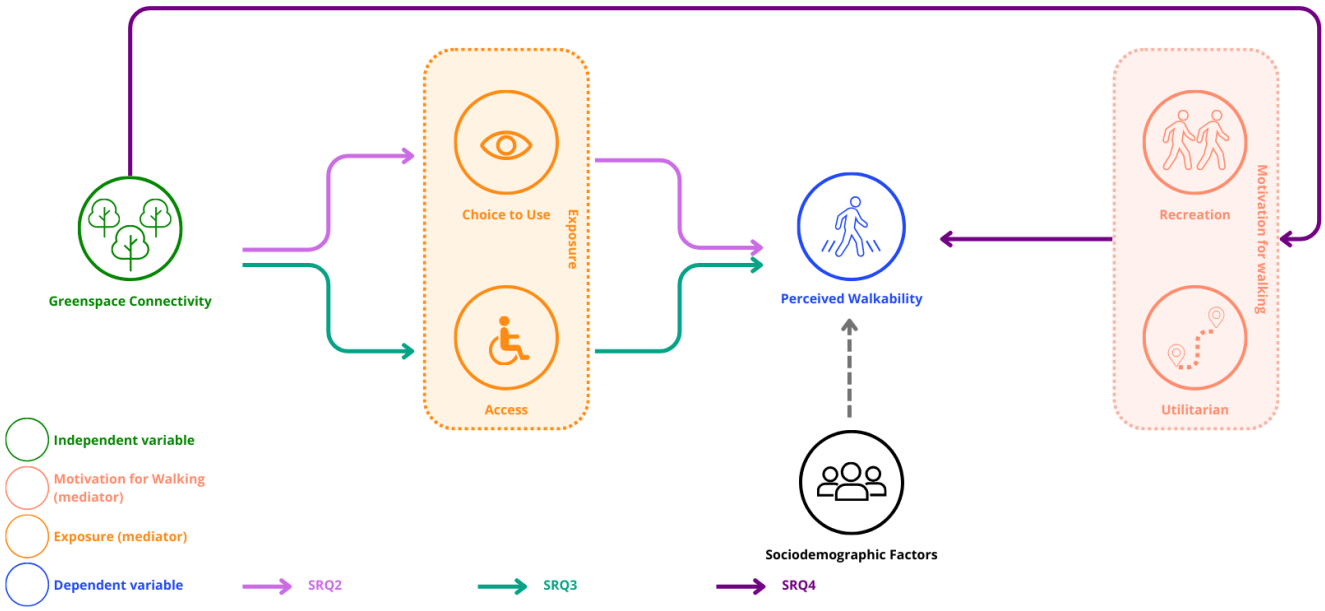


Figure 6: Conceptual Model

Table 1: Overview of variables and indicators and method used (Green: Phase One, Blue: Phase Two)

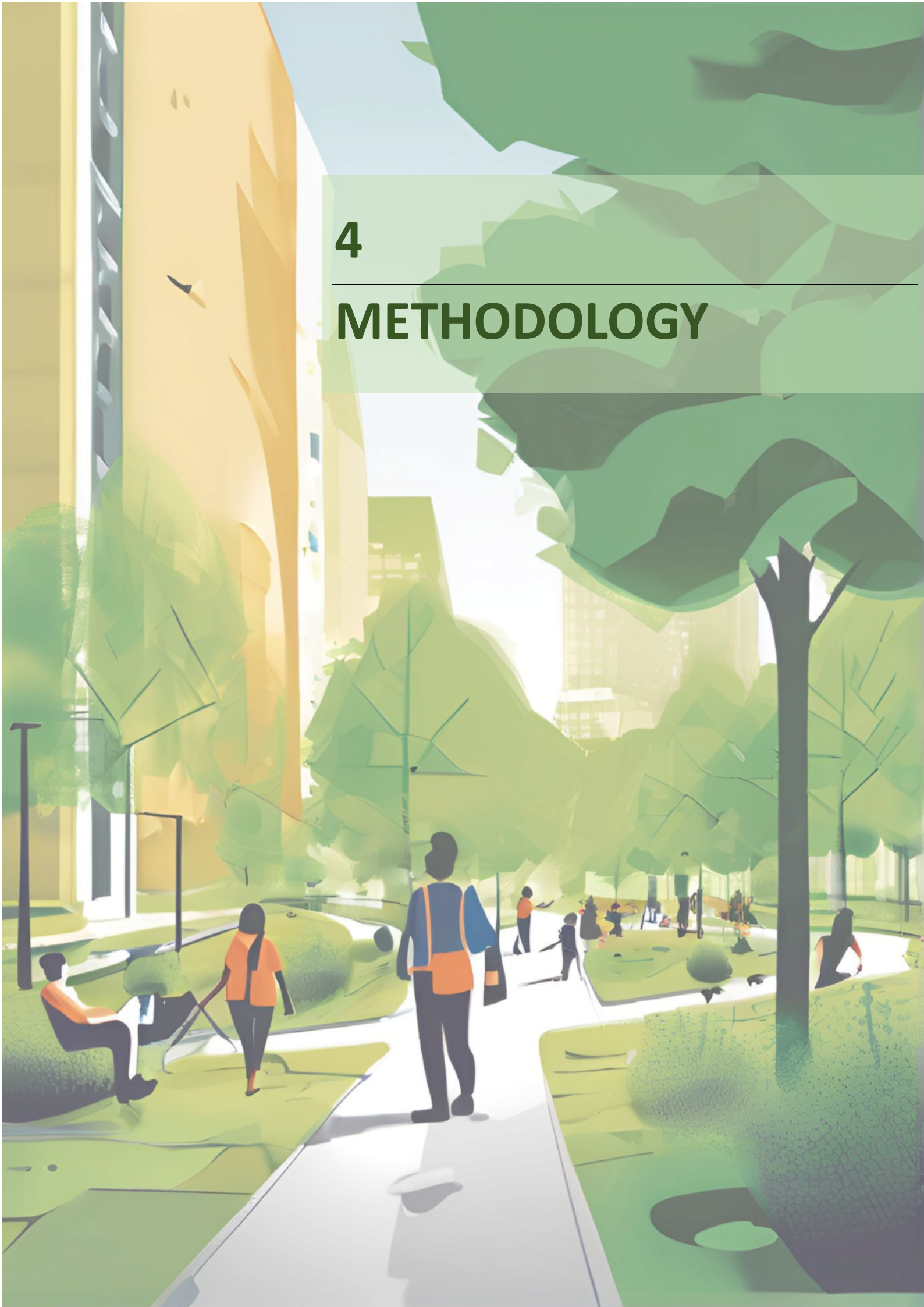
Variables and Indicators			
SRQ	**Indicator**	**Variable**	**Definition**
1	Socio-demographic	Age	The age of the respondent
		Gender	The identified gender of the respondent
		Education	Highest finished educational level
		Income	Income of respondent household
2	Greenspace connectivity	Gamma index	Ratio of actual number of links to maximum links possible, assesses overall structural connectivity of the network as a whole. The ratio is a number between 0 and 1.
3	Choice to use	Self-reported frequency walking	Amount of times individual walked in a week for at least 10 minutes at a time
		Self-reported duration walking	Time spent on each walk
		Alternative transport ownership	The availability of alternative transport options such as a car of bicycle
4	Access	Physical access	Individuals' ability to utilize the walking infrastructure and capacity to walk
		Perceived barriers	Individuals' perception of obstacles or challenges that hinder walking
		Perceived ease of access	Individual's perception of how easy it is to walk
5	Motivation for walking	Utilitarian walking	Walking with a destination
		Recreational walking	Walking without a destination

The definition of all concepts within the conceptual model have previously been explained in *2. Theoretical Framework*. Below is a summary of how the concepts are expected to influence the relationship between greenspace connectivity and the perceived walkability.

Socio-demographic factors of the neighborhoods are key determinants of physical activity and health and are known to affect outdoor and recreational activity, it is therefore important to consider these in the research (Lachowycz & Jones, 2013). These factors are likely to moderate relationships between greenspace connectivity and perceived walkability.

The first mediating variable is exposure to greenspace, consisting of two sub-variables; choice to use and access to greenspace as previously explained in *2.1.4. Exposure to Urban Greenspace.* Researching both these components of exposure separately can provide a comprehensive understanding of how greenspace connectivity contributes to perceived walkability.

The second mediating variable is motivation for walking. Walking can be either for utilitarian reasons or for recreational reasons. With a focus on this research, the expectation is that the effect of greenspace connectivity is higher on recreational walking than on utilitarian walking. As in previous research neighborhood aesthetics have shown more relation to recreational walking than to utilitarian walking (Pereira et al., 2024).



4

METHODOLOGY

4 Methodology

4.1 Research Design

This thesis will be conducted using a mixed methods research design to examine the influence of greenspace connectivity on perceived walkability in the city of Utrecht, The Netherlands. Qualitative research helps to understand residents' experiences and behaviors. This type of research provides deeper insights into motivations, emotions, and other aspects that can influence residents' behavior, diving deeper into the "why" and "how" of walkability (Baobeid et al., 2021). In contrast, quantitative research offers more information on trends and patterns. The combination of the two methods creates a comprehensive picture of the topic (Stefánsdóttir et al., 2024). Within this study, two neighborhoods with varying greenspace connectivity are selected and compared to assess choice, access, and motivation for walking. The comparison of these neighborhoods allows for stronger conclusions about the role of greenspace connectivity in shaping perceived walkability because other variables are controlled by selecting similar neighborhoods. Data collection for this research is based on three methods: GIS analysis, surveys, and interviews. Table 2 provides an overview of the variables, including the dimensions of the walkability model they belong to and the methods used for research. Self-reported frequency and duration of walking were not included in the interviews as the focus was primarily on understanding the underlying motivations for choices, which are not relevant to frequency and duration. Additionally, physical access was excluded from the interviews since all respondents were selected from those who are physically active respondents.

Table 2: Overview of methods per indicator

Variable and where they belong in the walkability model and where it will be researched			
Walkability Model	**Indicator**	**Variable**	**Where will it be researched?**
Phase One			
Physical Attributes	Greenspace connectivity	Gamma index	Geo Information System Analysis
Physical Attributes	Streetconnectivity	Gamma index	Geo Information System Analysis
Phase Two			
	Socio-demographic	Age	Survey
			Interviews
		Gender	Survey
			Interviews
		Education	Survey
			Interviews
		Income	Survey
			Interviews

Human Perceptions	Choice to use	Self-reported frequency walking	Survey
		Self-reported duration walking	Survey
		Alternative transport ownership	Survey
			Interviews
Human Perceptions	Access	Physical access	Survey
		Perceived barriers	Survey
			Interviews
		Perceived ease of access	Survey
			Interviews
Motivation for walking	Motivation for walking	Utilitarian walking	Survey
			Interviews
		Recreational walking	Survey
			Interviews

4.2 Methods Phase One

As mentioned above, the research can be divided in two different phases, based on the neighborhood selection. The selection of the neighborhoods that will be compared also takes place in two different phases. A pre-selection will be made of neighborhood in Utrecht based on the amount of public greenspace per household, which provides information on how much publicly accessible greenspaces the neighborhood has. Based on the percentage of greenspace coverage in the neighborhood, four neighborhoods will be selected as pre-selection. In addition to the greenspace coverage, the pre-selection will also be based on the density of the neighborhoods, and other factors based on the walkability model, to control for these variables as further explained in *5. Study Area.*

Then after this pre-selection, the results of the first sub-research question provided information for the final selection of two neighborhoods based on the greenspace connectivity. This will be done by a GIS analysis on graph theory metric, the gamma index. The gamma index evaluates the structural connectivity of the greenspace within the neighborhoods. Which will be further explained in *4.2.1 Data Collection Phase One.*

The pre-selection will ensure that the neighborhoods are similar, so that when the greenspace connectivity is measured, this is the main variating characteristic. The two selected neighborhoods will then be compared in the last three sub-research questions. The two selected neighborhoods will be further discussed in chapter *5. Study Area.*

4.2.1 Data Collection Phase One

The data collection method used for the first sub-research question is an objective measurement to look into the current state of the greenspace connectivity, therefore GIS will be used. To look into the structural connectivity of the greenspace within the neighborhood graph theory metrics will be used, on the network level. The metric that will be used is the gamma index, this index measures the ratio of actual links (also referred to as edges) with the maximum possible links in a network. This index evaluates the overall connectivity as a whole, at the network level, giving a value between 0 (no connectivity) and 1 (fully connected) (Ducruet & Rodrigue, n.d.).

The calculation of the gamma index is as followed:

$$\gamma = \frac{e}{3(n-2)}$$

Hereby e is the number of edges, which correlates to the connections between greenspaces in the neighborhood. For greenspace connectivity, it is considered an edge when the two street trees are located within five meters of one another. Nodes (n) are the greenspaces within the selected neighborhood, operationalized as street trees. For the street connectivity analysis, streets were used as edges and street intersects were used as nodes, based on the study of Porta et al. (2006).

Since the gamma index is a ratio, it has no dimension. The gamma index was used, since it calculates how well the amount of greenspace in a neighborhood is connected. It enables comparisons between neighborhoods which is needed for the selection of the neighborhoods.

4.2.2 Data Analysis Phase One

The data for the GIS analysis was downloaded from OpenStreetMap, for information on the street trees and from Rijkswaterstaat for information on streets and intersects. The first step was to spatial join the two layers of interest, so for greenspace connectivity the layer of the polygons with the neighborhood information and the street tree layer. This made sure that only trees within the neighborhood boundaries were taken into account. Trees that intersected the neighborhood boundary were also taken into account. The second step was to count edges and nodes, this was done by generating a near table. Hereby edges were automatically counted and nodes were counted when the distance to another tree was less than five meters. This information was then put in a summary statistics table. The final step was to calculate (calculate field) the gamma index using the gamma index formula in GIS. Which provided the gamma indices for greenspace connectivity for each neighborhood.

After the greenspace connectivity analysis also the street connectivity was determined. In the first step, the street information was joined with the neighborhood polygon layer. Streets that intersected the neighborhood boundary were also taken into account. The second step was again to count edges and nodes, by generating a near table. Hereby edges were also automatically counted and nodes were counted as street intersects. Identical to greenspace connectivity, this information was then put in a summary statistics table. The final step was to calculate (calculate field) the gamma index again using the gamma index formula in GIS. Which provided the gamma indices for the street connectivity for each neighborhood.

4.3 Methods Phase Two

4.3.1 Data Collection Phase Two

Data for the second, third and fourth sub-research questions, thus the second phase, will be collected using survey and interviews. The combination of these two subjective methods for walkability analysis provides a comprehensive view of the variables addressed in these sub-research questions. Where interviews can dive deeper in the reasons behind perceived walkability (Stefánsdóttir et al., 2024).

Survey

Inhabitants of the selected neighborhoods over the age of 18 were invited to participate in the online survey. The survey was distributed through various online channels, such as Facebook groups or WhatsApp communities. In addition, the survey was distributed via a QR- code on 800 flyers placed in home-mailboxes. The survey was in Dutch, and consisted of an online questionnaire. The software was

used for the questionnaire was Survey123 provided by ArcGIS. The survey topics were inspired by existing questionnaires. Existing relevant questions from the Neighborhood Environmental Walkability Scale, the Short Form Health survey, the physical activity questionnaire and the questionnaires used by were selected and structured (Dawson et al., 2007; De Vos et al., 2023; International Physical Activity Questionnaire, 1998; Neighborhood Environment Walkability Scale (NEWS), 2002; Stefánsdóttir et al., 2024). The socio-demographic questions about income and age were grouped according to relevant age or income groups according to Centraal Bureau voor de Statistiek (CBS, 2023, 2024a). The survey consists of four parts, socio-demographic, access, choice to use and motivation for walking. The parts and questions that were included, correlate with the variables of these three sub-research questions (see Table 3). For the survey, the aim was to have at least 50 respondents per neighborhood, but preferably above 75 respondents, so 150 in total. In the end, the survey had a total of 58 respondents, of which two did not walk in their neighborhood and had to be excluded.

Respondents will be asked whether they walk for recreation or for utilitarian reasons in the neighborhood. If the respondent answers no, the respondent will be asked why not, after this question the questionnaire will be ended, and no further questions will appear. The questionnaire can be found in Appendix 1.

Interviews

Walk-along or on-site interviews were conducted, with residents of the selected neighborhoods. Respondents were recruited among survey participants, using a snowball technique and/or via known contacts in the selected neighborhoods. The participants participated voluntarily, but agreed with the informed consent of the interview. The structure of the interview was predetermined and semi-structured consisting of two main parts. The questions of the interview were open ended questions, inviting the participant to explain the answer.

The interviews consisted of two main parts, the first focuses on recreational walking, and the second on utilitarian walking. Before asking about a specific type of walking the participant were asked if the participant walks in the neighborhood, and how the participant would describe the quality of the walking infrastructure in the neighborhood. The reason for this is, to see what people think of first, characteristics related to recreational walking or utilitarian walking.

For both types of walking, and thus the two parts of the interviews, questions were related to perceived barriers and other factors influencing choices to walk. In addition, the participant was asked to highlight what areas have room for improvement. The aim for this is to discover opportunities for planning more pedestrian-friendly environments in the neighborhoods, that might encourage people to walk more in their daily life. This information was used for the recommendation and to compare the neighborhoods.

4.3.2 Data Analysis Phase Two

The data of the survey was exported to excel and uploaded to SPSS version 29. All data had to be prepared for analysis, meaning that the data was transformed to ordinal variables with the use of dummy variables. For example, answer option; *Strongly disagree* became 1, *Somewhat disagree* became 2*, somewhat agree* became 3 and finally *strongly agree* became 4. For dichotomic questions the answer *yes* became 1 and *no* became 0. Then each survey question was grouped per variable so an overall score could be calculated. An overview of the indicators, and how the variables were grouped can be found in Table 3.

After the data was prepared and grouped, a multiple linear regression was done for all variables. This combined model brings an insight in the unique effect of each variable, but controlled for the other variables. It provides the possibility to compare the different variables and can help make conclusions about which indicator stays significant when combined with the others. This model was also tested for collinearity diagnostics, providing information on the multicollinearity of the variables, and for correlation with a correlation test, providing information on the relation of variables to other variables.

In addition to this multiple linear regression, a linear regression was done per indicator (independent variables) to assess what the influence of variables was on the perceived walkability (dependent variable). The data preparation for the survey can be found in Table 3 In this table can be seen which questions belong to which variables and indicators, and in addition, can be seen how the questions were grouped to correspond with the variables.

The neighborhoods were compared by analyzing and comparing the frequency distributions of the answers of the two neighborhoods.

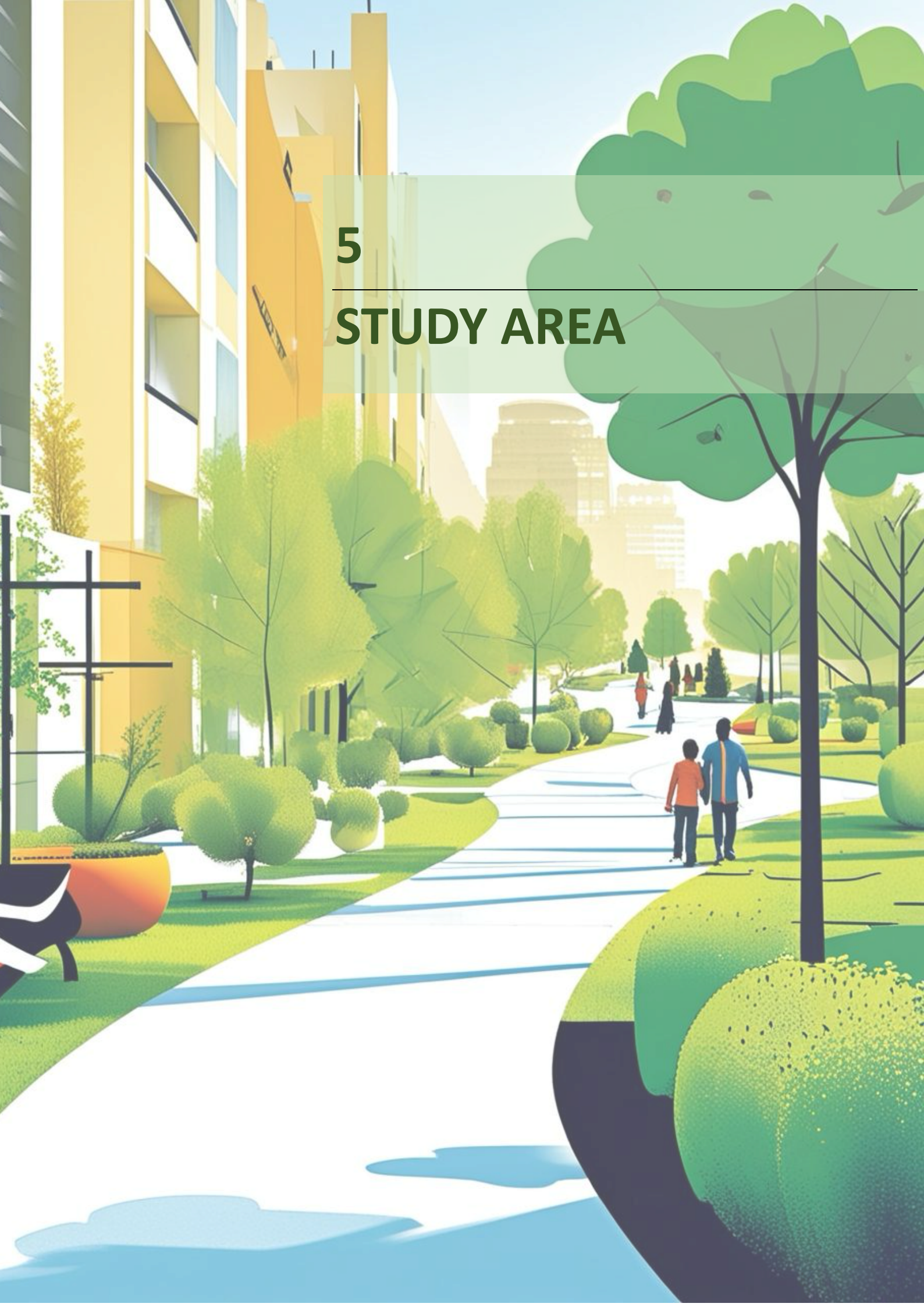
Table 3: Data preparation survey analysis

Data preparation survey analysis			
Indicator	**Variable**	**Questions**	**How were the questions grouped**
Choice to use	Self-reported frequency walking	21, 23, 26, 28	Mean frequency calculated
	Self-reported duration walking	22, 24, 27, 29	Mean duration calculated
	Alternative transport ownership	17, 18, 19, 20	Alternative score was determined. If for questions 17-19 the answer was yes, one point was given. The number of cars was already numerical. The sum of the 4 questions gave the alternative transport score (between 0-5). The higher the score, the more the respondent had access to alternative vehicles.
Access	Physical access	9 & 10	Mean physical access calculated
	Perceived barriers	12	Dummy variables were used
	Perceived ease of access	13, 14, 15, 16	Mean ease of access calculated
Motivation for walking	Recreational vs utilitarian walking	31	Transformed to ordinal dummy variable
Perceived walkability	Overall walkability	32, 33, 34, 35, 36	Mean perceived walkability calculated

	Utilitarian	32A, 33A, 34A, 35A, 36A,	Mean score perceived walkability recreational calculated
	Recreational	32B, 33B, 34B, 35B, 36B	Mean score perceived walkability utilitarian calculated

Interview

The interviews were analyzed using a thematic analysis to interpret motivations and the rationale behind walking behavior as perceived by residents of Utrecht. All interviews were recorded and transcribed before the analysis in Atlas.ti. All codes were categorized in main themes that matched the main topics of the research. The coding process was based on inductive coding, sub-codes of the quotes were based on the findings of the interviews. In total two rounds of coding were done by the researcher to minimalize bias. All codes and themes can be found in Table 20 (Interview Codebook and frequency of code mentioned) in chapter *7. Results Phase Two.*



5

STUDY AREA

5 Study area

5.1 Study Area

The study will take place in the city of Utrecht. Utrecht is the one of the G4, which are the four biggest municipalities of The Netherlands, including Amsterdam, Rotterdam and Den Haag (Centraal Bureau voor de Statistiek, n.d.). The municipality counts around 375 thousand inhabitants, this will increase further, the expectation is that within five years Utrecht will have more than 400 thousand inhabitants (Gemeente Utrecht, 2024b). With this increase in inhabitants, also the population density increases. Over the past 20 years, the population density has increased from 2,600 to 3,800 inhabitants per km^2 (Gemeente Utrecht, 2024b). The city can be divided into 10 *wijken* and 111 *buurten,* the focus for this study is on the *wijken* of Utrecht, as it is assumed that people walk outside of the *buurt* boundaries but mostly walk within their *wijk* (Gemeente Utrecht, 2016). In addition, it is assumed that international walkability studies often utilize larger neighborhoods than are common in The Netherlands, therefore to use international measurement instruments the choice was made to focus on *wijken*. Further on in this research the Dutch equivalent of neighborhood is a *wijk*.

Utrecht was chosen as the study area due to the city's challenges balancing urban greenspace with the increasing population density. Trends show that despite the known benefits of urban green, the amount of public green in Utrecht has decreased per inhabitant (Gemeente Utrecht, 2024a). Furthermore, since 2023 the inhabitants of Utrecht have been less satisfied with urban green within the city, and seek greenspaces outside of the city (Gemeente Utrecht, 2024a). This highlights the need to investigate the integration of urban greenspaces in urban planning to improve the walkability and overall livability of the city of Utrecht.

5.2 Neighborhood Selection Phase One

For the first phase, four neighborhoods were selected based on physical attributes, as outlined in the walkability model. The criteria, description and source for the first selection can be found in Table 4, all these criteria must be as similar as possible for the first selection. The first main selection criterium was population density, as walkability is influenced by the density of a neighborhood.

The second main selection criterium was public greenspace. This is the number of square meters public green per household. The data on the amount of public greenspace was divided in three groups with equal interval between the lowest and the highest amount of public greenspace per neighborhood.

The third selection criterium was land use mix. For this criterium the primary form of land use had to be housing. Other forms such as retail or industry where not taken into account. All ten neighborhoods have as primary land use housing.

Another important factor in the selection was parking availability, as the presence of fewer parking spaces may encourage walking over car use. To account for this aspect of the walkability model, information on satisfaction of parking spaces within neighborhoods was used.

The final selection criterium was car ownership, as this could be an alternative for walking, to account for this factor, information was used on the percentage of households with a certain number of cars (either 0, 1 or more than 1). The percentage were then classified by the author in four equal interval groups (each group being 25%).

Table 4: Phase one first selection criteria

Phase one selection criteria		
Criterium	**Description**	**Source**
Density	Number of inhabitants per square kilometer	Gemeente Utrecht (2025)
Public Greenspace	Amount of public greenspace in square meter per household (m^2/household)	Gemeente Utrecht (2025)
Land Use Mix	Primary form of land use in the neighborhood	Kadaster (2024)
Parking	Satisfaction of residents on parking availability within the neighborhood	Gemeente Utrecht (2025)
Car Ownership	Percentage of households with a certain number of cars (either 0, 1 or more than 1)	Gemeente Utrecht (2025)

The four selected neighborhoods for this first phase were chosen to be as similar as possible in terms of population density, primary land use, parking and car ownership. Then two neighborhoods having a low amount of public greenspace per household and two with average amount of public greenspace per household were selected. There was only one neighborhood with a high amount of public greenspace but this was assumed to be a unique feature and therefore not a selected neighborhood.

This led to the selection of the neighborhoods: “Overvecht”, “Leidsche Rijn”, “Zuidwest” and “Noordoost” which are marked in bold in Table 5. Figure 7 shows the location of the selected neighborhoods within Utrecht.

Table 5: Data on first neighborhood selection

Data on first neighborhood selection							
Neighborhood	**Density (inhabitants per km²)**	**Public Greenspace (m^2 per household)**	**Land Use Mix**	**Parking**	**Car Ownership**		
					0	**1**	**>1**
Vleuten-De Meern	1391	185,5	Residential	Not enough	8%	54%	38%
Oost	3059	49,5	Residential	Too much	52%	41%	7%
West	3280	47,7	Residential	Too much	42%	50%	8%
Overvecht	**4216**	**99**	**Residential**	**Not enough**	**42%**	**45%**	**13%**
Leidsche Rijn	**4536**	**97,9**	**Residential**	**Good**	**17%**	**57%**	**27%**
Zuid	6079	67,2	Residential	Good	35%	55%	10%
Zuidwest	**7381**	**30,3**	**Residential**	**Good**	**43%**	**47%**	**10%**
Binnenstad	7612	11,5	Residential	Too much	63%	32%	5%
Noordoost	**7898**	**33,3**	**Residential**	**Good**	**38%**	**51%**	**11%**
Noordwest	9944	22,9	Residential	Not enough	38%	53%	10%

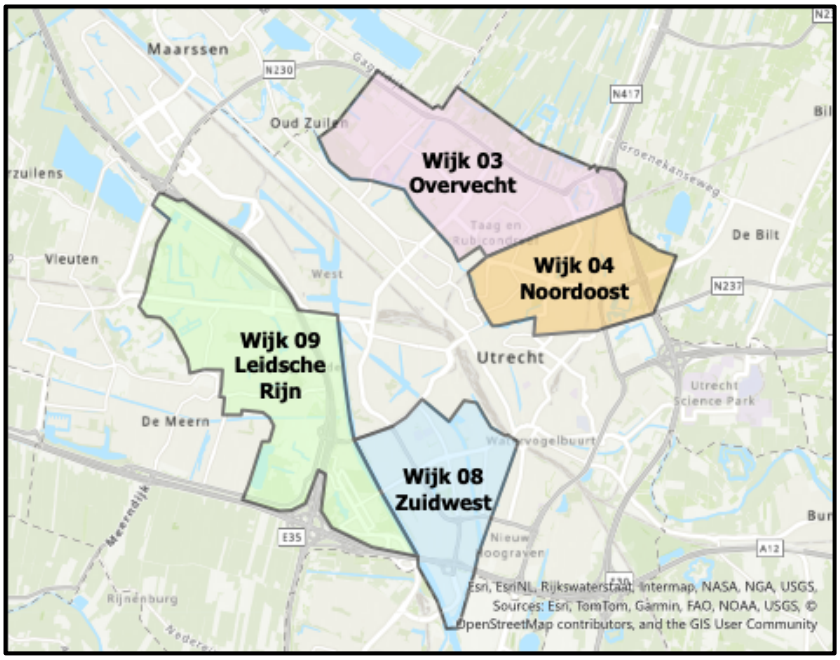
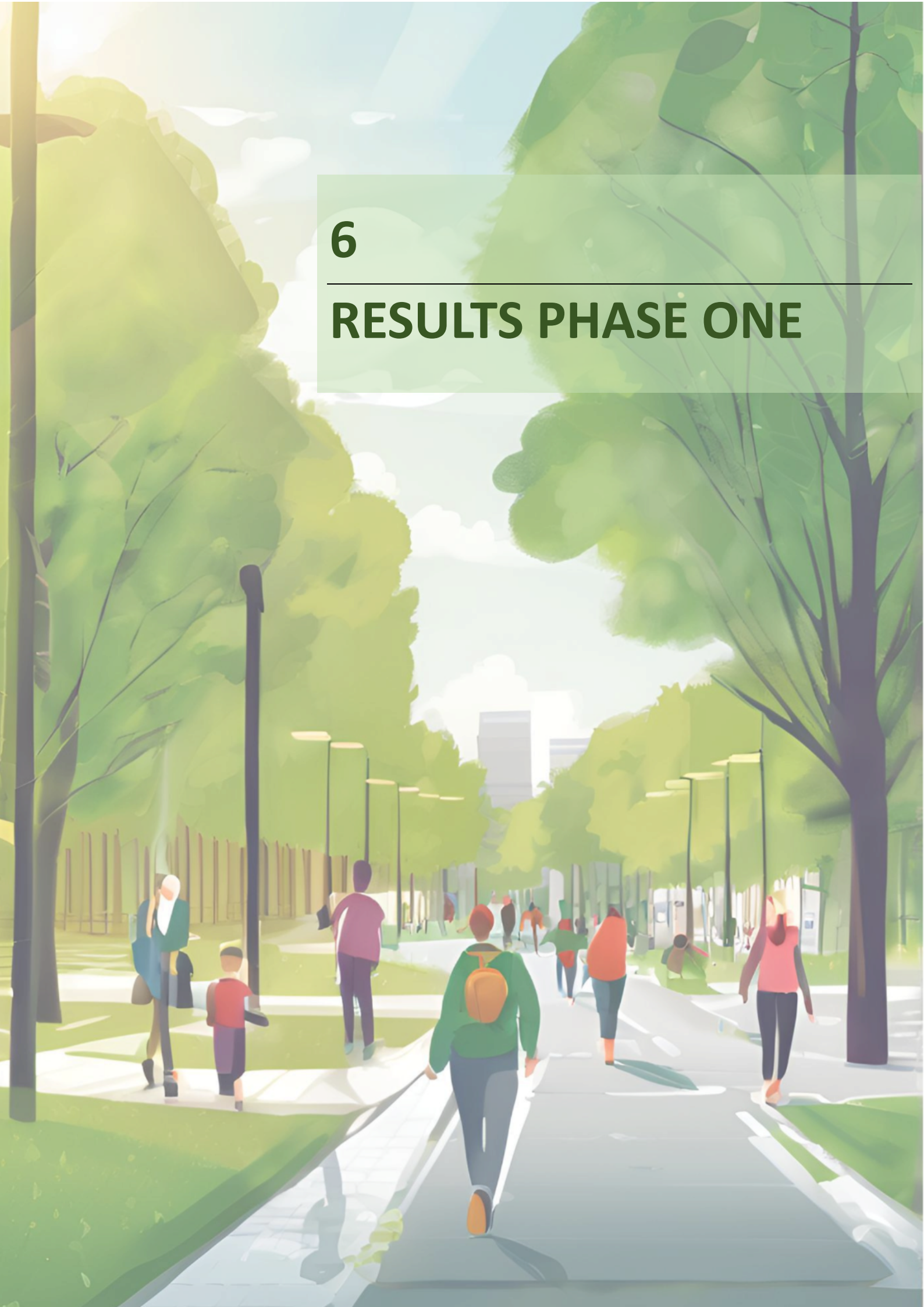


Figure 7: Location of neighborhoods first selection



6

RESULTS PHASE ONE

6 Results Phase One

This chapter focusses on the first phase of the research. Within this phase the neighborhoods will be selected using a network connectivity analysis of the greenspace. The first subchapter *6.1 Greenspace Structural Connectivity Analysis* will present the results of the GIS analysis. The second subchapter *6.3 Neighborhood Selection* will present which neighborhoods in Utrecht are selected for the second phase of the research.

6.1 Greenspace Structural Connectivity Analysis

Understanding greenspace connectivity in the neighborhoods starts with looking into the amount of public greenspace. Figure 8 shows the amount of public greenspace for the four selected neighborhoods in Utrecht. Here the darker the color, the higher the amount of public greenspace in that area. Within the neighborhoods public greenspace can be distributed differently, analyzing the amount of public greenspace within these neighborhoods can give information on how the greenspace is distributed. Looking at these maps it can be noted that within the neighborhoods the public greenspace is not equally distributed in the neighborhoods. For example, both Leidsche Rijn and Noordoost have areas where the public greenspace is less than 20% but also areas with 50-70% or above 75% for Leidsche Rijn. For Overvecht and Zuidwest the public greenspace seems to be better distributed across the neighborhood.

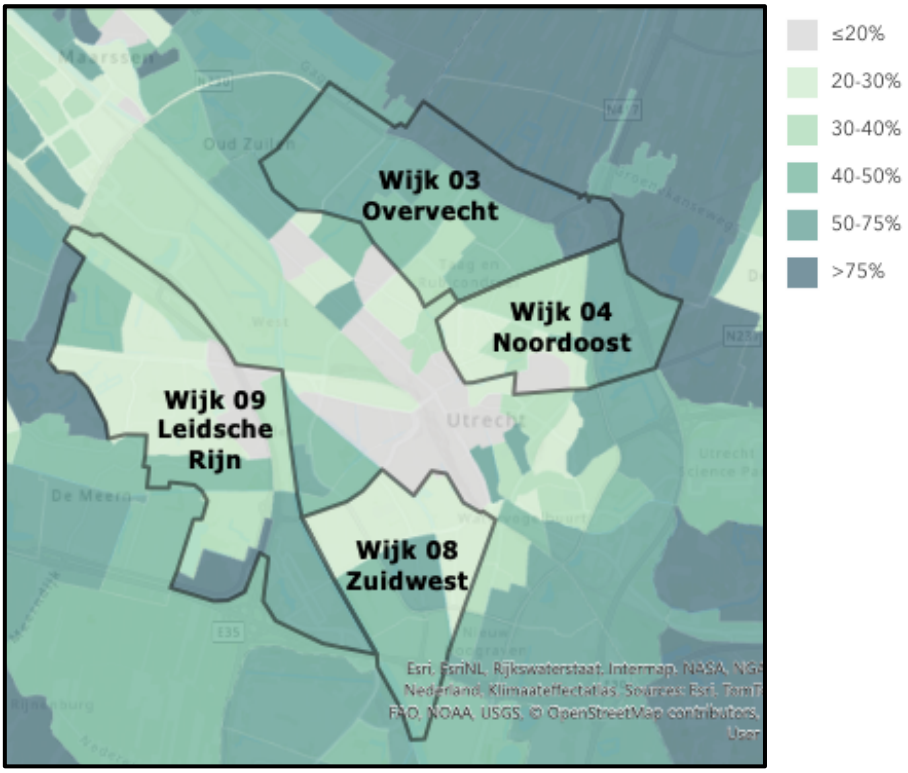


Figure 8: Public greenspace within the neighborhoods (Map created in ArcGIS)

To select the two neighborhoods that will be used for further analysis a structural connectivity of greenspace in these four neighborhoods was made in ArcGIS. For this analysis, trees in public spaces were used as greenspace (nodes) and the connection (distance between trees is less than five meters) between trees were used as edges. The distribution of trees in these neighborhoods can be found in Figure 9. A tree that is located within the public area is shown with a single green dot.

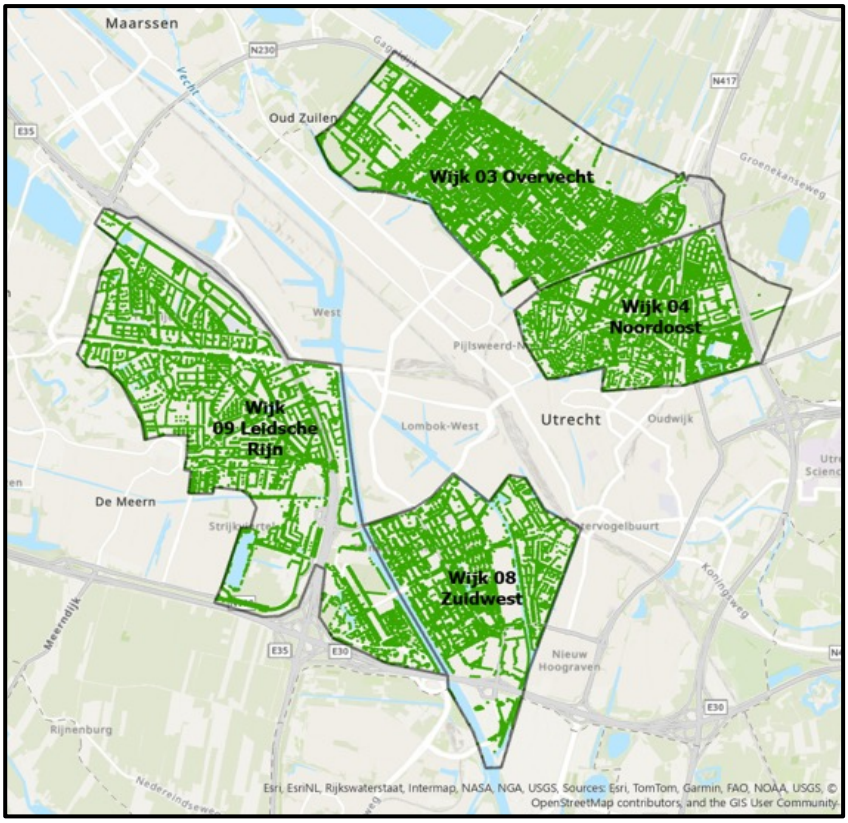


Figure 9: Trees within the neighborhoods (Map created in ArcGIS)

Based on the trees in public space, the gamma index was calculated. The edges and nodes and the corresponding gamma index per neighborhood can be found in Table 6. The visualization of these results can be found in Figure 10.

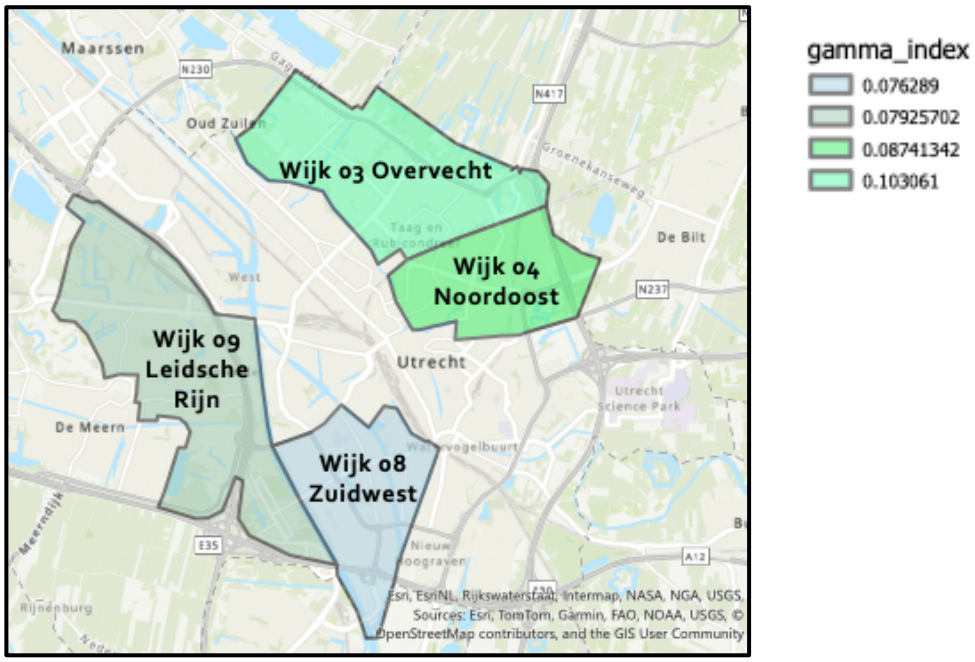


Figure 10: Greenspace Gamma Index (Map created in ArcGIS)

Table 6: Gamma Index greenspace per neighborhood

Gamma Index Greenspace			
Neighborhood	**Edges**	**Nodes**	**Gamma Index**
Wijk 03 Overvecht	7438	24.059	0,103061
Wijk 04 Noordoost	3294	12.563	0,087413
Wijk 08 Zuidwest	2534	11.074	0,076289
Wijk 09 Leidsche Rijn	4715	19.832	0,0792457

As can be seen in the figure and table above, the gamma index for *Wijk 04 Noordoost, Wijk 08 Zuidwest* and *Wijk 09 Leidsche Rijn* are very similar, with a difference of approximately 0,03. All four neighborhoods have relatively low gamma indices, this means that for all four neighborhoods the greenspace connectivity is low. For Overvecht the greenspace connectivity is highest, and Zuidwest has the lowest greenspace connectivity, while this difference is very small with Leidsche Rijn.

6.2 Street Connectivity Analysis

In addition to analyzing greenspace connectivity, this study also examined street connectivity using GIS. By analyzing both street connectivity as well as greenspaces connectivity, it allows for evaluating whether these networks work complementary to support walkability or whether misalignment between them may reduce their effectiveness. For instance, greenspaces may be present but disconnected from highly walkable routes, limiting their use, or a well-connected street network may lack green elements, reducing its appeal for walking. Understanding this interaction helps determine whether residents benefit from an integrated walking environment or whether one form of connectivity offsets the potential of the other.

Based on the streets within the neighborhoods, the gamma index was calculated. Hereby streets were used as edges and street intersections were used as nodes. The edges and nodes corresponding with the neighborhoods can be found in Table 7. The visualization of the gamma indexes can be found in Figure 11.

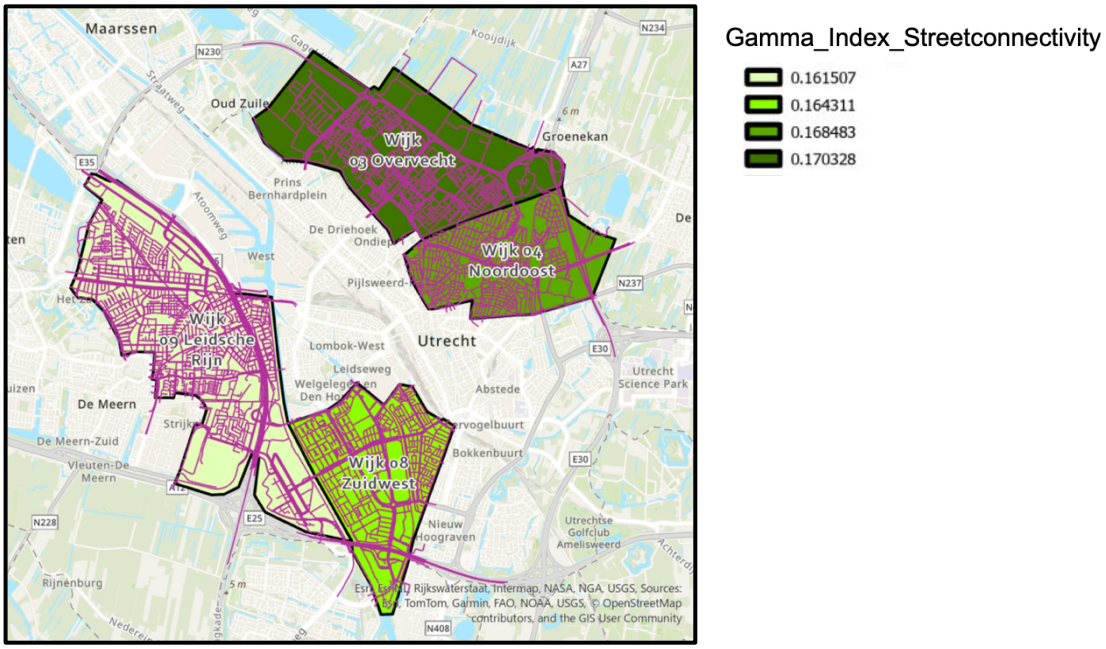


Figure 11: Street Connectivity Gamma Index (Map created in ArcGIS)

Table 7: Gamma Index Street Connectivity per Neighborhood

Gamma Index Street Connectivity			
Neighborhood	**Edges**	**Nodes**	**Gamma Index**
Wijk 03 Overvecht	2233	4372	0,170328
Wijk 04 Noordoost	1716	3397	0,168483
Wijk 08 Zuidwest	1953	3964	0,164311
Wijk 09 Leidsche Rijn	3584	7399	0,161507

Similar to the greenspace connectivity, the gamma indices of the street connectivity are also close to one another. All four neighborhoods score relatively low on street connectivity. Due to the similarity of the street connectivity within the neighborhoods, one could say that a difference in perceived walkability in the selected neighborhoods, is not likely to be caused by street connectivity.

6.3 Neighborhood Selection for Phase Two

After the GIS analysis, the two research neighborhoods were selected to have different greenspace connectivity but similar street connectivity. As can be seen above the gamma index for greenspace differed the most for the neighborhoods Overvecht and Zuidwest. The gamma index for street connectivity is for all four neighborhoods almost similar with little variation. Therefore, the two neighborhoods that were selected for the case area for the interview and survey are **Wijk 03 Overvecht** and **Wijk 08 Zuidwest.**

7

RESULTS PHASE TWO

7 Results Phase Two

This chapter focusses on the survey and interviews of this research, looking into walking behavior, perceptions of walkability and gaining understanding of why certain walk behavior is shown. The methods used for this chapter are the survey and the interviews that were conducted. In addition, in this phase the two neighborhoods will be compared.

First an overview of the sociodemographic variables will be given for both the survey and interviews. Then the survey and interview results will be discussed separately without distinction between neighborhoods. For the survey the statistical analysis will be discussed and for the interviews each indicator will be discussed with quotes that support the findings. Finally, the chapter concludes with a neighborhood comparison, where per indicator the results of Overvecht and Zuidwest are compared.

In total 58 respondents filled in the survey, of which 32 from Overvecht and 26 from Zuidwest. From these 58 respondents, 2 people mentioned never walking within the neighborhood. Both of these two respondents were from Overvecht and were further excluded from the data. From these 56 remaining respondents, 30 were from Overvecht and 26 lived in Zuidwest. Figure 12 shows the time distribution of survey responses.

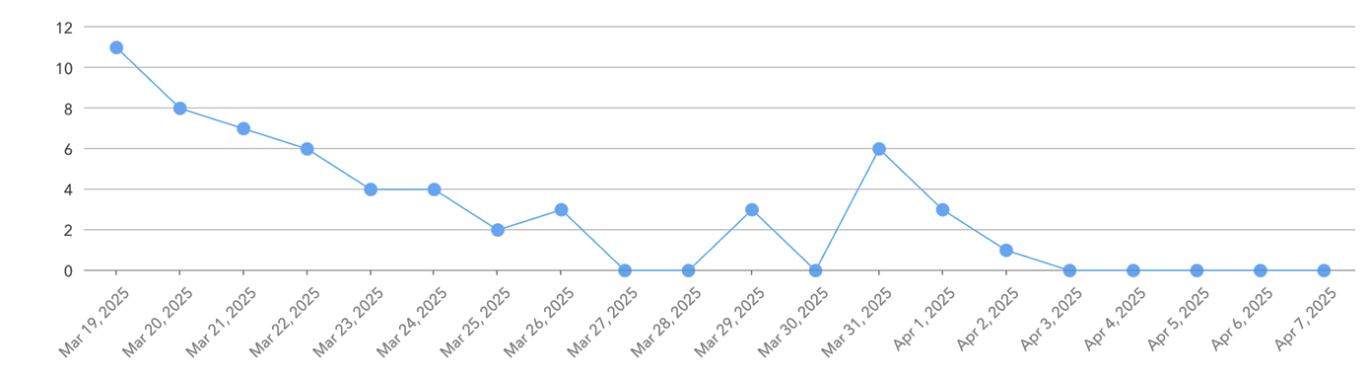


Figure 12: Survey respondents per day

Regarding the interviews, the aim was to conduct at least 6 interviews, to have at least three participants per selected neighborhood. In total 8 interviews were conducted due to additional participants, of these 8 participants, five lived in Overvecht and three in Zuidwest.

7.1 Sociodemographic information

The sociodemographic information of the survey and the interviews can be found in Tables 8 and 9. In general, more women participated than men. In addition, the educational level for both the interviews as the survey respondents was relatively high compared to the Dutch average. For the survey the sociodemographic information is shown separately for Overvecht and Zuidwest.

Table 8: Sociodemographic variables survey respondents

Sociodemographic variables survey respondents			
Sociodemographic variables	**Category**	**Overvecht (30 respondents) N (rounded %)**	**Zuidwest (26 respondents) N (rounded%)**
Age	**18-24**	5 (16%)	1 (4%)
	25-34	15 (50%)	12 (46%)
	35-44	3 (10%)	1 (4%)
	45-54	2 (7%)	3 (12%)
	55-64	4 (13%)	5 (19%)
	65-74	1 (3%)	3 (12%)
	>75	0 (0%)	1 (4%)
Gender	**Female**	21 (70%)	14 (54%)
	Male	9 (30%)	12 (46%)
	Other	0 (0%)	0 (0%)
Education	**None**	0 (0%)	0 (0%)
	Primary	0 (0%)	0 (0%)
	VMBO/MAVO	1 (3%)	1 (4%)
	HAVO/VWO	2 (7%)	1 (4%)
	MBO	4 (13%)	0 (0%)
	HBO	2 (7%)	5 (19%)
	WO	21 (70%)	17 (73%)
Income (x1000)	**< 27**	7 (23%)	3 (12%)
	27-31	1 (3%)	1 (4%)
	31-35	4 (13%)	1 (4%)
	35-39	5 (17%)	1 (4%)
	> 39	13 (44%)	17 (65%)
	Rather not say	0 (0%)	3 (12%)
Children <7	**Yes**	2 (7%)	1 (4%)
	No	28 (93%)	25 (96%)
Children 7-17	**Yes**	2 (7%)	0 (0%)
	No	28 (93%)	26 (100%)
Housing type	**Apartment no balcony**	5 (17%)	3 (12%)
	Apartment with balcony	18 (60%)	17 (65%)
	House no garden	1 (3%)	1 (4%)
	House with garden	5 (17%)	3 (12%)
	Other	1 (3%)	2 (8%)
Dog ownership	**Yes**	3 (10%)	3 (12%)
	No	27 (90%)	23 (88%)
Driver's license	**Yes**	25 (78%)	23 (88%)
	No	5 (16%)	3 (12%)
	Yes	20 (67%)	20 (77%)

Access to a car	**No**	10 (33%)	6 (23%)
Car ownership household	**Yes 1**	14 (46%)	13 (50%)
	Yes 2	3 (10%)	1 (4%)
	No	13 (44%)	12 (46%)
Scooter ownership	**Yes**	3 (9%)	0 (0%)
	No	27 (84%)	26 (100%)

Table 9: Sociodemographic variables interview participants

Sociodemographic variables interview participants					
Participant	**Age**	**Gender**	**Highest finished educational level**	**Income**	**Neighborhood**
1.	25-34	Female	WO	Less than 27 thousand	Overvecht
2.	25-34	Female	WO	27-31 thousand	Zuidwest
3.	25-34	Female	WO	31-35 thousand	Overvecht
4.	25-34	Male	MBO	35-39 thousand	Overvecht
5.	25-34	Male	Havo/VWO	More than 39 thousand	Zuidwest
6.	35-44	Female	WO	More than 39 thousand	Overvecht
7.	55-64	Female	MBO	Less than 27 thousand	Overvecht
8.	55-64	Male	WO	More than 39 thousand	Zuidwest

7.2 Survey results

7.2.1 General Survey Results

The survey respondents had a high physical ability to walk, with 96% of the respondents (All survey results can be found in Appendix 4) referring to their ability to walk as “easy” or “very easy”. Meaning that physical health barriers are relatively low in the sample of residents from Utrecht. Additionally, the majority of the respondents is satisfied with their walking behavior, and perceived barriers are low. The largest perceived barrier, was lack of greenspace, as shown in Figure 13. Finally, based on the survey, utilitarian walking is more common than recreational walking among respondents, and the perceived walkability for utility reasons is also higher than the recreational perceived walkability.

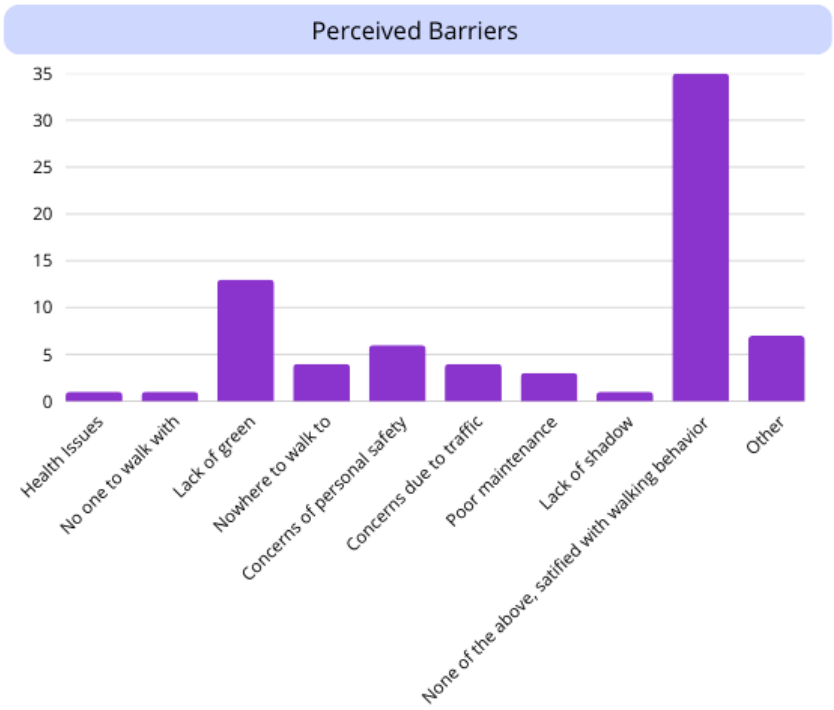


Figure 13: Perceived barriers as mentioned by survey respondents

To start the statistical analysis, a multiple linear regression analysis was done with all indicators. Based on the multiple linear regression model, it can be concluded that the model is significant (*p:0.003)*. In addition, the model explains 54,5% (R^2*: 0.545*) of the variance of perceived walkability and the correlation between all variables together is strong (*R: 0.738*). The model summary and model significance can be found in Tables 10 and 11.

Table 10: Model summary all variables on perceived walkability

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.738[a]	.545	.359	.64438

a. Predictors: (Constant), 31._Welke_vorm_van_lopen_doet_u_het_meeste?, 12g_trottoirs_slecht, Alternativetransport_score, 12h_geen_schaduw, 12b_Geen_samenloop, physicalaccess_mean, Frequency_mean, 12i_anders, 12a_Gezondheidsproblemen, perceivedaccess_mean, Duration_mean, 12e_veiligheid_persoonlijk, 12c_Geen_groene_gebieden, 12d_Geen_bestemming, 12f_veiligheid_verkeer, 12j_tevrede

Table 11: ANOVA results all variables on perceived walkability

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.416	16	1.214	2.923	.003[b]
	Residual	16.194	39	.415		
	Total	35.610	55			

a. Dependent Variable: perceivedwalkability_mean

b. Predictors: (Constant), 31._Welke_vorm_van_lopen_doet_u_het_meeste?, 12g_trottoirs_slecht, Alternativetransport_score, 12h_geen_schaduw, 12b_Geen_samenloop, physicalaccess_mean, Frequency_mean, 12i_anders, 12a_Gezondheidsproblemen, perceivedaccess_mean, Duration_mean, 12e_veiligheid_persoonlijk, 12c_Geen_groene_gebieden, 12d_Geen_bestemming, 12f_veiligheid_verkeer, 12j_tevrede

As can be seen in Table 12 only two variables were significant when controlling them for other variables, this were perceived access and frequency. All other variables were not significant according to the model. The results for the other variables that proved not significant can be found in Appendix 6 in *11.6.1 Full statistical results of the multiple linear regression with all variables predicting perceived walkability.*

Table 12: Significant variables of the multiple linear regression with all variables predicting perceived walkability

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	3.340	1.068		3.126	.003		
	perceivedaccess_mean	.460	.200	.280	2.299	**.027**	.788	1.269
	Frequency_mean	.153	.063	.297	2.450	**.019**	.791	1.264

a. Dependent Variable: perceivedwalkability_mean

When checking for multicollinearity, first the correlation between variables was determined. The correlation matrix can be seen in Appendix 4. From this matrix four key findings can be concluded. First of all, perceived access correlates positively with both utilitarian and recreational walking. This can possibly be explained since an environment that is perceived accessible, should facilitate walking, for both utility and recreation. In addition, recreational walking and utilitarian are strongly correlated (*r: 0.807, p<.001),* meaning that residents who perceived high walkability for recreational walking also perceive high walkability for utilitarian walking. The third key finding from the correlation's matrix is that some barriers (lack of green, personal safety) have a negative correlation with walkability types, which is also to be expected. Residents who experience more barriers related to green or personal safety, perceive their neighborhood as less walkable. Finally, alternative transport is not correlated with walkability measures. Meaning that according to the survey, owning a car or scooter, does not influence the perceived walkability.

Looking at the multicollinearity of the variables, almost all variables have a VIF (Variance Inflation Factor) between 1.2 and 2.8 meaning that there are no real multicollinearity concerns for these variables. Only 12j_satisfaction shows a high VIF of ± 7, see Appendix 6, however this can be explained as this variable of satisfaction often correlates with overall positive perceptions, while all other variables of 12 are perceived barriers. 12c also shows a higher VIF (4.024), this is still acceptable, but shows that some caution is needed when interpreting these results.

7.2.2 Exposure: Choice to Use

A high percentage (85%) of the respondents had a driver's license. In addition, most respondents either owned a car or had access to a car. Only a few respondents had more than 1 car of had no car at all.

Regarding the frequency of walking, most respondents mentioned walking seven days a week for recreation, and four days per week for utility. Since the survey was partly held in the winter, also the season the respondents walked most in was asked for a more representative answer. The season the respondents walked most in, was almost equally distributed across summer and spring. In the most preferred season, most respondents mentioned walking four days a week for recreation and seven days per week for utility. Based on the survey, recreational walking decreases when in the most preferred season, while utilitarian walking increases. Results to these questions can be found in Figure 14. Here the self-reported walking frequency for both types of walking are compared in the winter versus the season the respondents walked the most in.

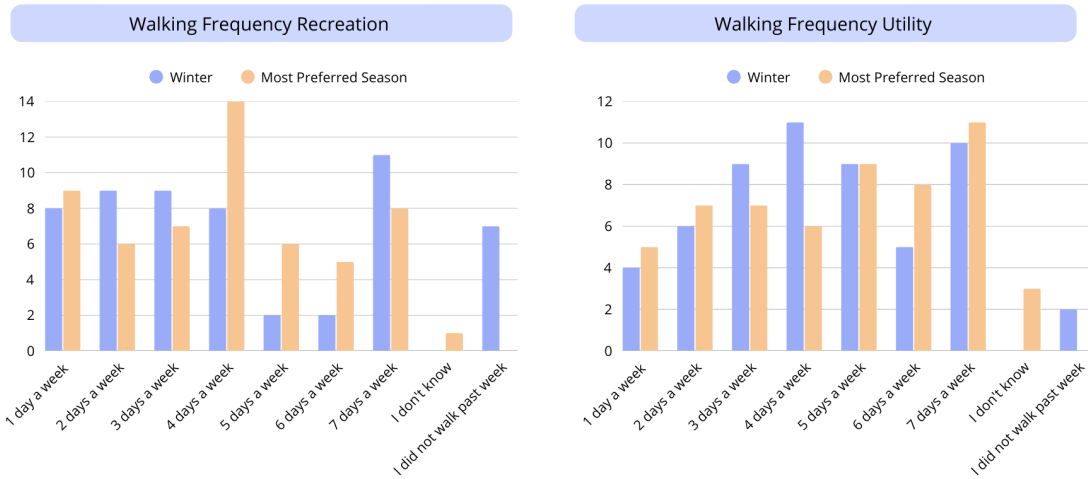


Figure 14: Self-reported walking frequency winter versus most preferred season for both types of walking

The duration of walking was the same for utilitarian walking in the winter (when the survey was conducted) versus the spring or summer, in both cases being under 30 minutes. The duration did vary for recreational walking between the winter and summer or spring. In the winter the respondents mostly mentioned walking under 30 minutes for recreation, while in spring or summer this was higher, namely being between 30 and 60 minutes.

Looking at these results statistically, the influence of choice to use was determined using a multiple linear regression model. From this analysis it can be said that 7.7% of the variance of perceived walkability was determined by choice to use, but this was not significant *(p: 0.239)*. Individually, self-reported duration of walking *(p: 0.720)* and alternative transport options *(p: 0.733)* also did not have

significant influence on the perceived walkability. Only self-reported frequency of walking showed to have significant influence on the perceived walkability *(p: 0.042).* The statistical analysis of choice to use can be found in Appendix 6 in *11.6.2 Statistical results of the multiple linear regression choice to use on perceived walkability*

7.2.3 Exposure: Access

Physical access was determined by asking about respondents' physical health status and their ability to walk. Almost all respondents viewed their physical health between "excellent" and "good", with only three respondents classifying themselves as "fair" and "poor". The same applies for respondents' ability to walk, 96% of the respondents mentioned walking being "easy" or "very easy" and 4% mentioned walking being "slightly difficult".

The second variable of access that was asked, were perceived barriers. Most respondents mentioned being satisfied with their walking behavior, but the barrier that was mentioned the most (±23%) "There are no green or pleasant areas to walk near my home" followed by "I worry about my personal safety around where I live", which was mentioned by 11% of the respondents.

The final variable of access is perceived ease of access. Most respondents agreed to not many cul-de-sacs in the neighborhoods, and that these cul-du-sacs are connected to each other. Almost all respondents (98%) agreed that most streets in their neighborhood have sidewalks. Finally, most respondents also agreed to the proximity of pedestrian trails in or near the neighborhoods that are easily accessible.

The influence of access was determined using a multiple linear regression analysis. This focused on physical access, perceived barriers and perceived ease of access. The model was statistically significant and explained approximately 46,3% of the variance of perceived walkability (*p: 0.003*). As can be seen in Tables 13 and 14.

Table 13: Model summary access on perceived walkability

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.681[a]	.463	.313	.66673

a. Predictors: (Constant), 12j_tevrede, physicalaccess_mean, 12h_geen_schaduw, 12b_Geen_samenloop, 12a_Gezondheidsproblemen, 12g_trottoirs_slecht, perceivedaccess_mean, 12i_anders, 12d_Geen_bestemming, 12e_veiligheid_persoonlijk, 12f_veiligheid_verkeer, 12c_Geen_groene_gebieden

Table 14: ANOVA results access on perceived walkability

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.495	12	1.375	3.092	**.003[b]**
	Residual	19.115	43	.445		
	Total	35.610	55			

a. Dependent Variable: perceivedwalkability_mean

b. Predictors: (Constant), 12j_tevrede, physicalaccess_mean, 12h_geen_schaduw, 12b_Geen_samenloop, 12a_Gezondheidsproblemen, 12g_trottoirs_slecht, perceivedaccess_mean, 12i_anders, 12d_Geen_bestemming, 12e_veiligheid_persoonlijk, 12f_veiligheid_verkeer, 12c_Geen_groene_gebieden

Among these predictors, only perceived ease of access, so the questions about the walking infrastructure available in the neighborhoods, showed a positive significant correlation with perceived walkability. None of the individual perceived barriers or physical access showed a significant influence on the perceived walkability. Also shown in Table 15. The full statistical results table can be found in Appenxix 6 underneath *11.6.3 Full table of the statistical results of access on perceived walkability.*

Table 15: Statistical results access on perceived walkability

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.207	.979		3.274	.002
	perceivedaccess_mean	.457	.205	.278	2.232	**.031**

a. Dependent Variable: perceivedwalkability_mean

7.2.4 Motivation for Walking

More respondents mentioned mostly walking for utilitarian reasons (64%) in comparison to walking for recreational reasons (36%). For motivation of walking, first a simple linear regression was done to determine whether the type of walking practiced most influenced the overall perceived walkability. This was not significant and explained a neglectable amount of the variance in perceived walkability *(p: 0.775, R^2: 0.002).* The statistical results can be found in Appendix 6 in *11.6.4 Statistical results of influence motivation for walking on perceived walkability.*

7.2.5 Perceived Walkability

The perceived walkability for each neighborhood was measured in the survey for each neighborhood but also for each type of walking. In general, the overall mean perceived walkability score across both neighborhoods was scored with a mean of 3.9. Based on the survey, a paired samples T-test (Tables 16 till 19) was conducted to compare the means of perceived walkability for utilitarian walking and for recreational walking. The mean for perceived walkability for utilitarian walking was 4.12, while the perceived walkability for recreational walking was 3.68. The perceived walkability for utilitarian walking was significantly higher than the perceived walkability for recreational walking *(p > 0.001).* The Cohen's d was 0.74, suggesting a practical difference in perceived walkability from utility versus recreational standpoints.

Table 16: Descriptive statistics perceived walkability per motivation type

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	walkfunctional_mean	4.1179	56	.70301	.09394
	walkrecreational_mean	3.6786	56	.98769	.13199

Table 17: Correlation perceived walkability per motivation type

Paired Samples Correlations

		N	Correlation	Significance One-Sided p	Significance Two-Sided p
Pair 1	walkfunctional_mean & walkrecreational_mean	56	.807	<.001	**<.001**

Table 18: Paired samples t-test results on perceived walkability per motivation type

Paired Samples Test

		Paired Differences								
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Significance One-Sided p	Significance Two-Sided p
Pair 1	walkfunctional_mean - walkrecreational_mean	.43929	.59136	.07902	.28092	.59765	5.559	55	<.001	**<.001**

Table 19: Effect size of perceived walkability per motivation type

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval Lower	95% Confidence Interval Upper
Pair 1	walkfunctional_mean - walkrecreational_mean	Cohen's d	.59136	**.743**	.444	1.036
		Hedges' correction	.59958	.733	.438	1.022

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

7.3 Interview results:

The interviews were coded using the codebook in Table 20. This table shows the description of the codes, how many times each code was mentioned and by how many participants. For example, the Time as barrier, was mentioned 7 times, but by 5 participants, which means that some participants mentioned it multiple times.

Table 20: Interview Codebook and frequency of code mentioned

Interview codes and participants information			
Topic theme code book	**Code name (# of code mentioned)**	**# of participants**	**Description of the code**
Alternative transport	Time as motivator (3)	3	*Alternative transport taking more time than walking*
	Time as barrier (7)	5	*Walking takes too much time*

	Carrying stuff (3)	3	*Carrying items makes walking less attractive*
	Car not as alternative (14)	7	*Car use is not seen as an alternative form of transport*
Perceived barriers	Weather (6)	4	*Bad weather such as rain*
	Time availability (9)	7	*Lack of time*
	Traffic congestion (14)	7	*Busy, fast or noisy roads*
	Safety (5)	3	*Concerns about personal safety*
	Quality of walking infrastructure (8)	5	*Poor quality of walking infrastructure*
Perceived access	Attractiveness (19)	8	*Pleasant environments*
	Clarity of the road and signage (13)	5	*Clear paths and signs for walking trails*
	Continuity of movement (8)	5	*Uninterrupted walking paths (no traffic lights or few crossings)*
Recreational walking	Social (2)	1	*Walking as form of interaction*
	Peacefulness (4)	3	*Walking provides relaxation*
	Aesthetics (12)	6	*Beautiful surroundings*
Utilitarian walking	Efficiency (8)	6	*Practical and quick routes*

7.3.1 Exposure: Choice to Use

Looking at choice to use within the interviews the focus was on **alternative transport**, and what motivations people have for using alternative transport options instead of walking. Four main reasons for using or not using alternative transport came forward.

Time was highlighted by the participants both as motivator as well as barrier for walking. Almost all participants mentioned using the bicycle as an alternative, since it is usually quicker than walking. Contrary, two participants mentioned that especially when utilities are close by it is quicker to go on foot than to use the bicycle, in this case time efficiency could be seen as a motivator for walking.

In addition to time, carrying stuff was also seen as a constraint for walking, as transporting goods is more convenient with either a bicycle or a car.

Finally, almost none of the participants mentioned the availability of a car as an alternative for walking. When asking the participants what the maximum length of walking was before considering taking the bicycle (or other forms of alternative transport), the answer varied between five minutes (Par. 8) and forty-five minutes (Par. 6). Almost all participants (7/8) mentioned that the car was not an alternative for walking but saw the bicycle as an alternative form of transportation for walking.

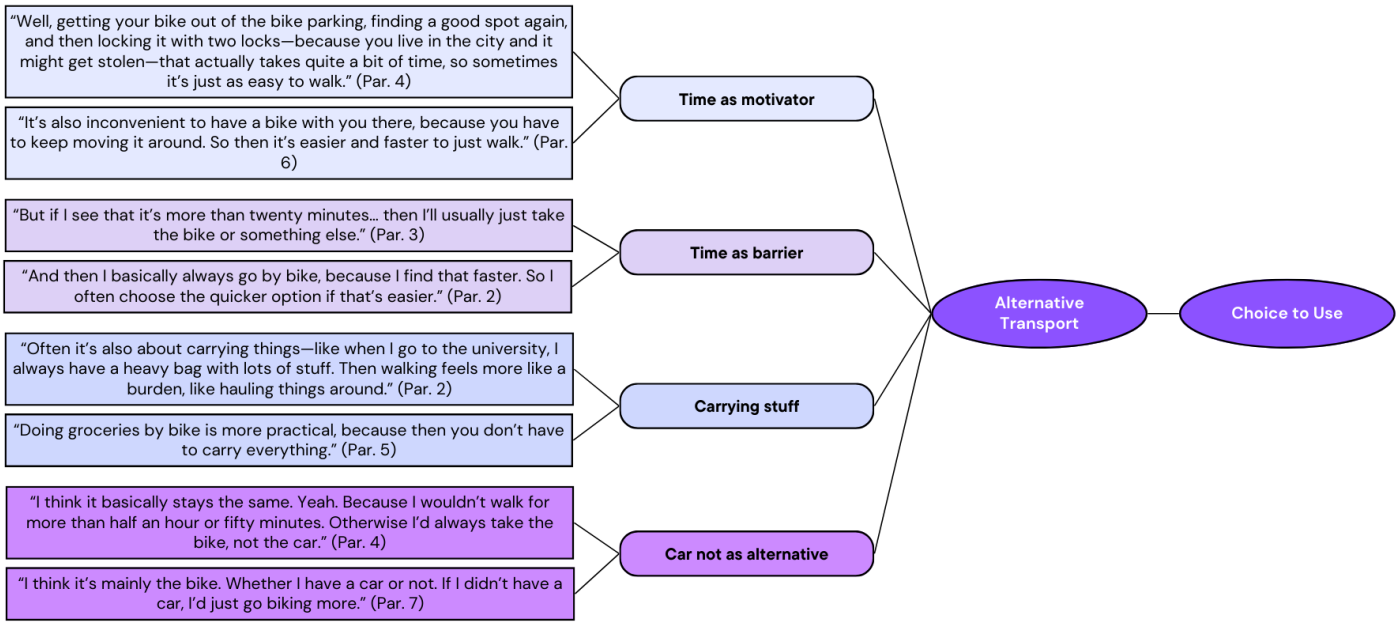


Figure 15: Important quotes interview participants on alternative transport

7.3.2 Exposure: Access

The interview focused asking the participants about perceived barriers and perceived ease of access of the walking infrastructure. Participants mentioned five different types of perceived barriers when walking in the neighborhood. First of all, weather was mentioned as barrier for walking, explaining that rain leads to less walking. In addition, time availability came forward as a barrier, if the participants have a tight schedule it led to more frequent use of the bicycle as alternative for walking. Third, traffic congestion was mentioned by several participants, this included crowded walking areas, but also busy car or bicycle roads. Fourth, safety was mentioned as barrier for walking, especially walking in the dark and speeding cars in the neighborhood. Finally, the quality of the walking infrastructure came forward, participants mentioned that loose tiles, or narrow sidewalks can be considered as barrier for walking.

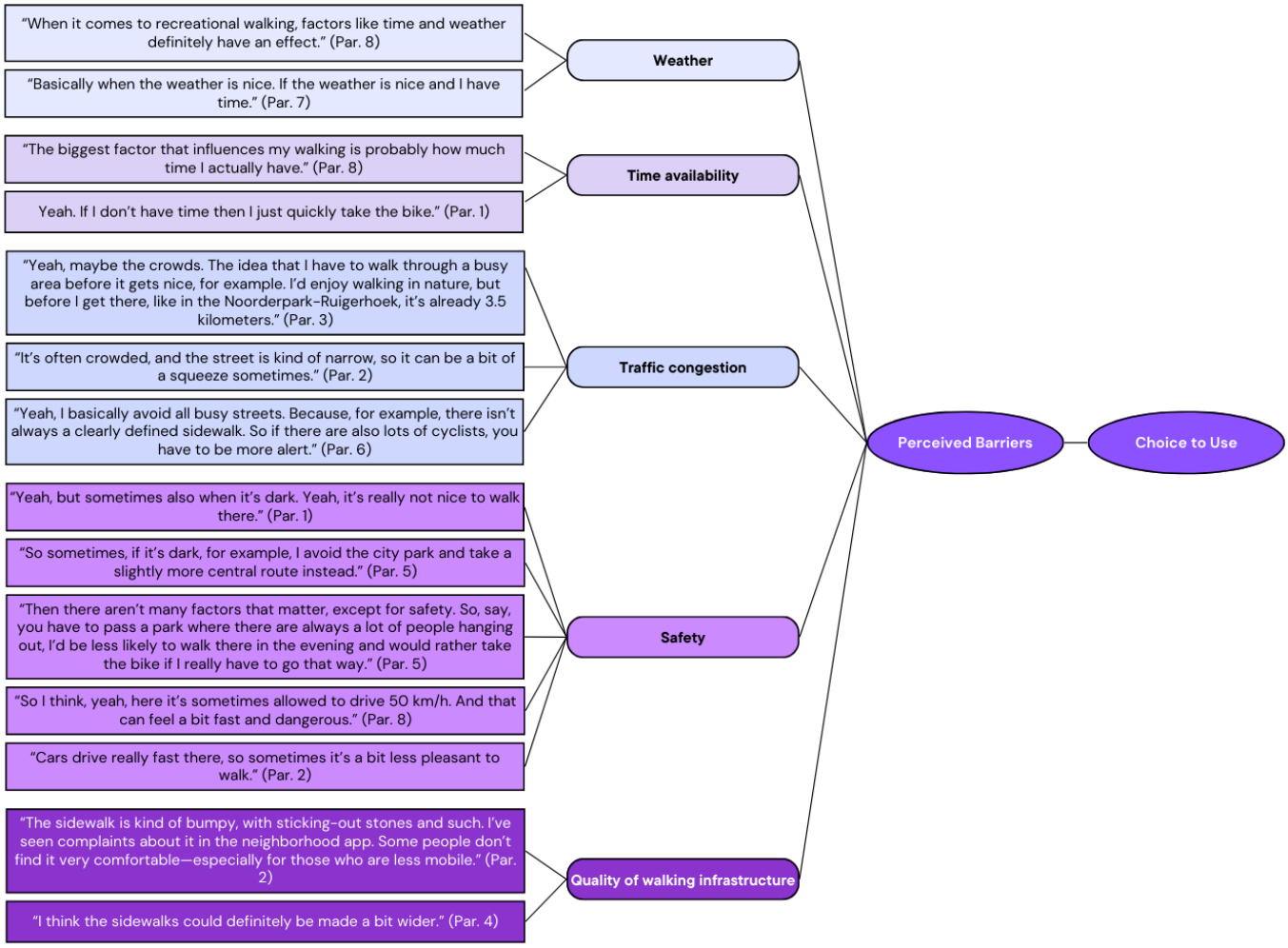


Figure 16: Important quotes interview participants on perceived barriers

In addition to perceived barriers also three types motivators for walking came forward. To start, attractiveness of the neighborhood was mentioned, mainly referring to greenspace in the neighborhood. The second motivator that participants mentioned was clarity of the road and signage, a clear division between different types of road users and signage to help navigate. Finally, continuity of movement was mentioned, several participants mentioned that as few crossings as possible is preferred when walking.

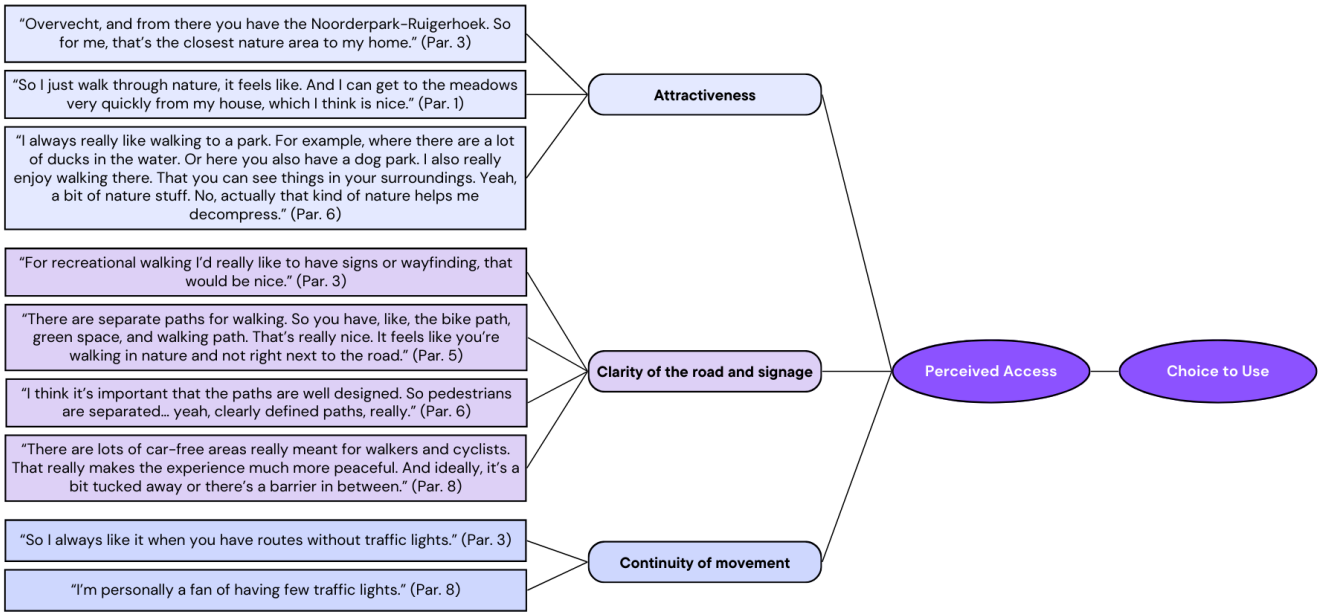


Figure 17: Important quotes interview participants on perceived ease of access

7.3.3 Recreational Walking

The interview focused on what participants mentioned as important motivators for recreational walking, leading to the recognition of three main motivators. Social engagement was mentioned as the first motivator for recreational walking. In addition, peacefulness was mentioned by multiple participants, meaning peace and quiet from the usual urban hustle, which was usually found in greenspace. Finally, aesthetics was mentioned as motivator for recreational walking, participants mentioned wanting to have a visual nice route when walking for recreational reasons.

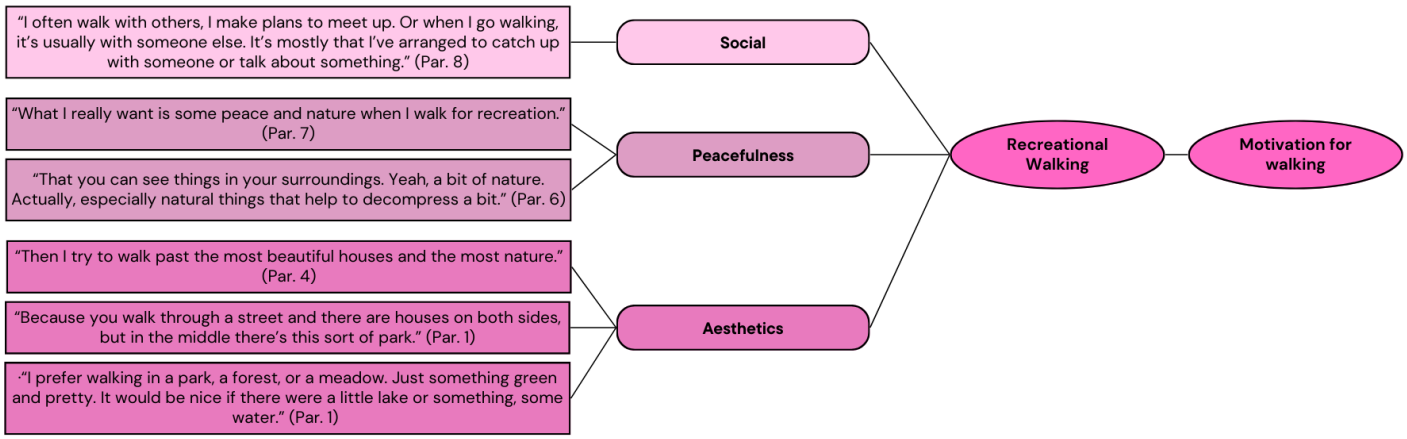


Figure 18: Important quotes interview participants on motivations for recreational walking

7.3.4 Utilitarian Walking

As explained above when asking for recreational walking several motivators came forward, on the contrary when asking what is important for utilitarian walking routes only one element came forward: efficiency. Almost all (6/8) participants mentioned that for utilitarian walking the preferred route is the shortest and most efficient route.

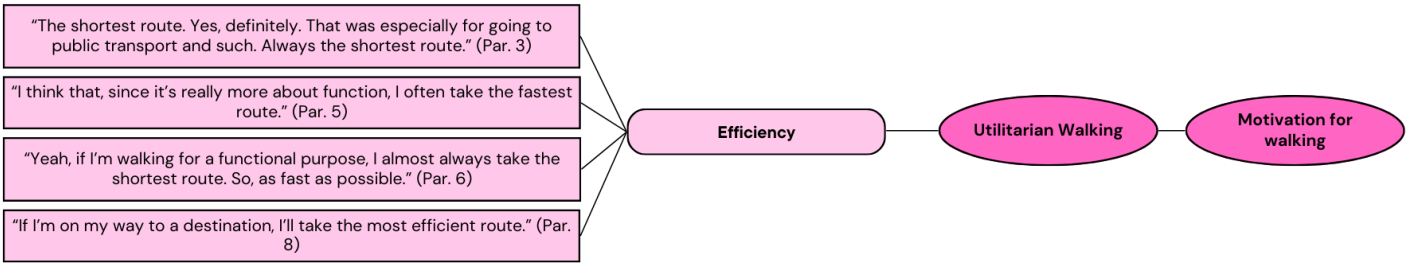


Figure 19: Important quotes interview participants on motivations for utilitarian walking

7.4 Neighborhood Comparison

7.4.1 Choice to Use

For both neighborhoods, the survey showed similar results regarding the availability of alternative transport options. The biggest difference for this could be found in car availability, where more respondents in Overvecht (10) mentioned having no access to a car than in Zuidwest (6). Looking at the interview responses, for both neighborhoods the bicycle was mentioned as an alternative for walking, and the car was not seen as an alternative form of travel.

In both neighborhoods the respondents mention walking most in summer or spring. On average walk seven days a week (in the winter) for recreation and in the summer or spring respondents of both neighborhoods mention walking four days on average for recreation. For utilitarian walking, this does not apply. Respondents from Overvecht on average walk four days a week for utility, while respondents from Zuidwest mention walking on average five or seven days a week in the winter for utility. In the summer or spring respondents from Overvecht walk six or seven days mostly for utility, and four days per week is mentioned the least. While for Zuidwest, it is the other way around; four and seven days per week are now mentioned the most. These results can be found in Figure 20.

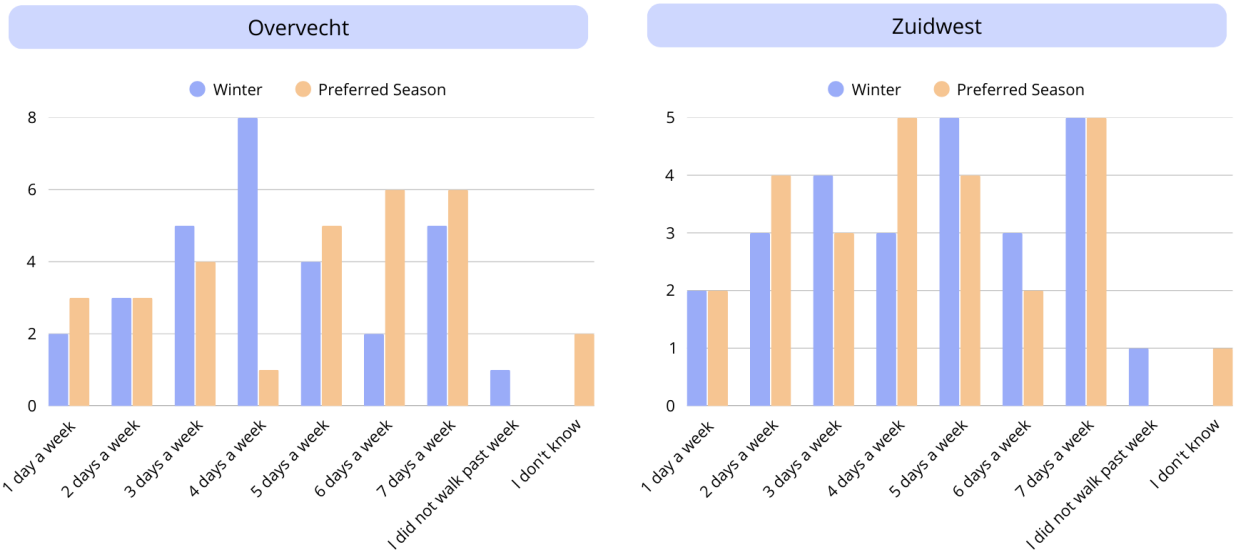


Figure 20: Neighborhood comparison walking frequency differing per season for utility

The duration of utilitarian walking does not differ per neighborhood or season. However, for recreational walking there are differences that can be seen per neighborhood and varieties per season. In Overvecht, respondents walk more for recreation (in winter) between 30 and 60 minutes but almost as much respondents from Overvecht walk for recreation under 30 minutes, while respondents from Zuidwest mention walking more for recreation under 30 minutes. When comparing this to summer or spring respondents from both neighborhoods mention walking for recreational reasons between 30 and 60 minutes.

Although there were no specific questions asking about self-reported duration of walking it did come forward in the interviews. The biggest difference between interview participants from Overvecht and Zuidwest was that, participants from Overvecht generally mentioned walking being less time bound than participants from Zuidwest. In Overvecht, the participants often mentioned walking to the forts or the meadows and not having a specific length in mind. While participants from Zuidwest generally walked shorter and more constrained by efficiency, for example combining recreational walking with errands.

7.4.2 Access

When comparing Overvecht and Zuidwest in terms of the physical access to walking infrastructure of respondents, it is almost similar. A small difference can be found in the capability of respondents to walk, for Zuidwest all respondents mention it being “easy” or “very easy”, while 7% of the respondents from Overvecht mention walking being “slightly hard”.

Regarding the perceived barriers more differences can be found. Figure 21 shows that for Zuidwest, most respondents mention being satisfied with their walking behavior, and only some barriers to walking are perceived. When comparing this to the responses from residents from Overvecht, it can be seen that here almost all barriers are perceived at least once.

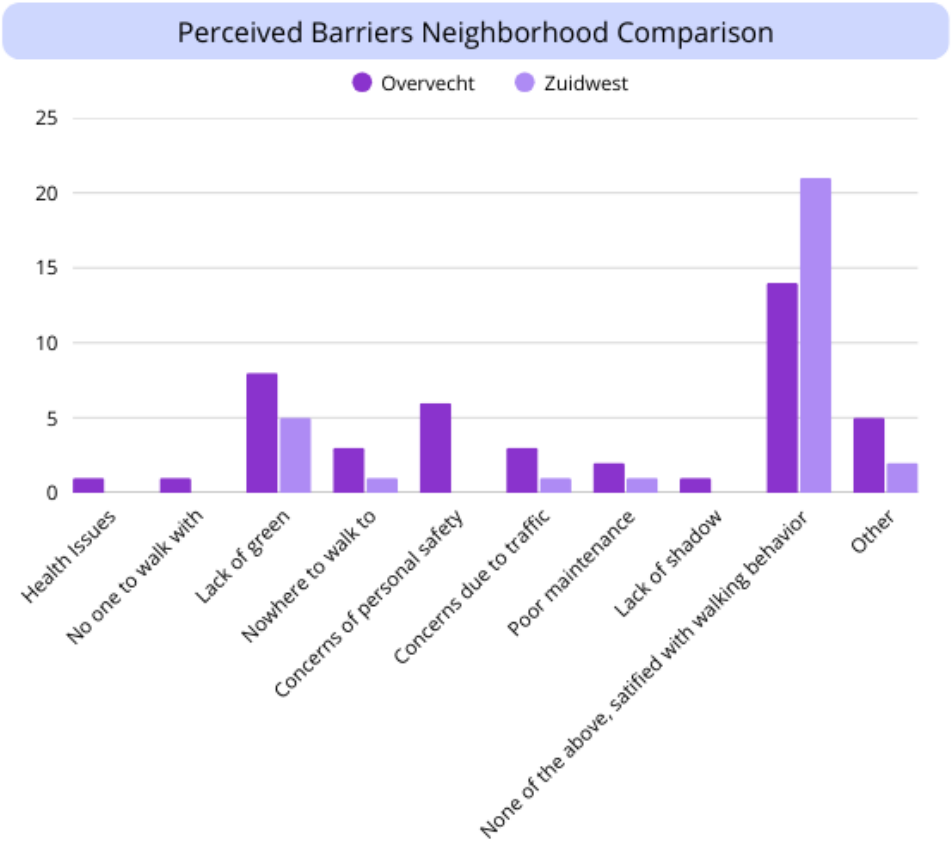


Figure 21: Differences in perceived barriers for Overvecht and Zuidwest

In line with the survey, interview participants from Overvecht also mentioned concerns of personal safety as a perceived barrier, which did not come forward with participants from Zuidwest. For other perceived barriers the interviews contrasted the survey, as residents from Overvecht generally mentioned greenspace as a strength and motivator for walking, and participants from Zuidwest mentioned a lack of greenspace. In addition, concerns due to traffic were also more present amongst interview participants from Zuidwest compared to Overvecht.

The final variable for access is perceived ease of access to walking infrastructure, when comparing the results of the two neighborhoods it can be seen that both neighborhoods almost equally agree to the number of cul-de-sacs in their neighborhood, pedestrian trails in and around their neighborhood, and the number of sidewalks in the neighborhoods. Only for the connectivity of streets the answers differ between the neighborhoods. From respondents from Overvecht 20% disagrees with the statement “There are walkways in my neighborhood that connect cul-de-sacs to streets, trails or other cul-de-sacs” while in Zuidwest twice as many respondents (40%) disagree with the statement. When looking into the differences between the neighborhoods based on the interviews, participants from Zuidwest more often mentioned complaints regarding the walking infrastructure than participants from Overvecht. For example, respondents two and five both mention narrow sidewalks and busy roads, while this does not come forward amongst participants from Overvecht.

7.4.3 Motivation for Walking

The responses from the two neighborhoods are similar, in both Overvecht as Zuidwest 65% of the residents walk more for utilitarian reasons.

Looking at the interviews, there are some differences in walking motivations between the two neighborhoods. Participants from Overvecht tend to be more motivated by presence and accessibility of greenspace for both recreational as well as utilitarian walking. For example, respondents one and seven both mention being more motivated to walk for facilities, since the walking route crosses through greenspaces to reach these facilities. Participants of Zuidwest generally mention walking as secondary to cycling, unless there's free time or a lack of other forms of exercise.

7.4.4 Perceived Walkability

For Overvecht the overall perceived walkability was 3.77 and for Zuidwest this was higher (4.0). To examine whether the difference in perceived walkability for recreational and utilitarian walking also varies by neighborhood, two separate paired samples T-tests (Tables 21 till 24) were conducted for Overvecht and Zuidwest. In both neighborhoods the utilitarian walking was rated significantly higher than recreational walkability.

Table 21: Descriptive statistics on perceived walkability per motivation type per neighborhood

Paired Samples Statistics

7._In_welke_wijk_woont_u?			Mean	N	Std. Deviation	Std. Error Mean
Overvecht	Pair 1	walkfunctional_mean	4.0133	30	.74821	.13660
		walkrecreational_mean	3.5400	30	1.04274	.19038
Zuidwest	Pair 1	walkfunctional_mean	4.2385	26	.64005	.12552
		walkrecreational_mean	3.8385	26	.91393	.17924

Table 22: Correlation between perceived walkability per motivation type per neighborhood

Paired Samples Correlations

7._In_welke_wijk_woont_u?			N	Correlation	Significance	
					One-Sided p	Two-Sided p
Overvecht	Pair 1	walkfunctional_mean & walkrecreational_mean	30	.782	<.001	**<.001**
Zuidwest	Pair 1	walkfunctional_mean & walkrecreational_mean	26	.832	<.001	**<.001**

Table 23: Paired samples t-test on perceived walkability per motivation type per neighborhood

Paired Samples Test

7._In_welke_wijk_woont_u?			Paired Differences					t	df	Significance	
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
						Lower	Upper				
Overvecht	Pair 1	walkfunctional_mean - walkrecreational_mean	.47333	.65281	.11919	.22957	.71710	3.971	29	<.001	**<.001**
Zuidwest	Pair 1	walkfunctional_mean - walkrecreational_mean	.40000	.52154	.10228	.18935	.61065	3.911	25	<.001	**<.001**

Table 24: Effect sizes on perceived walkability per motivation type per neighborhood

Paired Samples Effect Sizes

7._In_welke_wijk_woont_u?				Standardizer[a]	Point Estimate	95% Confidence Interval	
						Lower	Upper
Overvecht	Pair 1	walkfunctional_mean - walkrecreational_mean	Cohen's d	.65281	**.725**	.317	1.123
			Hedges' correction	.67032	.706	.309	1.094
Zuidwest	Pair 1	walkfunctional_mean - walkrecreational_mean	Cohen's d	.52154	**.767**	.322	1.200
			Hedges' correction	.53786	.744	.313	1.163

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

7.5 Summary of Results Phase Two

7.5.1 Survey Results

The survey examined the perceptions of walkability from residents across Utrecht Overvecht and Zuidwest. Residents from Zuidwest perceived the neighborhood as more walkable than residents from Overvecht, for both utilitarian and recreational motivations. Key predictors based on the survey for perceived walkability are perceived ease of access and self-reported frequency. Meaning that respondents who walked more frequent and perceived the neighborhood as accessible in relation to walking also perceived the neighborhood more walkable.

When comparing the survey results between the two neighborhoods, residents from Zuidwest walked more frequent for utilitarian reasons, had better access to amenities and perceived the neighborhood safer than residents from Overvecht.

7.5.2 Interview Results

The interviews provided deeper insights into how residents experience walking in the neighborhoods. In general, interview participants linked walking to green, aesthetics and continuity of movement. In the interviews came forward that recreational walking was more related to pleasant surroundings, while for utilitarian walking efficiency was the most important.

In the interviews, participants from Overvecht were appreciative of the availability of greenspaces in the neighborhood, but mentioned that differences in greenspace availability within the neighborhood were visible. Participants from Overvecht also mentioned barriers regarding personal safety, especially at night. Participants from Zuidwest mentioned a lack of greenspace within the neighborhood and in addition mentioned concerns due to traffic in the neighborhood.

8

DISCUSSION

8 Discussion

This chapter contains the findings of this research by answering the sub-research questions. In addition, some limitations to the research will be addressed. The first four parts correspond with the sub-research questions of this research, then followed by a further discussion and the chapter concludes with the strengths and limitations of this research.

8.1 What is the current state of greenspace connectivity in different neighborhoods in Utrecht?

Looking back at network analysis of the first phase of this research, it can be seen that the gamma indices of the selected neighborhoods are similar to each other. All varying between 0,07 and 0,1. This analysis indicates that the selected neighborhoods current state of greenspace connectivity is relatively low. These values align with literature from urban greenspace connectivity, suggesting that European cities often concentrate greenspace in a few large parks, which are often not included in a cohesive green network (Kabisch et al., 2016). It is possible that other neighborhoods which had similar amounts of public greenspace might have higher connectivity rates of urban green, however it is assumed that this might not be very likely based on the relatively small differences in the gamma indices of these four neighborhoods.

Using the gamma index has downsides to analyzing urban connectivity. The gamma index is solely defined by a number between 0 and 1, but the researcher found no clear universal interpretation of the gamma index. Using additional network analysis types such as the cost ratio of beta index can help triangulate these results and make stronger conclusions (Kong et al., 2010). In addition, working with one gamma index per neighborhood does not allow to make conclusions within neighborhoods. For example, interview participant one mentioned that the differences in greenspace varies between locations in Overvecht, and that some areas within the neighborhood have more greenspaces than others. This is not visible in the gamma index as it only calculates the greenspace connectivity for the entire neighborhood and does not make distinctions within the neighborhood.

Another limitation that comes with the use of gamma index for greenspace connectivity, is that there is no clear definition in the literature on what to operationalize as edges and nodes. In this research nodes were only based on street trees, and not on other public green, as there was no data available for this. This could possibly be one reason on why the gamma indices were low for all four neighborhoods. In addition, the edges were based on trees within five meters of each other, however in hindside this might have been too close to each other. In the future the average distance between trees in urban areas in The Netherlands could be calculated first to form a more scientific based definition for edges when calculating greenspace connectivity.

A suggestion for further research could be to include a mediation analysis on the relationship between street connectivity and greenspace connectivity. In this research, the relationship is assumed but not proven, a mediation analysis would help clarify the relationship between street connectivity and greenspace connectivity. For instance, (Cerin et al., 2017) emphasizes that street connectivity can influence physical activity partly by shaping access to greenspaces, suggesting a potential mediating role.

8.2 How does self-reported frequency of walking and alternative transport options influence their perceptions of walkability in urban environments?

The second sub-research question focused on choice to use, referring to the decision-making process that turns access to greenspace into actual usage of greenspace. Looking at the two neighborhoods, residents from Zuidwest walk more frequent for utility than residents from Overvecht. The survey data indicated that self-reported frequency of walking was the only variable within choice to use that was significantly associated with the perceived walkability, while alternative transport options and walking duration were not proven significant. These findings align with literature, Zhao et al. (2024) mention that frequent walking increases perceived walkability. This study argues that duration increases perceived walkability, but this was not significantly supported by the findings of this study (Zhao et al., 2024).

When comparing Overvecht and Zuidwest in relation to the second sub-research question, it becomes clear that there are differences in the availability of cars between the residents of the two neighborhoods. However, this does not influence walking behavior, as explained by the interview participants of both neighborhoods, who mention that primarily the bicycle is an alternative transport option for walking and not necessarily the car. Alternative transport did not show a significant relationship with perceived walkability, which also came forward in literature (van der Vlugt et al., 2019). However, as mentioned above, in the interviews came forward that the bicycle did influence walking. This can possibly be explained that the survey focusses mainly on motored vehicles as alternative (scooter and/or car), following the literature. While the interviews also focused on bicycle use since. Bicycle usage in The Netherlands is exceptionally high, more than three times higher than the European average (Euro News, 2023). Therefore, it might be assumed that in The Netherlands the bicycle as alternative transportation does influence walking behavior and perceived walkability, based on the conducted interviews.

8.3 How do perceived access and perceived barriers to walking, influence perceived walkability of residents in Utrecht?

Based on the survey, access related factors showed the strongest relation with perceived walkability, explaining 46,3% of the variance in the regression model. Within this model, remarkably only perceived ease of access (e.g., connected sidewalks, walking trail availability) had a significant effect. Findings from Cerin et al. (2017) claim that infrastructural characteristics are the most significant features shaping perceptions of walkability. Results from the two neighborhoods are similar in most questions related to access, only question related to the connectivity of streets are the answers different from resident of Overvecht compared to the answers of Zuidwest. Where residents of Zuidwest were less satisfied with the street connectivity than residents from Overvecht.

Residents from Overvecht perceived more barriers for all categories than residents from Zuidwest and were less satisfied with their walking behavior. Although barriers, such as traffic safety and unpleasant surroundings were mentioned in both the interviews as the survey, it did not prove to contribute significantly to the perceived walkability of residents of Utrecht. These findings could possibly be explained by the study of Tuomola et al. (2024) suggesting that resident actively adjust walking routines or routes to mitigate perceived barriers. This behavior ensures residents to maintain engagement in walking activities while minimalizing barriers. On the contrary, the study of van der Vlugt et al. (2025) did find a negative relationship between perceived walkability and perceived barriers, stating that perceived barriers have strong negative impacts on the perceived walkability.

8.4 What is the effect of walking motivation, recreational or utilitarian, on the perceived walkability of residents in Utrecht?

Most respondents from the survey mentioned walking more for utility reasons than for recreational reasons, but this did not significantly affect overall perceived walkability scores. However, when analyzing the perceived walkability separately for each walking type (recreation versus utility), it revealed significant higher walkability ratings for utilitarian walking compared to the recreational perceived walkability. This finding is supported by literature, arguing that perceived walkability for utilitarian walking is less sensitive to aesthetics and the experience of residents and relies instead more on efficient infrastructure (He & He, 2025; Kang et al., 2017). Which was also highlighted by this research's interview participants. A possible explanation for this looking at the neighborhoods could be that Zuidwest is denser than Overvecht, making it less attractive for cars and increasing proximity to facilities, which increases the attractiveness for walking. Both literature and results from this study have shown that increased (self-reported) frequency increases the perceived walkability, which could be an explanation for why Zuidwest has overall higher perceived walkability for both recreational as utilitarian walking while the greenspace connectivity is lower (van der Vlugt et al., 2025).

Perceived walkability for recreational walking is more reliant on environmental quality and other visual experiences, which was also came forward in the interviews (Kang et al., 2017). In section *7.2.2 Exposure: Choice to Use* it was mentioned that utilitarian walking increases while weather improves, which was also expected by the researcher. Remarkably, frequency of recreational walking decreases when the weather improves. This finding contradicts existing literature, where the summer and spring are mentioned as the seasons in which walking occurs the most (Tucker & Gilliland, 2007). Literature mentions heat discomfort as a possible explanation for the reduction of recreational walking, although it is assumed that this is not the case for The Netherlands, as extreme heat is not very common in The Netherlands (Ferguson et al., 2023). Another possible explanation for this could be when weather improves a substitution effect occurs, in which case, residents prefer other types of outdoor activities, although this is not supported by literature, and future research should be needed to conclude this.

8.5 Further Discussion

The association between street connectivity and greenspace connectivity does not have a prominent role in this research, as the street connectivity in the selected neighborhoods was relatively similar. However, it could be possible that the relationship is more complex and needs to be further addressed. A recent study of Chandrabose et al. (2024) highlights that greenspace and walkability are both independent beneficials of walking behavior. In addition, the study found that greenspace positively influenced walking in low-walkability neighborhoods, but that it had no significant association in high walkability neighborhoods (Chandrabose et al., 2024). This aligns with findings of this research, respondents from Overvecht, a neighborhood with relative low walkability but high greenspace connectivity, more frequently mentioned the importance of greenspace for recreational walking. This could be a possible explanation of why Overvecht has lower perceived walkability regardless of the neighborhoods' higher greenspace connectivity, but further research would be needed to draw conclusions.

The difference in perceived walkability between Overvecht and Zuidwest, could also possibly be explained by income. Based on the sample of the interviews and survey, the residents of Zuidwest, seem to have a higher income than the residents of Overvecht. van der Vlugt et al. (2025) states that

higher income neighborhoods also generally have highest levels of perceived walkability, which would explain why Zuidwest has a higher level of perceived walkability, while having lower greenspace connectivity.

Based on the neighborhood comparison, Zuidwest scored higher on the perceived walkability, despite having both lower street connectivity and lower greenspace connectivity. Overvecht had more concerns regarding barriers for walking such as safety and fewer amenities. In the case of Overvecht, it the interviews and the survey contradict each other regarding perceptions of greenspace. Interview participants mention the availability of greenspace as a walking motivator, mentioning that they are pleased with the amount of greenspace in their neighborhood. While lack of greenspace is mentioned as the highest perceived barrier by survey respondents. One possible explanation for this based on the literature could be the different social groups value greenspace differently (Cilliers, 2023). Another explanation could be, as mentioned by one of the interview participants, the differences in greenspace availability within Overvecht.

8.6 Strengths and Limitations

This research has several strengths, including its new focus on greenspace connectivity in urban planning, in contrast to other urban planning studies regarding urban greenspace this study goes beyond looking at greenspace quantity of proximity. Contributing to a relatively unresearched topic within urban environmental planning.

Additionally, the second phase of the research is characterized by a mixed-methods design. The combination of a survey and interview analysis helps triangulate findings, which can enhance the internal validity of this research and reduce bias.

Finally, another strength of this research is its neighborhood comparison design, comparing two neighborhoods that are similar in sociodemographic characteristics but different in greenspace connectivity isolates the variable of greenspace connectivity, while controlling for confounders such as land use and density. This comparison helps increase the internal validity of the research.

Although this study has several strengths, it additionally contains some limitations that should be noted. To start, this survey consisted of a relatively small sample size (n=56), which limits the statistical analyses. In addition, the sample was not a true representative of the residents of the neighborhoods, as most (±70%) respondents had a high educational level (WO-niveau), and most respondents walked often, compared to the Dutch average (CBS, 2024b). This could possibly be explained by respondents' interest regarding walking and therefore be more willing to participate in the survey compared to residents who have no interest in walking. Both the size of the sample and the quality of the sample can raise some concerns about the generalizability and external validity of this research.

Another limitation is the connectivity analysis of the first phase of the research. As this study relies on self-reported data it might be more sensitive to biases. In contrary to the second research phase, the first research phase relies on one measurement type; the gamma index. The use of the gamma index alone could be seen as a limitation. However, due to time constraints the use of additional connectivity analysis measurements was outside of the scope of this research, but in future research it is advised to incorporate additional connectivity analysis measurements such as cost-ratio analysis and alpha or beta index.

9

CONCLUSION AND RECOMMENDATIONS

9 Conclusion and Recommendations

9.1 Conclusion

This research has explored the relation between greenspace connectivity and perceived walkability, using a mixed methods approach, including a GIS analysis, survey quantitative analysis and semi-structured interviews based on a qualitative analysis. The research compared two neighborhoods in Utrecht with different greenspace connectivity levels. The research was guided by the main research question:

How does greenspace connectivity influence walkability in urban neighborhoods in Utrecht as perceived by residents?

The findings show that while greenspace connectivity varied slightly between Overvecht and Zuidwest, Overvecht did not score best on perceived walkability for either motivation type, even though it did have the highest gamma index, and thus the best greenspace connectivity within the neighborhood. This indicates that structural greenspace connectivity alone does not guarantee more walkable neighborhoods from the residents' perspectives, and that other factors may outweigh structural connectivity in shaping walkability perceptions.

Instead, perceived ease of access to walking infrastructure, such as the presence and quality of sidewalks, walking trails, and well-organized street layout, proves significant effect on the perceived walkability. In addition, self-reported frequency showed to be a significant determinant for perceived walkability in both neighborhoods, suggesting that walking habits themselves might also shape perceptions of walkability.

The influence of greenspace played a more important role towards recreational walking than to utilitarian walking. This suggests that while greenspace connectivity may increase the walking experience of residents, its impact is less prominent when walking is shaped by efficiency. Thus, greenspace connectivity plays a more prominent role in increasing walkability for recreational motivations.

To conclude, the comparison between Overvecht and Zuidwest revealed that higher greenspace connectivity in Overvecht did not lead to higher perceived walkability. Instead, Zuidwest, despite having lower greenspace connectivity, was perceived as more walkable by its residents. Due to higher perceived ease of access, continuity of the road and fewer barriers. These findings suggest that, greenspace connectivity alone is not enough to shape perceived walkability, since Overvecht has a higher greenspace connectivity, but a lower perceived walkability for both recreational and utilitarian walking motivations. By comparing the two neighborhoods with different greenspace connectivity levels, it became clear that greenspace connectivity shows an indirect and context-dependent influence on perceived walkability, primarily by enhancing the attractiveness and usability of walking routes. When incorporating greenspace connectivity into urban planning, it should be supported and accompanied with factors associated with perceived ease of access to have a more prominent effect. The findings of this study highlight that urban planners should integrate both structural and perceptional perspectives into urban planning, ensuring that it supports both physical health and user perception.

9.2 Scientific Recommendations

Based on the findings of this research, additional research is recommended. To start, it is recommended to look for hotspot where the greenspace network is the lowest, this could be based on multiple forms of a network analysis, including alpha, beta, gamma indices and the cost ratio analysis. The cost ratio analysis provides weak spots in the network and shows the shortest routes, which can be particularly important for enhancing utilitarian perceived walkability.

In the future additional research can be done in including Public Participation GIS analysis in researching perceived walkability. PPGIS was originally scheduled to be included in this research, but due to time and technical difficulties, the researcher chose to remove it from the research. Public Participation GIS (PPGIS), this is a map-based survey method to provide both geographic and non-geographic information (Fagerholm et al., 2021). In future research, respondents could be asked (both for recreation and for utilitarian) to pinpoint locations that enhance positive walking experiences. In addition, respondents could be asked to pinpoint locations on the map that need improvement. These questions could then provide information on where residents like to walk, and where in the neighborhood there is room for improvement. Looking into where people like to walk, could also provide information on what barriers are for utilitarian walking and what perceived barriers are for recreational walking. Which can help shape further urban planning recommendations.

9.3 Practical Recommendations

As the results have pointed out, residents of both neighborhoods perceive the environment as more walkable for utilitarian purposes than for recreational walking. This suggests that there is more room for enhancing the recreational perceived walkability. In addition, recreational perceived walkability is shaped more by greenspace connectivity than utilitarian walking. Therefore, the recommendation is focused on increasing the perceived walkability for recreational purposes.

The survey provided information on the importance of perceived ease of access for the perceived walkability, which also came forward in the interviews. The first recommendation would be to make multiple walking trails through the neighborhood, varying in length. These walking routes would be through greenspaces or walking passed interesting highlights in the neighborhood. If possible, several signs could be placed, marking the routes and providing information about the neighborhood. These walking trails could have several benches along the trail. This could be used by elderly for resting, leisure such as a picknick or enjoying the view.

The second and final recommendation would be to increase quality of the walking infrastructure, for example by increasing the crossing availability within the neighborhoods. In addition, the results showed that clarity of road also led to higher perceived walkability. For this a recommendation would be to distinguish road users with a small green barrier. This way, it is clear what part of the road is meant for what type of road user, and in addition it might be perceived safer due to the presence of a barrier. A visualization of this can be found in Figure 22. Here A shows the clear difference in designated area for cars and for cyclist, and B shows the sidewalk. In between is the green barrier that could improve sense of safety and the connection to greenspace in the neighborhood.

Figure 22: Implementation recommendation green barrier between road users. Partly generated with AI

To conclude, improvements for the perceived walkability in the neighborhoods Overvecht and Zuidwest can mostly be made regarding the walking infrastructure, for example by separating road users or providing walking trails in and through the neighborhoods in Utrecht.

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11 Appendix

11.1 Appendix 1: Survey questions

Beste deelnemer,

Voor mijn afstuderen aan de Wageningen Universiteit doe ik onderzoek naar hoe bewoners in Utrecht Overvecht en Zuidwest de loopvriendelijkheid van hun wijk ervaren. Mede door deze enquete wil ik hier inzicht krijgen.

Uw deelname is volledig **anoniem**, en het invullen van de vragenlijst duurt ongeveer **7 minuten**. De enquete bestaat uit 50 korte vragen, waarbij geen goede of foute antwoorden zijn. Het gaat om uw persoonlijke beleving.

Alvast bedankt voor uw tijd!
Met vriendelijke groet,

Jasmijn Ansinger
Studente aan de Wageningen Universiteit & Research

English	**Dutch**
Survey Questions **Sociodemographic information** 1. Age (years) a. 18-24 b. 25-34 c. 35-44 d. 45-54 e. 55-64 f. 65-74 g. >75 2. Gender a. Female b. Male c. Other d. Prefer not to answer 3. Highest finished educational level a. No education b. Primary school c. VMBO/MAVO d. HAVO/VWO e. MBO f. HBO g. WO 4. What is your income per year for your household a. Less than 31 thousand b. 31 till 35 thousand c. 35 till 39 thousand d. 39 till 43 thousand e. More than 43 thousand f. Prefer not to answer	**Enquêtevragen** **Sociodemografische gegevens** 1. Wat is uw leeftijd a. 18-24 b. 25-34 c. 35-44 d. 45-54 e. 55-64 f. 65-74 g. >75 2. Wat is uw geslacht a. Vrouw b. Man c. Anders d. Zeg ik liever niet 3. Wat is uw hoogst voltooide opleidingsniveau a. Geen onderwijs b. Basisonderwijs c. VMBO/MAVO d. HAVO/VWO e. MBO f. HBO g. WO 4. Wat is het jaarlijks netto-inkomen van je huishouden? a. Minder dan 27 (duizend euro) b. 27 tot 31 (duizend euro) c. 31 tot 35 (duizend euro) d. 35 tot 39 (duizend euro) e. 39 of meer (duizend euro) f. Zeg ik liever niet

5. Do you have children under 7 a. Yes b. No	5. Heeft u kinderen jonger dan 7 jaar? a. Ja b. Nee
6. Do you have children between 7 and 17 a. Yes b. No	6. Heeft u kinderen tussen de 7 en 17 jaar? a. Ja b. Nee
7. Which neighborhood do you live in? a. Overvecht b. Zuidwest	7. In welke wijk woont u? a. Overvecht b. Zuidwest
8. What type of house do you live in? a. Apartment without balcony b. Apartment with balcony c. House without garden d. House with garden e. Other	8. In wat voor soort woning woont u? a. Appartement zonder balkon b. Appartement met balkon c. Huis zonder tuin d. Huis met tuin e. Anders
Access Questions about physical access	**Mobiliteit** Fysieke mobiliteit
9. In general, would you say your physical health is a. Excellent b. Very Good c. Good d. Fair e. Poor f. Very Poor	9. Hoe zou u over het algemeen uw fysieke gezondheid beoordelen? a. Uitstekend b. Zeer goed c. Goed d. Matig e. Slecht f. Zeer slecht
10. How physically easy is it for you to walk? a. Very easy b. Easy c. A bit difficult d. Very difficult	10. Hoe fysiek gemakkelijk is lopen voor u? a. Zeer gemakkelijk b. Gemakkelijk c. Een beetje lastig d. Zeer lastig
11. Do you walk for recreation or transportation in the neighborhood? a. Yes b. No	11. Loopt u in uw wijk voor recreatie of vervoer? a. Ja b. Nee
[If the respondent does not walk; go to questions about why not (question A)] *[If the respondent does walk continue survey with question 12]*	(Als de respondent niet loopt, ga naar vraag A.) (Als de respondent wel loopt, ga verder met vraag 12.)
Questions about perceived barriers Select box if applicable	Waargenomen barrières voor lopen (Selecteer alle opties die van toepassing zijn.)
12. I would walk more in my neighborhood but, ○ I have problems with my health (breathlessness, dizziness or painful joints) ○ There is no one to go walking with me around where I live ○ There are no green or pleasant areas to walk near my home	12. Ik zou graag meer lopen in mijn wijk, maar... ○ Ik heb gezondheidsproblemen (kortademigheid, duizeligheid of gewrichtspijn of andere gezondheidsproblemen die lopen beïnvloeden). ○ Er is niemand om mee samen te lopen in mijn wijk. ○ Er zijn geen groene of prettige gebieden om te wandelen in de buurt van mijn huis.

- There is nowhere to walk to where I live (shops, pub, church, parks etc.)
- I worry about my personal safety around where I live
- I worry about my personal safety around where I live due to traffic (cars or bikes)
- The sidewalks in my neighborhood are not well maintained (paved, even, ant not a lot of cracks)
- There is a lack of shadow on the pavements
- Other…
- None of the above, I am satisfied with my walking behavior

Questions about perceived ease of access

13. The streets in my neighborhood do not have many or any cul-de-sacs (dead-end streets)
    a. Strongly disagree
    b. Somewhat disagree
    c. Somewhat agree
    d. Strongly agree

14. There are walkways in my neighborhood that connect cul-de-sacs to streets, trails or other cul-de-sacs
    a. Strongly disagree
    b. Somewhat disagree
    c. Somewhat agree
    d. Strongly agree

15. There are sidewalks on most of the streets in my neighborhood
    a. Strongly disagree
    b. Somewhat disagree
    c. Somewhat agree
    d. Strongly agree

16. There are pedestrian trails in or near my neighborhood that are easy to get to
    a. Strongly disagree
    b. Somewhat disagree
    c. Somewhat agree
    d. Strongly agree

Choice to use

Questions about alternative transport

17. Do you have a driver's license for a car or scooter?
    a. Yes
    b. No

18. Do you have access to a car?
    a. Yes
    b. No

19. Do you have access to a scooter?

- Er is niets om naartoe te lopen in mijn buurt (bijv. winkels, café, kerk, parken).
- Ik maak me zorgen over mijn persoonlijke veiligheid in mijn buurt.
- Ik maak me zorgen over mijn veiligheid vanwege het verkeer (auto's of fietsen).
- De trottoirs in mijn buurt zijn niet goed onderhouden (bijv. gebarsten asfalt, of losse stoeptegels).
- Er is een gebrek aan schaduw op de trottoirs.
- Anders: ___
- Geen van bovenstaande, ik ben tevreden met mijn loopgedrag.

Waargenomen toegankelijkheid

13. Mijn wijk heeft weinig tot geen doodlopende straten
    a. Helemaal mee oneens
    b. Een beetje mee oneens
    c. Een beetje mee eens
    d. Helemaal mee eens

14. Er zijn voetpaden of olifantenpaadjes in mijn wijk die doodlopende wegen verbinden met straten, paden of andere doodlopende wegen.
    a. Helemaal mee oneens
    b. Een beetje mee oneens
    c. Een beetje mee eens
    d. Helemaal mee eens

15. Er zijn trottoirs langs de meeste straten in mijn wijk.
    a. Helemaal mee oneens
    b. Een beetje mee oneens
    c. Een beetje mee eens
    d. Helemaal mee eens

16. Er zijn wandelroutes in of nabij mijn wijk die gemakkelijk toegankelijk zijn.
    a. Helemaal mee oneens
    b. Een beetje mee oneens
    c. Een beetje mee eens
    d. Helemaal mee eens

Keuze om te lopen vs.

Vragen over alternatief vervoer

17. Bezit u een (auto of scooter) rijbewijs?
    a. Ja
    b. Nee

18. Heeft u toegang tot een auto?
    a. Ja
    b. Nee

19. Heeft u toegang tot een scooter

20. Wat is het aantal auto's in uw huishouden: ___

a. Yes b. No 20. Number of cars in the household Questions about self-reported frequency walking *Think about the time you spent walking for recreation in the last 7 days in the neighborhood. This includes, walking for exercise, dog walking, social walking or any other form of walking without a destination.* 21. During the last 7 days, on how many days did you walk at least for 10 minutes at a time for recreation? a. …. Days per week b. Don't know/ not sure c. I did not walk in the past week 22. How much time did you usually spend walking for recreational reasons on one of those days? a. …. Hours per day b. …. Minutes per day c. Don't know/not sure d. I did not walk in the past week *Now do the same but then for utilitarian walking, this includes walking for transport and any other forms of walking with a destination.* 23. During the last 7 days, on how many days did you walk at least for 10 minutes at a time for utilitarian reasons? a. …. Days per week b. Don't know/ not sure c. I did not walk in the past week 24. How much time did you usually spend walking for utilitarian reasons on one of those days? a. …. Hours per day b. …. Minutes per day c. Don't know/not sure d. I did not walk in the past week *Think about the season which you walk the most in, how much time do you then spent you spent walking for recreation in a week in the neighborhood. This includes, walking for exercise, dog walking, social walking or any other form of walking without a destination.* 25. The season I walk the most in is: a. Summer b. Fall c. Winter d. Spring 26. During an average week in the season you walk the most in, on how many days do you walk at least for 10 minutes at a time for recreation? a. …. Days per week	Zelfgerapporteerde loopfrequentie Recreatief lopen *Denk aan de tijd die u de afgelopen 7 dagen in de buurt hebt besteed aan wandelen voor recreatie. Dit omvat wandelen voor lichaamsbeweging, het uitlaten van de hond, sociaal wandelen of elke andere vorm van wandelen zonder specifieke bestemming.* 21. Op hoeveel dagen in de afgelopen 7 dagen heeft u minimaal 10 minuten achter elkaar gewandeld voor recreatie? a. ___ dagen per week b. Weet ik niet/zeker c. Ik heb de afgelopen week niet gewandeld 22. Hoeveel tijd besteedt u meestal aan recreatief wandelen op die dagen? a. ___ uur per dag b. ___ minuten per dag c. Weet ik niet/zeker d. Ik heb de afgelopen week niet gewandeld *Nu doen we hetzelfde maar dan voor functioneel wandelen. Dit omvat lopen als vervoer of lopen met een bestemming (zoals naar de supermarkt).* 23. Op hoeveel dagen in de afgelopen 7 dagen heeft u minimaal 10 minuten achter elkaar gewandeld voor functionele doeleinden? a. ___ dagen per week b. Weet ik niet/zeker c. Ik heb de afgelopen week niet gewandeld 24. Hoeveel tijd besteedt u meestal per dag aan functioneel wandelen op die dagen? a. ___ uur per dag b. ___ minuten per dag c. Weet ik niet/zeker d. Ik heb de afgelopen week niet gewandeld *Denk aan het seizoen waarin u het meest wandelt. Hoeveel tijd besteedt u in dat seizoen per week aan wandelen voor **recreatie** in de buurt? Dit omvat dus wandelen voor lichaamsbeweging, het uitlaten van de hond, sociaal wandelen of elke andere vorm van wandelen zonder specifieke bestemming.* 25. Ik loop het meest in de … a. Zomer b. Herfst c. Winter d. Lente 26. In een gemiddelde week in het seizoen waarin u het meeste loopt, op hoeveel dagen per week loopt u dan voor ten minste 10 minuten voor recreatie? a. ___ dagen per week

b. Don't know/ not sure	b. Weet ik niet/zeker
27. How much time did you usually spend walking for recreational reasons on one of those days? a. …. Hours per day b. …. Minutes per day c. Don't know/not sure d. I did not walk in the past week	27. Hoeveel tijd besteedt u meestal op zo'n dag aan wandelen voor recreatie (in het seizoen waarin u het meeste wandelt)? a. ___ uur per dag b. ___ minuten per dag c. Weet ik niet/zeker
Now do the same but then for utilitarian walking, this includes walking for transport and any other forms of walking with a destination.	*Doe nu hetzelfde, maar dan voor **functioneel** wandelen in het seizoen waarin u het meeste wandelt. Dit omvat wandelen voor transport en andere vormen van wandelen met een bestemming.*
28. During an average week in the season you walk the most in, on how many days do you walk at least for 10 minutes at a time for utilitarian reasons? a. …. Days per week b. Don't know/ not sure c. I did not walk in the past week	28. In een gemiddelde week in het seizoen waarin u het meeste loopt, op hoeveel dagen per week loopt u dan voor ten minste 10 minuten voor functionele redenen? a. ___ dagen per week b. Weet ik niet/zeker
29. How much time did you usually spend walking for utilitarian reasons on one of those days? a. …. Hours per day b. …. Minutes per day c. Don't know/not sure d. I did not walk in the past week	29. Hoeveel tijd besteedt u meestal op zo'n dag aan wandelen voor functionele redenen (in het seizoen waarin u het meeste wandelt)? a. ___ uur per dag b. ___ minuten per dag c. Weet ik niet/zeker
Motivation for walking 30. Do you own a dog? a. Yes b. No	**Motivatie om te lopen** 30. Heeft u een hond? a. Ja b. Nee
31. What type of walking do you do the most? a. Recreational walking b. Utilitarian walking	31. Welke vorm van lopen doet u het meest? a. Recreatief lopen b. Functioneel lopen
Perceived Walkability 32. In my neighborhood, it is feasible to walk - utilitarian o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree - Recreationally o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree	**Waargenomen wandelvriendelijkheid** 32. In mijn wijk is er mogelijkheid om te lopen - A: Functioneel o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens - B: Recreatief o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens
33. In my neighborhood, it is convenient to walk - utilitarian o Totally disagree	33. In mijn wijk is het praktisch om te lopen - A: Functioneel o Helemaal mee oneens

o Somewhat disagree o Neutral o Somewhat agree o Totally agree - Recreationally o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree	o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens - B: Recreatief o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens
34. In my neighborhood, it is comfortable to walk - utilitarian o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree - Recreationally o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree	34. In mijn wijk is het comfortabel om te lopen (Gaat over het gemak van lopen; bijv. brede stoepen weinig obstakels) - A: Functioneel o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens - B: Recreatief o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens
35. In my neighborhood, it is pleasant to walk - utilitarian o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree - Recreationally o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree	35. In mijn wijk is het aangenaam om te lopen (Gaat over de beleving van lopen; bijv. fijne sfeer, veel groen, rust) - A: Functioneel o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens - B: Recreatief o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens
36. My neighborhood stimulates me to walk - utilitarian o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree - Recreationally o Totally disagree o Somewhat disagree o Neutral o Somewhat agree o Totally agree	36. Mijn wijk stimuleert mij om te lopen - A: Functioneel o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens o Helemaal mee eens - B: Recreatief o Helemaal mee oneens o Enigszins mee oneens o Neutraal o Enigszins mee eens
QUESTION FOR PEOPLE WHO DO NOT WALK	

A. You answered that you do not walk in your neighborhood; please select the reason(s) why not, select all that applies; a. It is easier to use the car b. The distances are too far to walk c. It is too hot outside (during summer) d. Health reasons e. I have a lack of time f. I prefer to other forms of exercise g. I do walk but, in another neighborhood h. The sidewalks are not maintained i. Other; Participate in the interview? Besides this survey also interviews are conducted, if you are interested in participating you can leave your email address below and I will contact you.	o Helemaal mee eens **Voor mensen die niet lopen** A. U heeft aangegeven dat u niet loopt in uw buurt. Wat is hiervoor de reden? (Selecteer alstublieft alle opties die van toepassing zijn): a. Het is makkelijker om de auto te gebruiken. b. De afstanden zijn te groot om te lopen. c. Het is te warm buiten (in de zomer). d. Vanwege gezondheidsredenen e. Ik heb geen tijd om te wandelen. f. Ik geef de voorkeur aan andere vormen van lichaamsbeweging. g. Ik loop wel, maar in een andere wijk. h. De trottoirs zijn niet goed onderhouden. i. Anders: ___ Wilt u bijdragen aan de interviews? Naast deze vragenlijst worden er ook interviews gehouden, mocht u interesse hebben om hieraan bij te dragen kunt u hier uw emailadress achterlaten en dan wordt er contact met u opgenomen.

11.2 Appendix 3: Interview Guide

Interview Guide

Introduction to interview:
Thank you for participating in this interview, the interview aims to look at what influences walkability in a neighborhood. The interview will be done while walking through the neighborhood and answers will be recorded. Your responses will be anonymized and used for research purposes only. The interview will take about 30-40 minutes.
[-Give consent form-]

1. What is your age?
2. What is your gender?
3. What is your highest finished educational level?
4. Do you walk in your neighborhood?
5. How would you describe the quality of the walking infrastructure in your neighborhood? -> to see if they first mention aesthetics or transport related

Recreational walking
The first half of the questions will be about walking for recreational reasons, this is walking without a destination, such as walking for exercise, walking a dog, and any other form of walking for leisure.

1. Do you walk in your neighborhood for recreation?
2. If so, do you have typical routes you like to take? Why?
3. Thinking about your daily routine, how do you decide whether to walk (for recreation) or not?
4. What factors influence your choice to walk for recreational reasons, or not to walk (note for self: think of physical health, time constraints, or other barriers)
5. How do you determine the length of your walk?
6. Are there specific areas in your neighborhood that you enjoy walking to for recreational purposes?
7. Are there specific areas in your neighborhood that you think could improve for making it more appealing for recreational walking? Why?
    a. If you could change one thing in your neighborhood to make walking more attractive, what would it be?
8. Do you avoid certain areas in your neighborhood when recreational walking? Why?
9. What do you consider important when recreational walking?

Utilitarian walking
The second half of the questions will be about walking for utilitarian reasons, this is walking with a destination, such as walking to shops, commuting and walking for transport.

1. Do you walk in your neighborhood for utilitarian reasons?
2. If so, do you have typical routes you like to take? Could you describe them to me?
3. Thinking about your daily routine, how do you decide whether to walk (for utility) or not?
4. What factors influence your choice to walk for utilitarian reasons, or not to walk (note for self: think of physical health, time constraints, or other barriers)
5. How do you determine the length of your walk?
    a. When is something to far to walk? What is the max length?
6. Do you ever choose not to walk even when walking is an option?
    a. If so, why?
7. Are there specific areas in your neighborhood that you walking to for utilitarian purposes?
8. Are there specific areas in your neighborhood that you think could improve for making it more appealing for utilitarian walking? Why?
    a. If you could change one thing in your neighborhood to make walking more attractive, what would it be?
9. Do you avoid certain areas in your neighborhood when utilitarian walking? Why?
10. What do you consider important when walking for utility?
11. Do you own a car, scooter or a bicycle?
    a. Does this influence your decision to walk?
    b. Would you walk more or less if you did not or do have access to a car or a bike? Why?

Introductie van het interview:

Bedankt voor je deelname aan dit interview. Dit interview heeft als doel te onderzoeken welke factoren de wandelvriendelijkheid van een buurt beïnvloeden. Het interview zal plaatsvinden terwijl we samen door de buurt lopen, en je antwoorden worden opgenomen. Je antwoorden worden geanonimiseerd en uitsluitend gebruikt voor onderzoeksdoeleinden.

[-Geef toestemmingsformulier-]

Algemene vragen

1. Wat is uw geslacht?
2. Wat is uw leeftijd?
3. Wat is uw hoogst afgeronde opleidingsniveau?
4. Loop je in jouw wijk?
5. Hoe zou je de kwaliteit van de wandelinfrastructuur in jouw buurt omschrijven? → *Om te zien of de deelnemer eerst aesthetische of transport gerelateerde aspecten benoemt.*

Recreatief wandelen

De eerste helft van de vragen gaat over wandelen om recreatieve redenen. Dit betekent wandelen zonder specifieke bestemming, zoals wandelen voor beweging, het uitlaten van een hond, of andere vormen van vrijetijdswandelen.

6. Loop je in jouw buurt voor recreatie?
7. Zo ja, heb je vaste routes die je graag neemt? Waarom hier?
8. Hoe beslis je, in je dagelijkse routine, of je gaat wandelen (voor recreatie) of niet?
9. Welke factoren beïnvloeden jouw keuze om recreatief te wandelen of juist niet te wandelen? (Bijvoorbeeld fysieke gezondheid, tijdsdruk of andere barrières)
10. Hoe bepaal je hoelang je gaat wandelen?
11. Zijn er specifieke plekken in jouw wijk waar je graag naartoe wandelt voor recreatieve doeleinden?
12. Zijn er specifieke plekken in jouw wijk die verbeterd zouden kunnen worden om aantrekkelijker te zijn voor recreatief wandelen? Waarom?
    a. Als je één ding in jouw wijk zou kunnen veranderen om wandelen aantrekkelijker te maken, wat zou dat dan zijn?
13. Vermijd je bepaalde gebieden in jouw wijk tijdens recreatief wandelen? Waarom?
14. Wat vind je belangrijk bij recreatief wandelen? (Groen, park etc.)

Functioneel wandelen

De tweede helft van de vragen gaat over wandelen met een bestemming, zoals lopen naar winkels, woon-werkverkeer, of wandelen als transportmiddel.

15. Loop je in jouw buurt voor functionele doeleinden?
16. Zo ja, heb je vaste routes die je graag neemt? Kun je deze beschrijven?
17. Hoe beslis je, in je dagelijkse routine, of je gaat wandelen (voor functionele doeleinden) of niet?
18. Welke factoren beïnvloeden jouw keuze om functioneel te wandelen of juist niet te wandelen? (Bijvoorbeeld fysieke gezondheid, tijdsdruk of andere barrières)
19. Hoe bepaal je de lengte van je wandeling?
    a. Wanneer is iets te ver om te lopen? Wat is jouw maximale loopafstand?
20. Kies je er weleens voor om niet te wandelen, zelfs als dat een optie is?
    a. Zo ja, waarom?
21. Zijn er specifieke plekken in jouw wijk waar je vaak naartoe wandelt voor functionele doeleinden?
22. Zijn er specifieke plekken in jouw wijk die verbeterd zouden kunnen worden om aantrekkelijker te zijn voor functioneel wandelen? Waarom?
    a. Als je één ding in jouw wijk zou kunnen veranderen om wandelen aantrekkelijker te maken, wat zou dat dan zijn?
23. Vermijd je bepaalde gebieden in jouw wijk tijdens functioneel wandelen? Waarom?
24. Wat vind je belangrijk bij functioneel wandelen? (goede stoepen etc.)
25. Bezit je een auto, scooter of een fiets?
    a. Beïnvloedt dit jouw beslissing om te wandelen?
    b. Zou je meer of minder wandelen als je geen of juist wel toegang had tot een auto of fiets? Waarom?

11.3 Appendix 3: Flyer for survey

Actual size is ¼ A4 paper

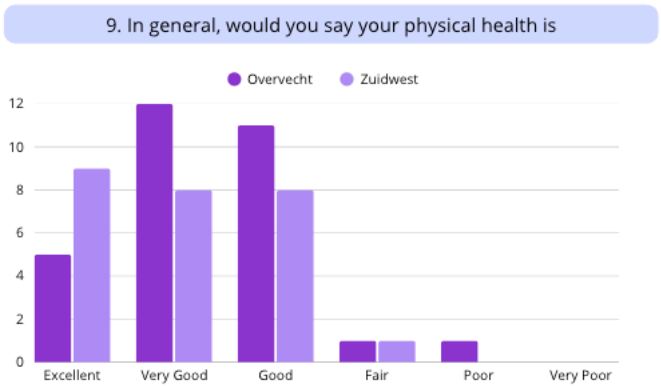
11.4 Appendix 4: Descriptive Statistics and Frequency Distribution Survey

Sociodemographic information

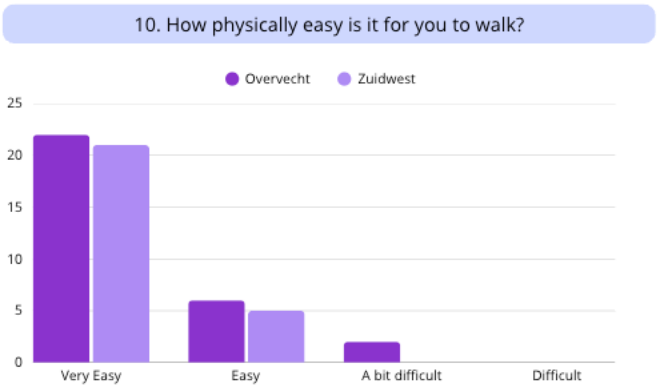
1) Shown in sociodemographic table in results
2) Shown in sociodemographic table in results
3) Shown in sociodemographic table in results
4) Shown in sociodemographic table in results
5) Shown in sociodemographic table in results
6) Shown in sociodemographic table in results
7) Shown in sociodemographic table in results
8) Shown in sociodemographic table in results

Physical Access

9)



10)

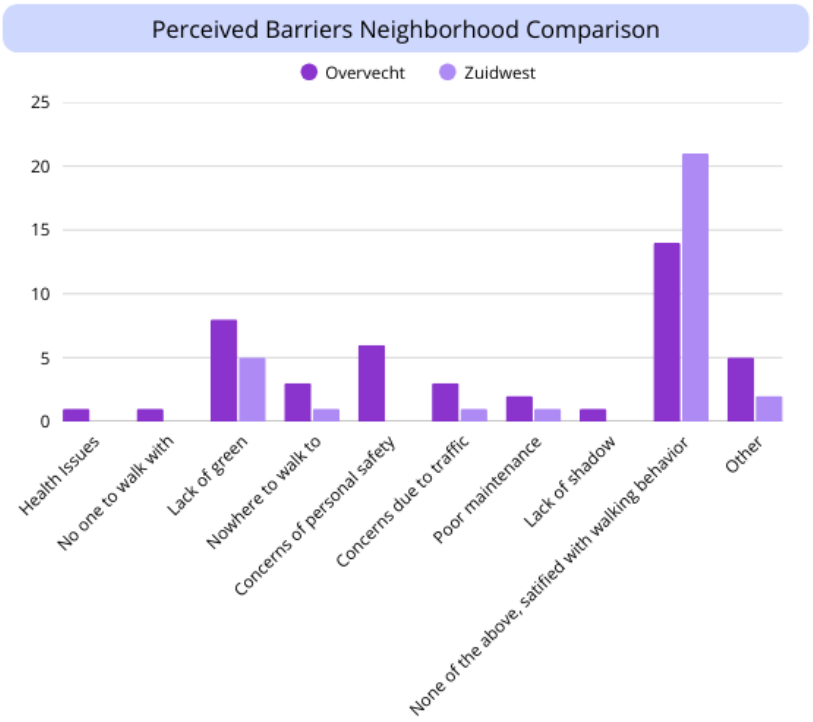


Note for question 11: If answer no; respondent was excluded

Survey results			
Question	**Variable**	**Category**	**N (%)**
11)	**Do you walk?**	**Yes**	56 (100%)
		No	0 (0%)

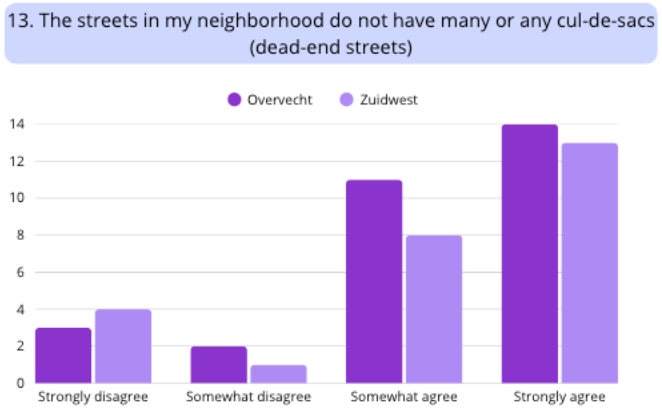
Perceived barriers

12)

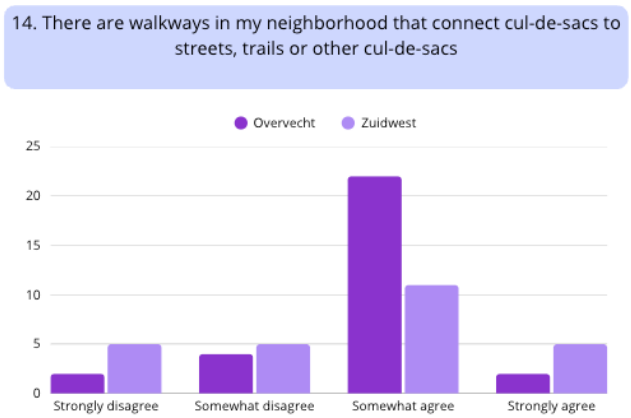


Perceived ease of access

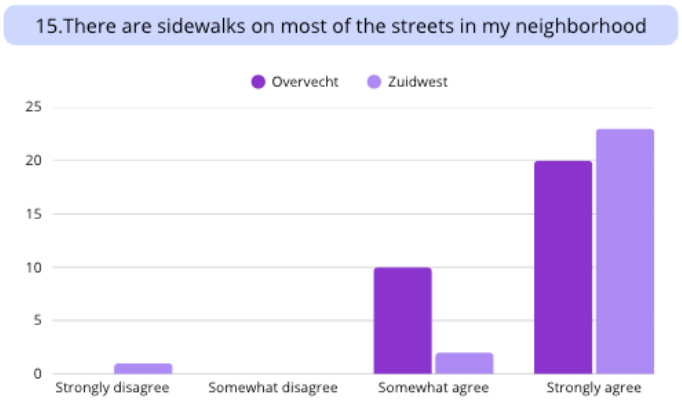
13)



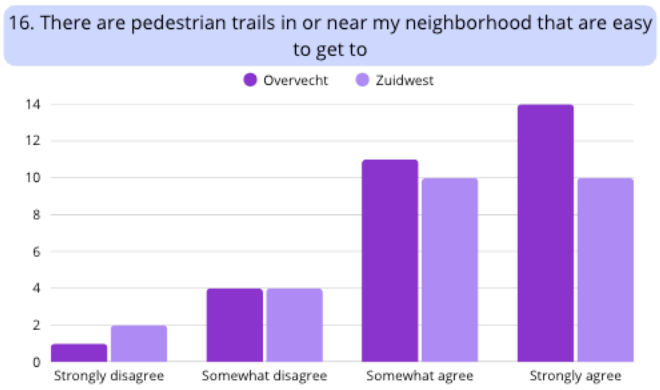
14)



15)



16)

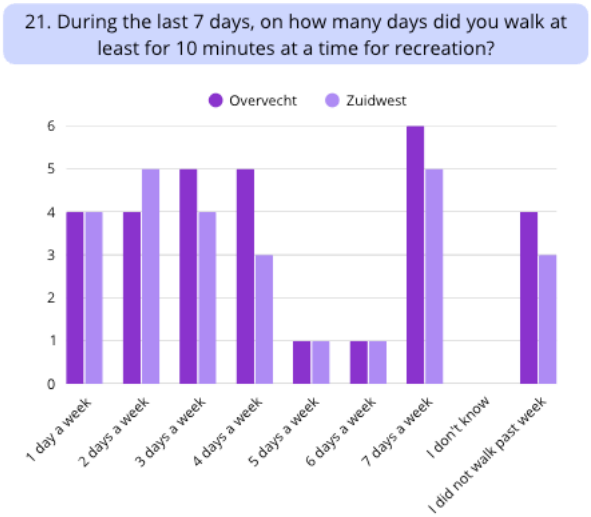


Alternative transport:

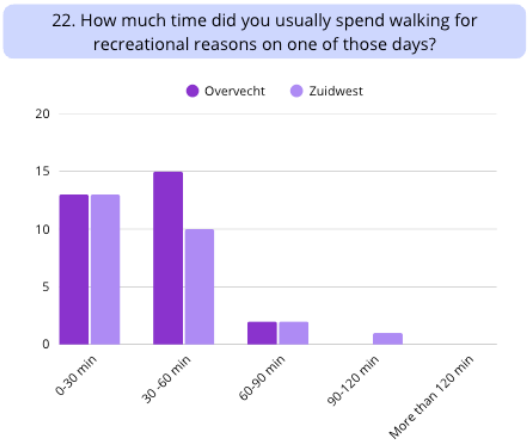
17) Shown in sociodemographic table in results
18) Shown in sociodemographic table in results
19) Shown in sociodemographic table in results
20) Shown in sociodemographic table in results

Self-reported frequency

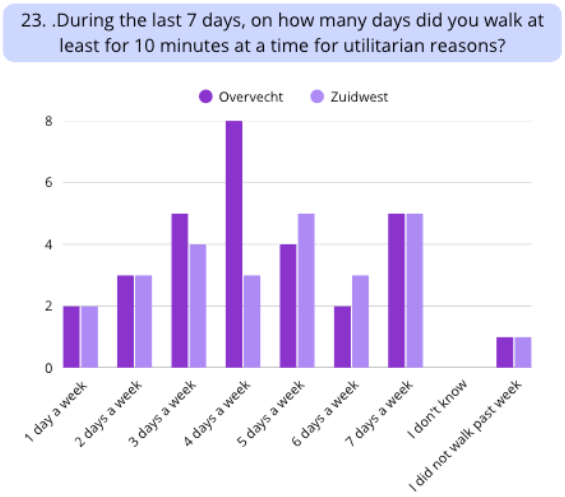
21)



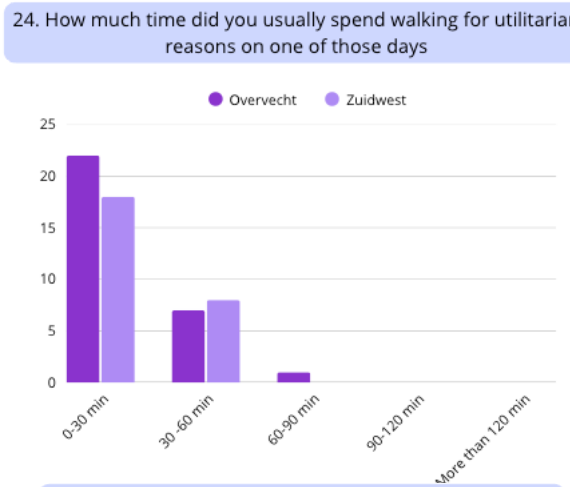
22)


22. How much time did you usually spend walking for recreational reasons on one of those days?
Overvecht
Zuidwest
20
15
10
5
0
0-30 min
30 -60 min
60-90 min
90-120 min
More than 120 min

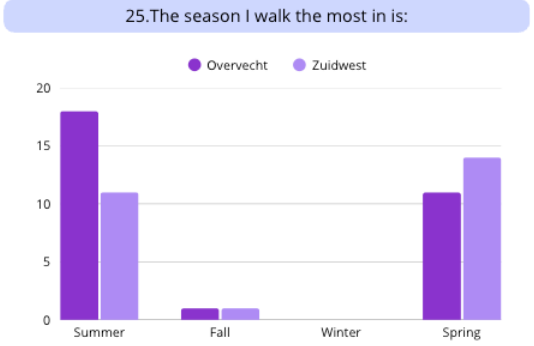
23)


23. .During the last 7 days, on how many days did you walk at least for 10 minutes at a time for utilitarian reasons?
Overvecht
Zuidwest
8
6
4
2
0
1 day a week
2 days a week
3 days a week
4 days a week
5 days a week
6 days a week
7 days a week
I don't know
I did not walk past week

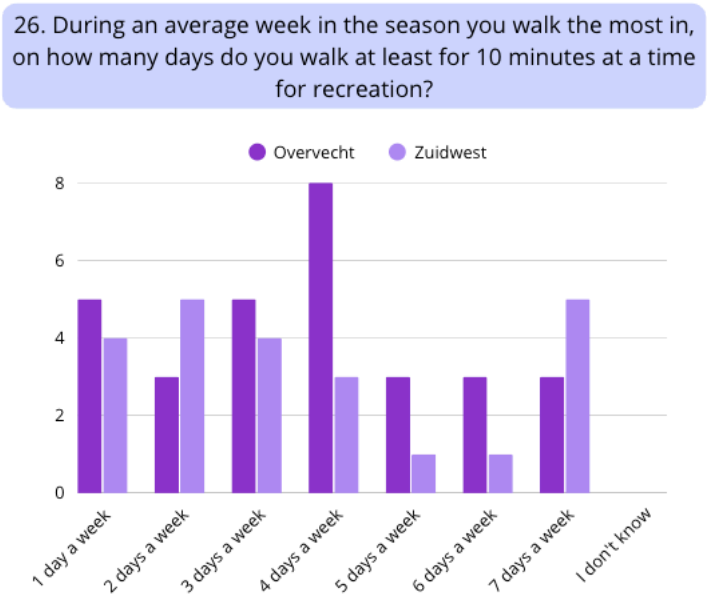
24)


24. How much time did you usually spend walking for utilitarian reasons on one of those days
Overvecht
Zuidwest
25
20
15
10
5
0
0-30 min
30 -60 min
60-90 min
90-120 min
More than 120 min

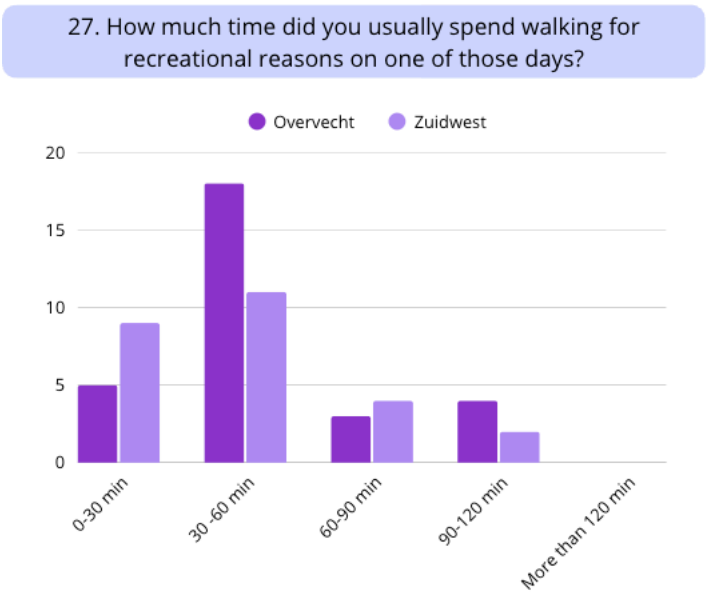
25)


25.The season I walk the most in is:
Overvecht
Zuidwest
20
15
10
5
0
Summer
Fall
Winter
Spring

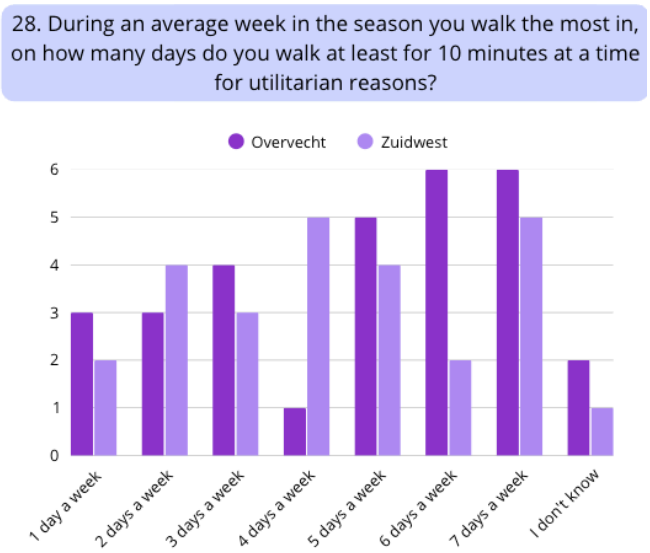
26)


26. During an average week in the season you walk the most in, on how many days do you walk at least for 10 minutes at a time for recreation?
Overvecht
Zuidwest
8
6
4
2
0
1 day a week
2 days a week
3 days a week
4 days a week
5 days a week
6 days a week
7 days a week
I don't know

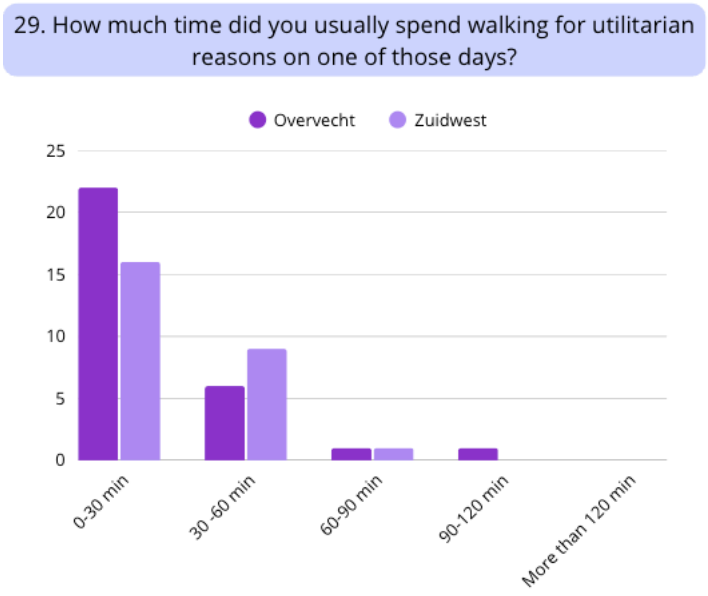
27)


27. How much time did you usually spend walking for recreational reasons on one of those days?
Overvecht
Zuidwest
20
15
10
5
0
0-30 min
30-60 min
60-90 min
90-120 min
More than 120 min

28)


28. During an average week in the season you walk the most in, on how many days do you walk at least for 10 minutes at a time for utilitarian reasons?
Overvecht
Zuidwest
6
5
4
3
2
1
0
1 day a week
2 days a week
3 days a week
4 days a week
5 days a week
6 days a week
7 days a week
I don't know

29)

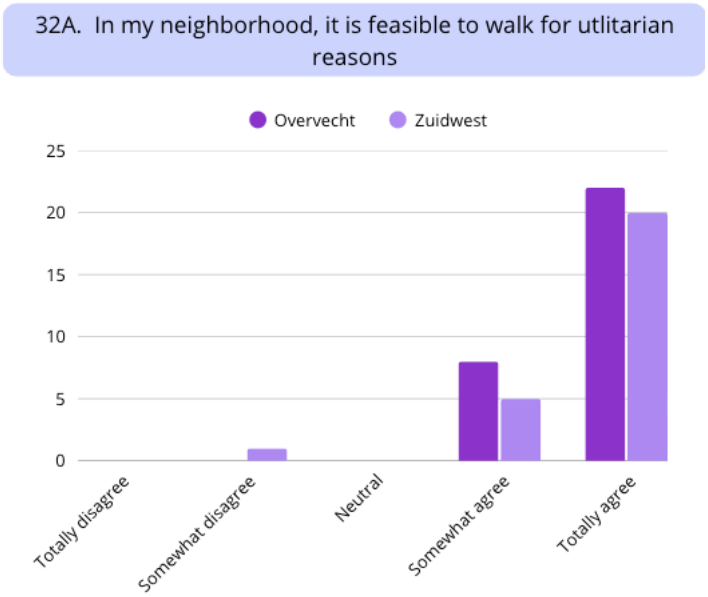


30) Dog ownership: Shown in sociodemographic table in results

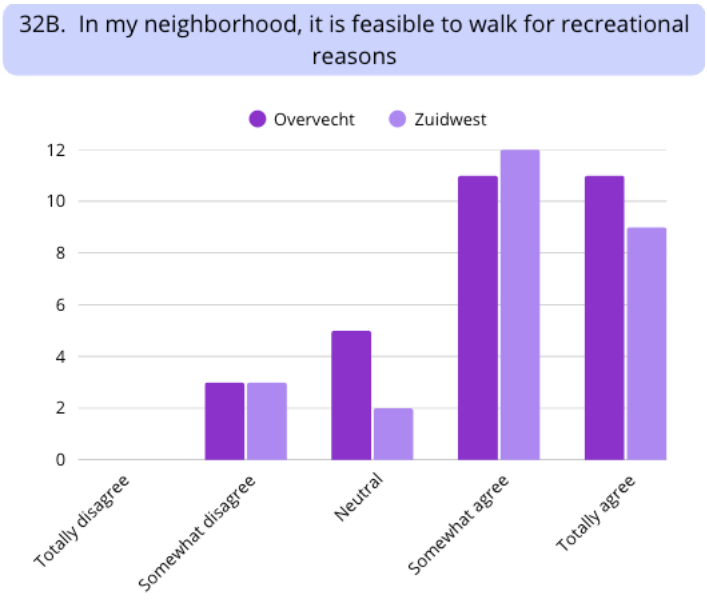
Survey results			
Question	**Variable**	**Category**	**N (%)**
31)	**Walking type**	**Utilitarian**	36 (64%)
		Recreational	20 (36%)

Perceived walkability

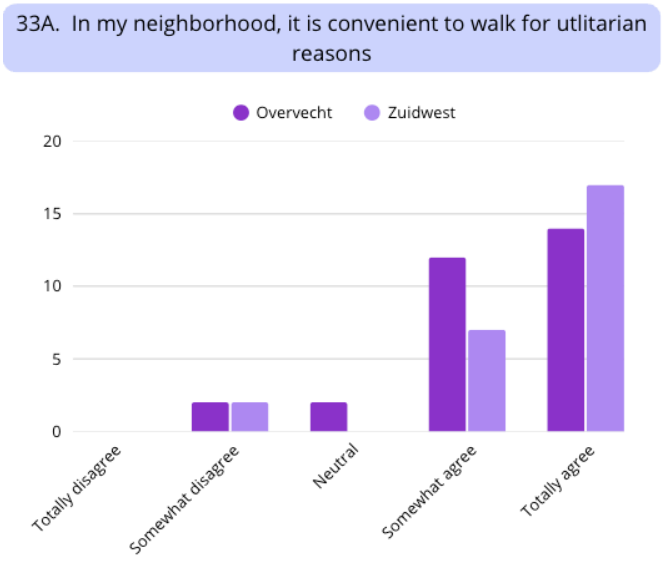
32A)



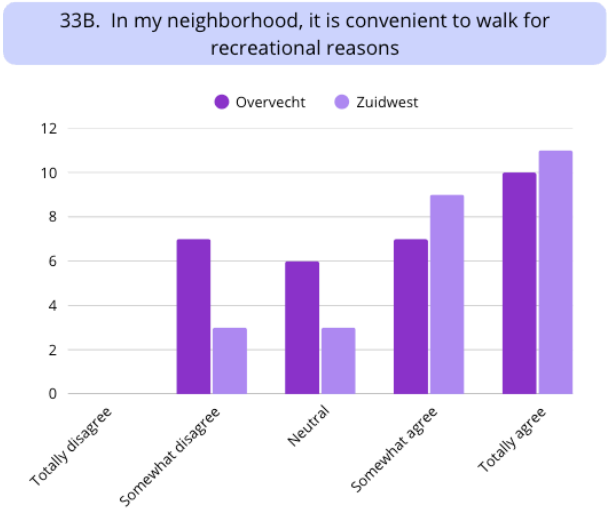
32B)


32B. In my neighborhood, it is feasible to walk for recreational reasons
Overvecht
Zuidwest
12
10
8
6
4
2
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

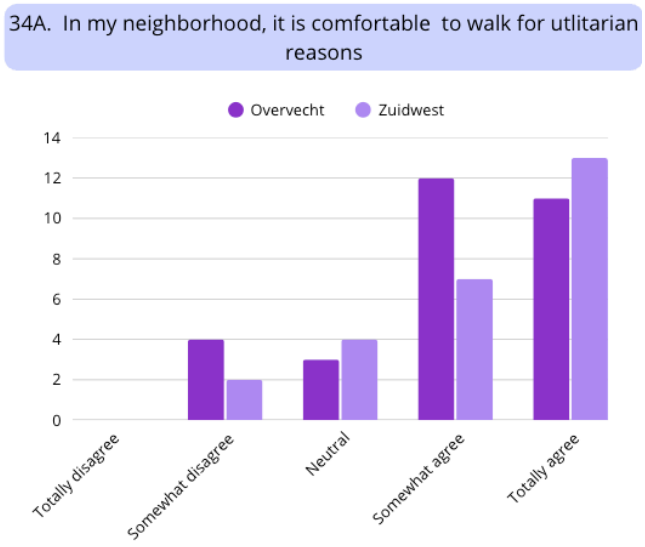
33A)


33A. In my neighborhood, it is convenient to walk for utlitarian reasons
Overvecht
Zuidwest
20
15
10
5
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

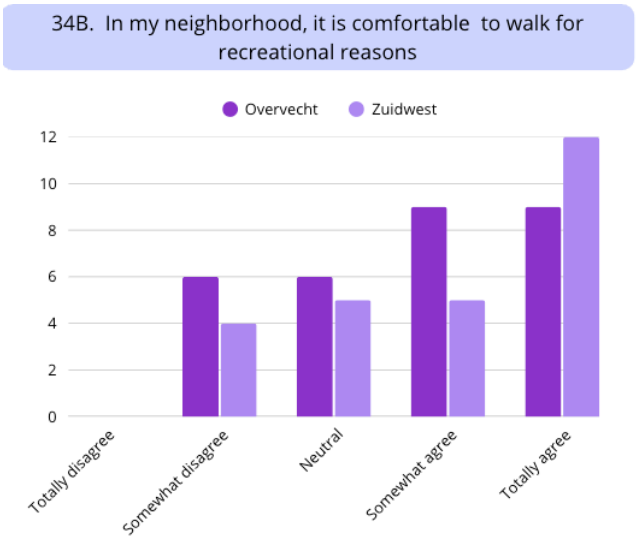
33B)


33B. In my neighborhood, it is convenient to walk for recreational reasons
Overvecht
Zuidwest
12
10
8
6
4
2
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

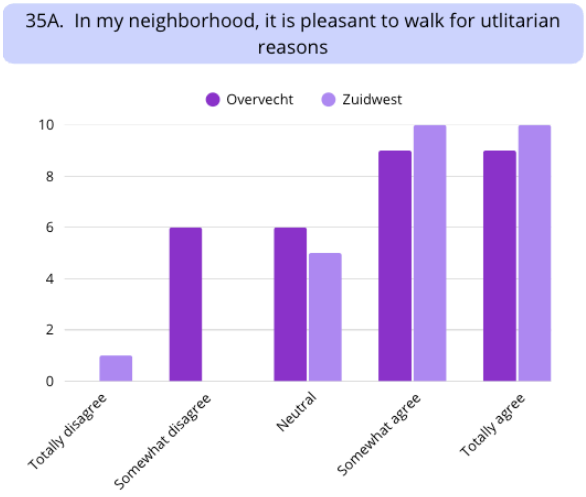
34A)


34A. In my neighborhood, it is comfortable to walk for utlitarian reasons
Overvecht
Zuidwest
14
12
10
8
6
4
2
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

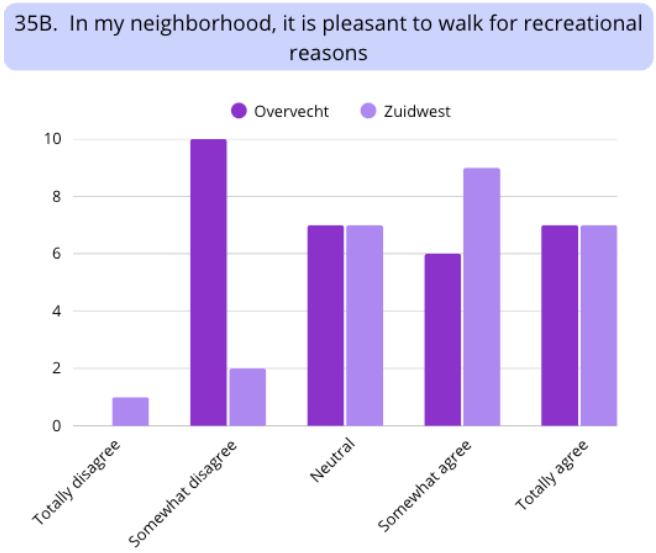
34B)


34B. In my neighborhood, it is comfortable to walk for recreational reasons
Overvecht
Zuidwest
12
10
8
6
4
2
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

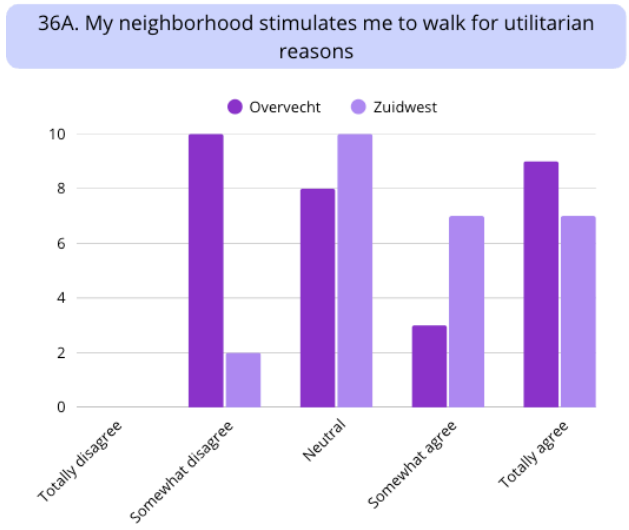
35A)


35A. In my neighborhood, it is pleasant to walk for utlitarian reasons
Overvecht
Zuidwest
10
8
6
4
2
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

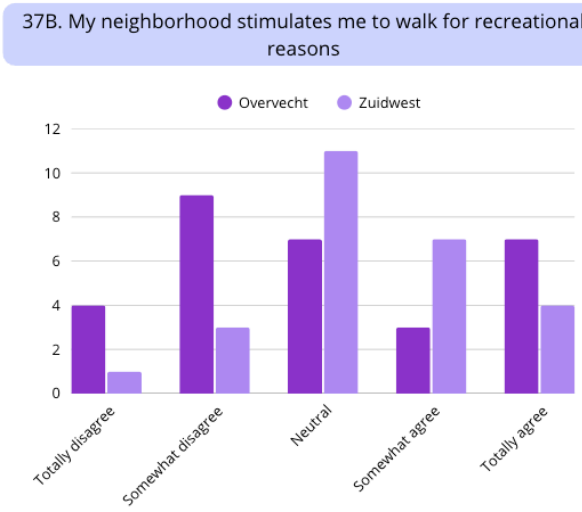
35B)


35B. In my neighborhood, it is pleasant to walk for recreational reasons
Overvecht
Zuidwest
10
8
6
4
2
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

36A)


36A. My neighborhood stimulates me to walk for utilitarian reasons
Overvecht
Zuidwest
10
8
6
4
2
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

37B)


37B. My neighborhood stimulates me to walk for recreational reasons
Overvecht
Zuidwest
12
10
8
6
4
2
0
Totally disagree
Somewhat disagree
Neutral
Somewhat agree
Totally agree

11.5 Appendix 5: Correlations Matrix

Correlations

		physicalaccess_mean	perceivedaccess_mean	walkfunctional_mean	walkrecreational_mean	Alternativetransport_score	Duration_mean	Frequency_mean	12a_Gezondheidsproblemen	12b_Geen_samenloop	12c_Geen_groene_gebieden	12d_Geen_bestemming	12e_veiligheid_persoonlijk	12f_veiligheid_verkeer	12g_trottoirs_slecht	12h_geen_schaduw	12i_anders	12j_tevreden
physicalaccess_mean	Pearson Correlation	1	.072	-.149	-.148	.143	-.222	-.009	-.274*	-.056	.077	.164	.042	.108	.157	-.056	-.027	.026
	Sig. (2-tailed)		.598	.272	.275	.293	.099	.946	.041	.680	.571	.227	.761	.429	.249	.680	.842	.849
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
perceivedaccess_mean	Pearson Correlation	.072	1	.384**	.352**	.091	-.006	.021	.014	-.125	-.228	-.258	-.143	-.151	-.180	-.334*	.094	.207
	Sig. (2-tailed)	.598		.003	.008	.503	.965	.879	.920	.357	.091	.055	.292	.268	.184	.012	.491	.126
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
walkfunctional_mean	Pearson Correlation	-.149	.384**	1	.807**	.012	-.052	.204	.171	-.023	-.360**	-.306*	-.423**	-.445**	-.382**	-.023	-.064	.375**
	Sig. (2-tailed)	.272	.003		<.001	.931	.701	.132	.208	.867	.006	.022	.001	<.001	.004	.867	.640	.004
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
walkrecreational_mean	Pearson Correlation	-.148	.352**	.807**	1	-.023	.064	.296*	.182	-.149	-.554**	-.263	-.346**	-.320*	-.214	-.259	-.152	.537**
	Sig. (2-tailed)	.275	.008	<.001		.866	.639	.027	.179	.274	<.001	.050	.009	.016	.114	.054	.264	<.001
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Alternativetransport_score	Pearson Correlation	.143	.091	.012	-.023	1	-.122	.110	-.256	-.142	-.152	.059	-.122	-.117	.084	-.028	.103	.164
	Sig. (2-tailed)	.293	.503	.931	.866		.369	.421	.057	.295	.264	.668	.371	.390	.540	.835	.452	.228
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56

Duration_mean	Pearson Correlation	-.222	-.006	-.052	.064	-.122	1	.211	.107	-.166	-.055	.116	.042	.186	-.052	-.098	-.164	.187
	Sig. (2-tailed)	.099	.965	.701	.639	.369		.119	.430	.221	.686	.396	.760	.170	.705	.474	.226	.167
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Frequency_mean	Pearson Correlation	-.009	.021	.204	.296*	.110	.211	1	-.087	.000	-.116	-.056	-.028	.090	.192	-.065	-.140	.215
	Sig. (2-tailed)	.946	.879	.132	.027	.421	.119		.523	1.000	.394	.682	.838	.511	.156	.632	.305	.112
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12a_Gezondheidsproblemen	Pearson Correlation	-.274*	.014	.171	.182	-.256	.107	-.087	1	-.018	-.074	-.037	-.047	-.037	-.032	-.018	-.051	-.174
	Sig. (2-tailed)	.041	.920	.208	.179	.057	.430	.523		.894	.587	.784	.732	.784	.814	.894	.709	.199
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12b_Geen_samenloop	Pearson Correlation	-.056	-.125	-.023	-.149	-.142	-.166	.000	-.018	1	.245	-.037	-.047	-.037	-.032	-.018	-.051	-.174
	Sig. (2-tailed)	.680	.357	.867	.274	.295	.221	1.000	.894		.069	.784	.732	.784	.814	.894	.709	.199
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12c_Geen_groene_gebieden	Pearson Correlation	.077	-.228	-.360**	-.554**	-.152	-.055	-.116	-.074	.245	1	.340*	.357**	.340*	.245	.245	-.080	-.710**
	Sig. (2-tailed)	.571	.091	.006	<.001	.264	.686	.394	.587	.069		.010	.007	.010	.069	.069	.558	<.001
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12d_Geen_bestemming	Pearson Correlation	.164	-.258	-.306*	-.263	.059	.116	-.056	-.037	-.037	.340*	1	.128	.462**	.242	.486**	.105	-.358**
	Sig. (2-tailed)	.227	.055	.022	.050	.668	.396	.682	.784	.784	.010		.347	<.001	.072	<.001	.442	.007
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12e_veiligheid_persoonlijk	Pearson Correlation	.042	-.143	-.423**	-.346**	-.122	.042	-.028	-.047	-.047	.357**	.128	1	.576**	.430**	-.047	-.131	-.447**
	Sig. (2-tailed)	.761	.292	.001	.009	.371	.760	.838	.732	.732	.007	.347		<.001	<.001	.732	.336	<.001
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56

12f_veiligheid_verkeer	Pearson Correlation	.108	-.151	-.445**	-.320*	-.117	.186	.090	-.037	-.037	.340*	.462**	.576**	1	.550**	-.037	-.105	-.358**
	Sig. (2-tailed)	.429	.268	<.001	.016	.390	.170	.511	.784	.784	.010	<.001	<.001		<.001	.784	.442	.007
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12g_trottoirs_slecht	Pearson Correlation	.157	-.180	-.382**	-.214	.084	-.052	.192	-.032	-.032	.245	.242	.430**	.550**	1	-.032	-.090	-.307*
	Sig. (2-tailed)	.249	.184	.004	.114	.540	.705	.156	.814	.814	.069	.072	<.001	<.001		.814	.510	.021
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12h_geen_schaduw	Pearson Correlation	-.056	-.334*	-.023	-.259	-.028	-.098	-.065	-.018	-.018	.245	.486**	-.047	-.037	-.032	1	-.051	-.174
	Sig. (2-tailed)	.680	.012	.867	.054	.835	.474	.632	.894	.894	.069	<.001	.732	.784	.814		.709	.199
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12i_anders	Pearson Correlation	-.027	.094	-.064	-.152	.103	-.164	-.140	-.051	-.051	-.080	.105	-.131	-.105	-.090	-.051	1	-.376**
	Sig. (2-tailed)	.842	.491	.640	.264	.452	.226	.305	.709	.709	.558	.442	.336	.442	.510	.709		.004
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
12j_tevrede	Pearson Correlation	.026	.207	.375**	.537**	.164	.187	.215	-.174	-.174	-.710**	-.358**	-.447**	-.358*	-.307*	-.174	-.376**	1
	Sig. (2-tailed)	.849	.126	.004	<.001	.228	.167	.112	.199	.199	<.001	.007	<.001	.007	.021	.199	.004	
	N	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

11.6 Appendix 6: Full Tables Statistical Tests

11.6.1 Full statistical results of the multiple linear regression with all variables predicting perceived walkability

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	3.340	1.068		3.126	.003		
	physicalaccess_mean	-.185	.159	-.144	-1.168	.250	.767	1.304
	perceivedaccess_mean	.460	.200	.280	2.299	**.027**	.788	1.269
	12a_Gezondheidsproblemen	.894	.840	.148	1.064	.294	.599	1.670
	12b_Geen_samenloop	-.444	.729	-.074	-.609	.546	.796	1.257
	12c_Geen_groene_gebieden	-.401	.409	-.212	-.980	.333	.249	4.024
	12d_Geen_bestemming	.525	.527	.170	.996	.325	.402	2.485
	12e_veiligheid_persoonlijk	-.328	.424	-.127	-.774	.444	.431	2.319
	12f_veiligheid_verkeer	-.594	.563	-.192	-1.054	.298	.352	2.838
	12g_trottoirs_slecht	-.349	.519	-.099	-.674	.504	.544	1.839
	12h_geen_schaduw	-.769	.896	-.128	-.858	.396	.526	1.899
	12i_anders	-.458	.434	-.190	-1.057	.297	.361	2.773
	12j_tevrede	.164	.471	.100	.348	.729	.143	7.004
	Alternativetransport_score	-.076	.082	-.113	-.929	.359	.789	1.267
	Frequency_mean	.153	.063	.297	2.450	**.019**	.791	1.264
	Duration_mean	-.256	.214	-.158	-1.192	.240	.663	1.507
	31._Welke_vorm_van_lopen_doet_u_het_meeste?	-.120	.218	-.072	-.552	.584	.680	1.470

a. Dependent Variable: perceivedwalkability_mean

11.6.2 Statistical results of the multiple linear regression choice to use on perceived walkability

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.278[a]	.077	.024	.79496

a. Predictors: (Constant), Frequency_mean, Alternativetransport_score, Duration_mean

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.748	3	.916	1.450	.239[b]
	Residual	32.862	52	.632		
	Total	35.610	55			

a. Dependent Variable: perceivedwalkability_mean

b. Predictors: (Constant), Frequency_mean, Alternativetransport_score, Duration_mean

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.507	.471		7.443	<.001
	Alternativetransport_score	-.031	.091	-.046	-.343	.733
	Duration_mean	-.080	.223	-.050	-.361	.720
	Frequency_mean	.148	.071	.286	2.081	**.042**

a. Dependent Variable: perceivedwalkability_mean

11.6.3 Full table of the statistical results of access on perceived walkability

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.207	.979		3.274	.002
	physicalaccess_mean	-.152	.157	-.118	-.970	.337
	perceivedaccess_mean	.457	.205	.278	2.232	**.031**
	12a_Gezondheidsproblemen	.765	.831	.127	.920	.363
	12b_Geen_samenloop	-.075	.727	-.012	-.103	.919
	12c_Geen_groene_gebieden	-.480	.412	-.254	-1.165	.251
	12d_Geen_bestemming	.217	.517	.070	.420	.677
	12e_veiligheid_persoonlijk	-.367	.427	-.142	-.858	.396
	12f_veiligheid_verkeer	-.545	.551	-.176	-.989	.328
	12g_trottoirs_slecht	-.036	.497	-.010	-.073	.942
	12h_geen_schaduw	-.349	.891	-.058	-.392	.697
	12i_anders	-.426	.435	-.177	-.979	.333
	12j_tevrede	.160	.464	.097	.345	.731

b. Dependent Variable: perceivedwalkability_mean

11.6.4 Statistical results of influence motivation for walking on perceived walkability

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.039[a]	.002	-.017	.81144

a. Predictors: (Constant), 31._Welke_vorm_van_lopen_doet_u_het_meeste?

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.054	1	.054	.083	.775[b]
	Residual	35.555	54	.658		
	Total	35.610	55			

a. Dependent Variable: perceivedwalkability_mean

b. Predictors: (Constant), 31._Welke_vorm_van_lopen_doet_u_het_meeste?

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.875	.135		28.653	<.001
	31._Welke_vorm_van_lopen_doet_u_het_meeste?	.065	.226	.039	.287	.775

a. Dependent Variable: perceivedwalkability_mean