The influence of different types of greenery in Dutch population's leisure activities

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To Roberto and Kátia. Wherever you are, know that your legacy remains alive in our hearts.

Preface

Dear reader,

Here I present my master thesis to you. It is the result of months of study and dedication, and it represents not only the end of my studies, but also the end, at least for now, of my journey in the Netherlands.

The year of 2020 will be stamped in my memory as the most challenging year of my life. It was the year in which we had to learn how to live, love and take care of ourselves again. The year of losses and reconstruction. But personally, it was the year in which I could finally achieve one of my biggest goals in life, that I dreamed of since I was in high school: to study and live abroad. So, finishing my masters in Spatial Planning at Radboud University represents much more than a diploma to me, but also a proof to myself that dreams come true if we dedicate ourselves enough and put our hearts in it.

Concerning the content of this thesis, I did my best to address one of the themes that interest me the most: the importance of greenery and nature for human beings' daily lives. Most literature available about greenery focus on its importance for other species, but it is equally important to debate its importance for human beings, after all, we are the main responsible for its destruction and, at the same time, restoration. Therefore, to place humans in the center of this analysis is to show our role, as individuals and as society, in keeping our environment (and ourselves) healthy and alive.

The process of writing this thesis was a challenge for me, and I would like to thank my supervisor, Huub Ploegmakers, for guiding me through this journey. His patience and valuable advice about statistics were essential for me to achieve the results. I would also like to thank all the friends that I made in the Netherlands, especially my dear friend Justina, which was also my study buddy and kept me going even when I did not have the strength to do so, and my "musketeers" Mauricio and Ricky, that make me feel that I will always have a family in them. Finally, I thank my Brazilian friends for all the videocalls and demonstrations of love, and my family for their unconditional support… It is because of you that I am who I am today.

I hope the reading is pleasant and that it can give you good insights.

Stay safe,
Sabrina do Nascimento Cordeiro

Abstract

The aim of this research is to contribute to the knowledge about the importance of different types of greenery for the performance of leisure activities and for the increase of the health and the quality of life of the Dutch population. To verify this relationship, two hypotheses were elaborated: a) People that live in greener neighborhoods are more likely to perform leisure activities than people who do not; and b) People that live in greener neighborhoods spend more time walking and cycling for leisure purposes than people who do not. To test both hypotheses, a secondary data survey was performed for the period of 2010 to 2019 based on the information collected from the OViN and ODiN mobility surveys. In total, 256,059 individuals were considered for the analysis, and the amount of different types of greenery within the radiuses of 1, 3 and 5 kilometers around the centroid of each individual' postal code was calculated. A binary logistic regression and a zero-inflated negative binomial regression were performed with controls for socio-demographic characteristics, and through the analysis of both models, it was observed that greenery, in general, is a highly statistically significant element in predicting the likelihood of performing leisure activities and the time spent walking and cycling during these activities, although this relation is weak and differs according to the type of greenery. While the influence of Ecological Network, specifically, could not be determined in this analysis, the influence of Green Infrastructure could be measured mainly by two categories of greenery, Urban Green Areas and Percentage of Green. For all radiuses of analysis, Urban Green Areas presented negative influence in people's odds to perform leisure activities, and Green Percentage presented positive influence on it. Concerning the time spent walking and cycling during these activities, Urban Green Spaces presented a weak positive influence in the time spent during cycling, whilst for walking and the total time spent during leisure activities Green Percentage presented a weak negative influence and Urban Green Spaces presented a weak positive influence on it. In summary, it was not possible to confirm the hypothesis of this research due to the different results that were obtained, and for future research it is recommended that other aspects regarding people's personal preferences and their immediate environment are collected to provide a broader view of the elements that directly influence people's behavior concerning leisure activities.

Keywords: Ecological Network; Green Infrastructure; Leisure activities; Dutch population.

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List of Abbreviations

AIC	Aikaike Information Criterion
BBG	Bestand bodemgebruik
CBS	Centraal Bureau voor de Statistiek
EN	Ecological Network
GI	Green Infrastructure
ILG	Investment Budget for Rural Areas
NOK	Natuurmeting op Kaart
ODiN	Onderweg in Nederland
OViN	Onderzoek Verplaatsingen in Nederland
Pc4	Postcode
PCB	Perceived Behavioral Control
RIVM	Rijksinstituut voor Volksgezondheid en Milieu
SC	Stages of Change
SCT	Social Cognitive Theory
SD	Standard Deviation
SLT	Social Learning Theory
SS	Social Support
TPB	Theory of Planned Behavior
TTM	Transtheoretical Model
VRN	Voortgangsrapportage Natuur

Table of Content

1. Introduction

The origins of the concept of green infrastructure (GI) are attributed to the work of Frederick Law Olmsted, more than a hundred years ago (McMahon & Benedict, 2000), and it can be defined as an "interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations" (Benedict & McMahon, 2002, p. 12). Ecological network (EN), on the other hand, is a term that can be used in a variety of contexts and scales to indicate different concepts (Boitani, Falcucci, Maiorano, & Rondinini, 2007). Nevertheless, it can be broadly defined as a network of nature reserves and their interconnections that make a fragmented natural system consistent to support more biodiversity than its non-connected form (Pryke & Samways, 2015). Because of its focus on biodiversity's integrity, EN can be framed as a component of GI, and, therefore, refers to specific landscape's elements, such as core areas, nature development areas and corridors (Beunen & Hagens, 2009).

The importance of GI for human health has been well documented in the literature, mainly by the analysis of green spaces. Defined as "all publicly owned and publicly accessible open space with a high degree of cover by vegetation" (Hunter *et al.*, 2015, p. 247), green spaces are recognized as having positive effects on people's health (Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Maas *et al.*, 2009), especially considering its positive association with physical activity (Ball, Bauman, Leslie, & Owen, 2001; Hunter *et al.*, 2015; Sallis, Johnson, Calfas, Caparosa, & Nichols, 1997; Wendel-Vos *et al.*, 2004), reduction of stress (Arnberger & Eder, 2015; Nielsen & Hansen, 2007) and negative association with antidepressant prescription rates (Helbich, Klein, Roberts, Hagedoorn, & Groenewegen, 2018).

Notwithstanding the importance of GI for enhancing human health through physical activity is highly recognized, there is still a gap in the literature concerning the specific EN's role in this context. The significance of EN is already acknowledged for the provision of ecosystem services such as the maintenance of biodiversity, production of ecosystem goods, provision of life-support functions such as cleansing, recycling and renewal, and their aesthetic and cultural benefits (Daily, 1997). At the same time, an investigation about the relevance of these spaces for the population's daily lives and health, more specifically about their influence in physical activity, is still needed, and this research aims to fill this gap. Therefore, this research aims to explore the relevance of GI in general, and EN, in particular, for Dutch population's quality of life, and, to achieve that, an analysis of people's leisure activities patterns will be performed by means of a survey.

Based on the literature about the importance of green infrastructure for people's physical activities patterns and health, it is hypothesized in this research that: a) People that live in greener neighborhoods are more likely to perform leisure activities than people who do not; and b) People that live in greener neighborhoods spend more time walking and cycling for leisure purposes than people who do not. The two hypotheses that guide this research are also in accordance with the phenomenon on Distance Decay, already observed in previous studies (Coles & Bussey, 2000; Hörnsten & Fredman, 2000; Maas, Verheij, Spreeuwenberg, & Groenewegen, 2008; Nielsen & Hansen, 2007). This phenomenon describes the effects of distance on interactions between two separate locations and is an important precept of spatial analysis (Pun-Cheng, 2017).

In a study made by Coles and Bussey (2000) it was discovered that residents of Redditch, a district in the UK, prefer local woods in a 5-minute walk from home, where a preferred “home range location" was discovered. Hörnsten and Fredman (2000), through a survey made with Swedish population, had a similar result, and found out that over 40% of the population would prefer a shorter distance from their homes to the forest, and for those who live further from forested areas, distance can be a barrier and even inhibit visits. Nielsen and Hansen (2007) found the association between distance and use of outdoor spaces especially in residential areas. Similarly, Maas and colleagues (2008) also discovered that green spaces close to people's homes appeared to be more important in explaining individual's level of physical activity than green spaces further away. In summary, not only the availability of greenery in the neighborhood, but also the distance from people's dwellings to those spaces are especially relevant for this research and will be explored in the analysis.

1.1. Research Aim and Research Questions

The aim of this research is to contribute to the knowledge about the importance of Green Infrastructure and Ecological Network for the performance of leisure activities and for the increase of the health and the quality of life of the Dutch population. More specifically, it intends to determine if greener neighborhoods positively influence the leisure activities' patterns of the local population and the time spent walking or cycling during these activities. Based on the research aim, this study intends to address the main research question:

What is the influence of different types of greenery on Dutch population' behavior patterns concerning leisure activities?

In order to properly respond to the main research question, the following sub-questions were elaborated:

- Are people who live in greener neighborhoods more likely to perform leisure activities than people who do not?
- Do people who live in greener neighborhoods spend more time walking and cycling when performing leisure activities?

To answer the first sub-question, an analysis of the greenery' availability in people's neighborhood, combined with the frequency of the leisure activities performed outdoors by the local population will be performed. Similarly, the second sub-question will be answered by an analysis of the amount of time spent walking and cycling during leisure activities and the availability of greenery next to people's dwellings.

By answering the sub-questions, this research aims to present an overview of the population's leisure activities patterns, and specially determine in which ways different types of greenery influence the performance of leisure activities within the Dutch neighborhoods.

1.2. Scientific Relevance

Green infrastructure has a positive contribution to public health, with potential psychological, physical, economic, social, and environmental benefits (Hunter *et al.*, 2015). The literature provides evidence of this contribution, and in the Netherlands the investigation of the relation between green spaces in people's living environments and health is present in studies such as Maas and colleagues (2006, 2009), de Vries (2004), and Helbich *et al.* (2008).

Maas and colleagues (2006) discovered that Dutch greener neighborhoods resulted in a greater sensation of health for the residents. Their research showed that 15.5% of the studied residents felt unhealthy living in places where 10% of the environment was green, while only 10.2% had the same sensation comparing with a percentage of 90% of green. Similar to those findings, de Vries (2004) noticed that independently of the category of green (agriculture field or native nature, for example), the exposure to the amount of local green was a mediator factor for health, and this relation was stronger for groups that in general spend more time at home, such as housewives and the elderly.

The relation between health and green infrastructure can also be measured by the absence of illnesses in the population. In a research about morbidity carried by Maas and colleagues (2009), it was discovered that the annual prevalence rate of 15 of the 24 disease clusters studied by the researchers was lower in living spaces with more green spaces. This relation was especially stronger for anxiety disorder and depression, similarly to the findings of Helbich and colleagues (2018), that suggested that more green space is negatively associated with antidepressant prescription rates. Statistical results achieved by Nielsen and Hansen (2007) in Denmark also indicated the association between less stress rates, lower likelihood of obesity and facilitated access to gardens and short distances to green areas from people's dwelling.

The positive influence of green spaces in people's health can also be associated with physical activity, especially considering the capacity that physical environments have in facilitating or obstructing it. Considered the least studied potential determinants of physical activity (Sallis *et al*., 1997), physical environments have been increasingly recognized in the last decades as important elements for the performance of physical activities, along with psychological factors (Ball *et al*., 2001).

In a systematic review of 12 studies carried out by Hunter and colleagues (2015), physical activity was positively associated with proximity, access, size and quality of urban green spaces. Concerning the first item, Giles-Corti and Donovan (2002), in a study about the Australian population, and Sallis and colleagues (1997) in a study carried with united-statian college students, obtained positive correlation between the proximity of the recreational facilities and physical activity. The importance of the amount of green spaces available in the neighborhood was also identified by Wendel-vos *et al*. (2004), in a study about the population of Maastricht. It was concluded that this factor positively influenced the participant's time spent on cycling.

The quality and aesthetics of green infrastructure are also important elements that influence people to be physically active. Maas and colleagues (2008) concluded that people in the Netherlands are inclined to perform physical activities in aesthetically appealing environments, and, in green spaces that present these characteristics people are more stimulated not only to perform activities such as walking and cycling, but also to spend more time on them. Similar results were found in Australia (Ball *et al*., 2001) and Austria (Arnberger & Eder, 2015). The direct influence of environmental attributes in walking for exercise was found by Ball and colleagues (2001), while in the study of Arnberger and Eder (2015), it was proved that the visitors preferred visually accessible green areas of medium size when visiting green spaces. Therefore, interventions in these spaces are seen by the studied authors as relevant to encourage physical activity behavior change of the population.

To conclude, by the analysis of the literature, it is possible to say that there is a positive influence of GI in physical activity and health. It is also important to notice that, although there is a consolidated literature about the influence of green spaces in general, no literature was found specifically about the importance of ecological relevant sites for physical activity and recreation. Most of the literature concerning EN comprehends its importance in providing ecosystem services, lacking deeper analysis of its direct influence in people's behavior and daily lives, which explains the relevance of this research. In this context, this study aims to contribute to the knowledge about the relevance of both GI and EN for human's quality of life. Specially concerning EN, it is expected that its implementation can equally benefit the animal and vegetal populations that live in these spaces and also the surrounding human population. Through the analysis of the Dutch population's leisure activities patterns in relation to the amount of greenery available in their neighborhood, it is expected to discover if these sites are, in fact, relevant for the population's physical activities, and consequently, health.

Another relevant aspect of the present study is its spatial dimension, which aims to clarify the importance of the dispersion of green spaces in the territory in order to encourage people performing leisure activities in outdoor spaces. Although two of the studies described in this review (Giles-Corti & Donovan, 2002; Nielsen & Hansen, 2007) included in their analyses the localization of people's physical activities, associating them to the available local green spaces, it is possible to note that this association remains missing in a significant part of the literature in the Netherlands (Maas *et al*., 2008; Wendel-vos *et al*., 2004) and abroad (Ball *et al*., 2001; Hunter *et al*., 2015). Therefore, this is a gap in the analyzed literature that the present research also aims to fill. A correlation between people's leisure activities and the green spaces in their neighborhood can help understanding the importance of these sites for the performance of physical activities.

2. Literature Review and Theoretical Framework

In this section a brief literature review is presented, containing the main theories used in previous research to explain physical activity and health behavior change. The relationship between physical environment, physical activity and health will also be addressed. By the end of the section, it will be possible to understand the reasons that led to the choice of the Social Ecology theory to guide the analysis of the results obtained in this research.

2.1. Identification of the Main Theoretical Approaches

The relationship between physical environment, physical activity and health is well documented in both Dutch and international literature, as already presented in section 1.2. In this section, a specific analysis of the theories behind this interaction will be presented, based on the identification of the theoretical frameworks presented in nineteen articles analyzed (Arnberger & Eder, 2015; Ball *et al.*, 2001; de Vries, 2004; Giles-Corti & Donovan, 2002; Helbich *et al.*, 2018; Hunter *et al.*, 2015; King, Stokols, Talen, Brassington, & Killingsworth, 2002; Maas *et al*., 2006, 2008, 2009; Nielsen & Hansen, 2007; Orstad, McDonough, Stapleton, Altincekic, & Troped, 2017; Peters *et al*., 2020; Pikora, Giles-Corti, Bull, Jamrozik, & Donovan, 2003; Sallis *et al*., 1997; Sallis, Bauman, & Pratt, 1998; Van Cauwenberg *et al.*, 2011; Wendel-vos *et al*., 2004; Yen, Michael, & Perdue, 2009).

From the totality of the articles, only ten (53%) (Ball *et al.*, 2001; Giles-Corti & Donovan, 2002; King *et al*., 2002; Orstad *et al*., 2017; Peters *et al*., 2020; Pikora *et al*., 2003; Sallis *et al*., 1997, 1998; Van Cauwenberg *et al.*, 2011; Yen *et al*., 2009) provided a clear theoretical framework, and were used to identify the most relevant theories in this field. Through the analysis of the literature, it was possible to identify two main approaches that explain, in general, physical activity and health behavior: the personal-level perspectives and the environment-influenced perspectives, that also consider the physical environment as important element for encouraging physical activity. Details about these approaches will be presented on the next subsections.

2.1.1. Personal-level Perspectives

The majority of the theories used by the literature to explain physical activity patterns are part of the personal-level perspectives, that focus primarily on the cognitive, affective and social influences surrounding the individual and his/her choice to be active (King *et al.*, 2002). Within the articles analyzed for this review, the most cited theories in this field were Social

Cognitive Theory (King *et al*., 2002; Orstad *et al*., 2017; Sallis *et al.*, 1997; Van Cauwenberg *et al.*, 2011; Yen *et al*., 2009), Social Learning Theory (Sallis *et al*., 1998), Theory of Planned Behavior (Giles-Corti & Donovan, 2002; King *et al*., 2002; Orstad *et al*., 2017), Transtheoretical Model (King *et al*., 2002; Orstad *et al*., 2017), Social Cohesion (Orstad et al., 2017), Social Support (Giles-Corti & Donovan, 2002; Orstad *et al*., 2017; Yen *et al*., 2009) and Collective Efficacy (Yen *et al*., 2009).

2.1.1.1. Transtheoretical Model

The Transtheoretical Model (TTM) is one of the most commonly used theoretical frameworks for physical activity and health behavior change (de Menezes, Bedeschi, dos Santos, & Lopes, 2016; Hutchison, Breckon, & Johnston, 2009). It uses a temporal dimension, known as stages of change (SC), to integrate processes and principles of change from different theories of intervention, hereinafter the name transtheoretical (Jo & Velicer, 1997).

The model has four pillars. The first is the SC, that represents the individual's motivation and promptness of change. Progression in behavior change is measured by the other three components of the model, which are decisional balance, self-efficacy, and processes of change (de Menezes *et al.*, 2016). Decisional balance refers to the individual's perception of the benefits and disadvantages of modifying behavior, self-efficacy is the confidence that the individual has in his ability to adopt new behaviors and, at last, the processes of change contain cognitive, experimental, and behavioral strategies that encourage the progression across stages (de Menezes *et al.*, 2016).

2.1.1.2. Planned Behavior

The Theory of Planned Behavior (TPB) is one of the most used theories to explain the factors that influence health-related behaviors (McEachan, Conner, Taylor, & Lawton, 2011). The central idea of this theory is that there are two main factors that codetermine the performance of any behavior, which are behavior intention and perceived behavioral control (PCB) (Armitage, 2005). Behavior intention is the representation of people's will, and reflects people's motivation to engage in a behavior, while PCB reflects people's confidence in their ability to perform a particular behavior (Armitage, 2005; Conner, 2020). The interplay between these factors shapes people's behaviors.

The importance of TPB is also recognized for the analysis of behaviors such as physical activity and sports participation (Conner, 2020). The theory allows the understanding of many different behaviors related to these activities, although there are still external influences that may not be completely captured by its components due to the complex social environment in which people are inserted (Conner, 2020).

2.1.1.3. Social Support

Social Support (SS) is “any activity on the part of one individual which aids another individual in reaching desired goals” (Treiber *et al*., 1991, p. 738). It has been recognized as a predictor of health behaviors, having a direct effect on people’s physical activity patterns and well-being (Mowen, Orsega-Smith, Payne, Ainsworth, & Godbey, 2007).

There are two main sources of SS that influence physical activity, which are familiar support and friends support (Treiber *et al*., 1991). Literature suggests that the type and source of SS are important for physical activity in general (Haughton McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006; Mowen *et al*., 2007; Teixeira, Carraça, Markland, Silva, & Ryan, 2012; Treiber *et al*., 1991), and particularly for leisure time physical activities. According to a study conducted by Smith, Banting, Eime, O’Sullivan e Van Uffelen (2017), when measured separated from other types of physical activities, leisure time physical activities were associated with SS in a greater percentage of studies than when different types of physical activities were measured together.

2.1.1.4. Social Cohesion

Social Cohesion can be defined as an equivalent of a sense of community, with a focus on trust, positive friendly relationships, and the feeling of belonging (de Vries, Van Dillen, Groenewegen, & Spreeuwenberg, 2013). It is one aspect of the social environment of a neighborhood that has the potential to influence individual health and health-related behaviors such as physical activity, because it can contribute to physical activity in different ways (Cradock, Kawachi, Colditz, Gortmaker, & Buka, 2009; Yip, Sarma, & Wilk, 2016). At the neighborhood level, high levels of social cohesion are associated with lower crime rates, encouraging the individual’s involvement in physical activity, and at the individual level, the social connection with the neighborhood makes the individual more likely to take advantage of local opportunities to perform physical activity (Yip *et al*., 2016).

2.1.1.5. Collective Efficacy

Collective Efficacy is a measurement of neighborhood social capital and corresponds to the individual’s perceptions about the social cohesion that exists among neighbors combined with the willingness to intervene aiming for the common good (Cohen, Inagami, & Finch, 2008). It is one of the most studied psychosocial constructs due to its implications for performance and involves behaviors and interactions among neighbors or members of a group (Zumeta, Oriol, Telletxea, Amutio, & Basabe, 2015). Lower levels of collective efficacy have been associated in the literature with obesity in children and adolescents and with higher incidence of crime (Cohen *et al*., 2008). On the other hand, higher levels of collective efficacy were positively associated with features of the environment such as parks, as found in a study carried by Cohen and colleagues (2008).

2.1.1.6. Social Learning and Social Cognitive Theory

The Social Learning Theory (SLT) presupposes that the individuals learn from their interactions with others in a social context and is the most influential theory of learning and development (Nabavi, 2012). This theory differentiates itself from behavior theories because it argues that learning can occur without a change in behavior (Nabavi, 2012).

The Social Cognitive Theory (SCT) evolved from the SLT and is focused on a more comprehensive overview of human cognition within social learning, providing a structure to understand, predict and change human behavior (Nabavi, 2012). In the context of physical activity and health behavior, one’s habits of exercise might influence his associated friends (Hofstetter, Hovell, & Sallis, 1990). This interaction can reinforce continued exercise activity or self-efficacy, one of the most powerful mediators of behavior performance, and thus, central for SCT (Hofstetter *et al*., 1990).

2.1.2. Environment-influenced Perspectives

Differently from the personal-level perspectives, that ground their understanding of behavior change mostly through the analysis of social interactions and self-motivation, theories that have focused in the dynamic interplay between intrapersonal factors and the immediate environmental influences have gained increasing support in explaining individual’s choice to be physically active (King *et al*., 2002). This can be verified by the fact that all the selected articles (Arnberger & Eder, 2015; Ball *et al*., 2001; de Vries, 2002; Giles-Corti & Donovan, 2002; Helbich *et al*., 2008; Hunter *et al*., 2015; King *et al*., 2002; Maas *et al*., 2006, 2008, 2009; Nielsen & Hansen, 2007; Orstad *et al*., 2017; Peters *et al*., 2020; Pikora *et al*., 2003; Sallis *et al*., 1997, 1998; Van Cauwenberg *et al*., 2011; Wendel-vos *et al*., 2004; Yen *et al*., 2009) mentioned the importance of social ecological models in this context. The theory of Utility Maximization, although not explicitly mentioned in the previous literature reviewed for this research, will also be presented in this section due to its importance for explaining individual's decision-making.

2.1.2.1. Utility Maximization

The Utility Maximization concept in economics is almost as old as economics itself (Gilad, Kaish, & Loeb, 1987). This theory determines that a change in behavior is brought about by a change in the optimal solution to the choice variable(s), and the individual is always aiming to maximize the utility (or benefits) of his choices (Gilad *et al*., 1987).

Applied to the field of mobility, the Utility Maximization theory implies that each choice of destination or mode results in utility for the traveler, and the model estimates the probability of a certain choice, supported by the utility of that choice relative to the utility of all choices (Handy, Boarnet, Ewing, & Killingsworth, 2002). Previous models proved that travel time is the most significant predictor of mode choice, and that for walking and biking, the quality of the travel experience, including safety and aesthetics are also relevant components of utility for the traveler (Handy *et al*., 2002).

2.1.2.2. Social Ecology

The field of social ecology has its origins in the mid-1960s, and it differentiates itself from human ecology because of its focus on the social, institutional, and cultural aspects of people's environmental relations (Stokols, 1996). The basic assumption of this theory is that healthfulness is a phenomenon that encompasses physical health, emotional well-being, and social cohesion (Stokols, 1992).

Differently from most of the health promotion research that focuses on identifying personal behaviors that enhance physical health, the ecological perspective sees health promotion not only as an individual behavior, but as a dynamic transaction between individuals, groups, and their socio physical ambience (Stokols, 1992). This premise is central in the social ecology theory, and this characteristic demonstrates why this theory is broadly used for explaining the determinants of physical activity. According to Stokols (1992), exposure to "certain environmental conditions such as natural, aesthetic, and symbolic amenities can alleviate stress and promote physical and emotional well-being" (p. 13), which supports the importance of ecological infrastructure for the health of the population that make use of them.

The socio ecological model acknowledges that behavior can be influenced by social, physical, and interpersonal environments (Sallis *et al*., 1997), and it proposes a combination of behavior change strategies and environmental protection programs in order to make the design and management of environmental settings more efficient (Stokols, 1992). This conception endorses the mutual influence that people and the environment have on each other, and the importance to combine both environmental services and people's behavioral changes in order to provide more functional green spaces.

2.2. Conceptual Framework

There are four main elements that influence physical activity and health behavior change, namely cognitive, affective, social, and environmental factors. The personal-level perspectives, such as Social Learning, Social Cognitive Theory, Transtheoretical Model, Planned Behavior, Social Cohesion, Social Support and Collective Efficacy, although relevant to explain behavior change through social interactions and self-motivation, miss an important element of analysis, that is the influence of the physical environment in this context. In this research, the main focus of analysis is precisely the influence of the physical environment in people's choices, therefore the environment-influenced perspectives are more adequate to guide our findings.

Within the environment-influenced perspectives, the economic character of the Theory of Utility Maximization does not chain with the focus of the present research. The Social Ecology theory, on the other hand, has the best fit because it places the physical environment as the central element that shapes human behavior and, for that reason, will be used as reference to guide the analysis of the achieved results. Figure 1 provides a schematic representation that summarizes this information.

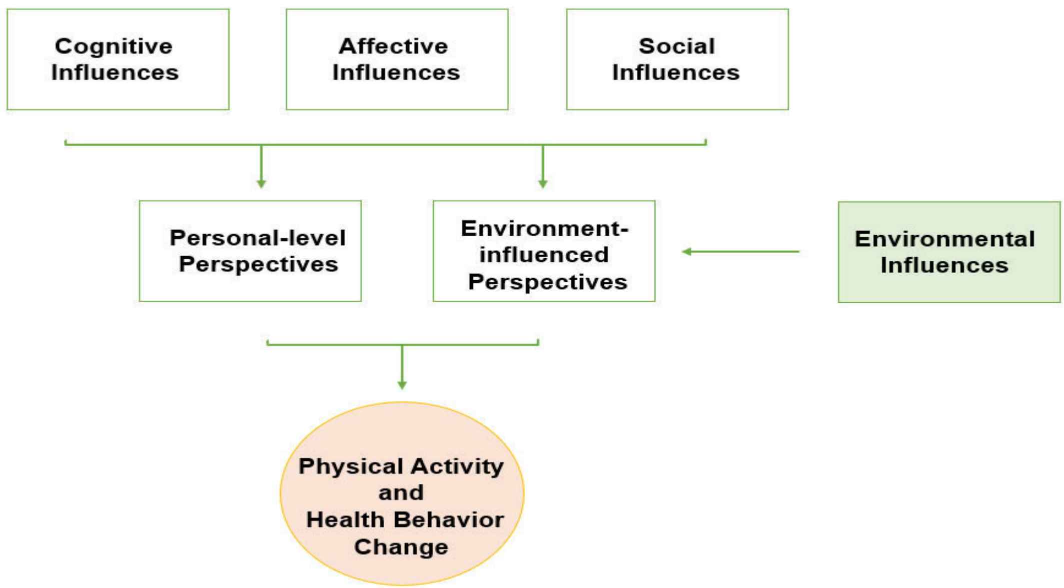

Figure 1. Conceptual Framework

3. Methodology

3.1. Research Strategy and Research Methods

This section presents the strategic and methodological decisions that have been made in order to design this research. First, this research was based in the post positivist research philosophy. The research followed a deductive approach because it was conceived based on the premise, already well-explored in the literature, that the existence of greenery close to people's dwellings positively influences physical activity, recreation, and health. Accordingly, two hypotheses about the behavior patterns of the Dutch population concerning leisure activities were formulated and tested, namely a) People that live in greener neighborhoods are more likely to perform leisure activities than people who do not; and b) People that live in greener neighborhoods spend more time walking and cycling for leisure purposes than people who do not.

In order to test the hypotheses that were made, the survey was chosen as the research strategy to carry out this study because it would be necessary to obtain a large amount of data to generalize the results for the entire Dutch population, and also because of the availability of the necessary datasets online, which facilitated the data collection. Hence, the present research can be considered a secondary data survey because it combines information acquired by means of previous surveys. According to Van Thiel (2014), the survey is a strategy that is especially suitable for deductive forms of research and allows the researcher to collect a great amount of data on a large number of subjects, which makes it very efficient. The capacity of the survey to deal with a considerable body of data was, therefore, essential for this research.

Based on the aim of the research, that is to measure the effects of different types of green areas in Dutch population' leisure activities patterns, two quantitative methods have been used to prepare and to analyze the data. First, the data was prepared to identify and to quantify the green areas within the Dutch territory. Second, a statistical analysis (more precisely, binary logistic regressions and zero-inflated negative binomial regressions) was performed in order to correlate the green areas' availability to the leisure activities' performance during the period of 2010 to 2019 in the Netherlands.

3.1.1. Data Collection

To obtain the necessary data for this research, seven main datasets were collected. All the information acquired is freely available on the internet for download and use. The specificities of the datasets, such as their general descriptions and sources, can be found in Table 1.

Table 1. Description of the Datasets

Dataset	Year	Description	Format	Source
Onderzoek Verplaatsingen in Nederland (OViN)	2010-2017	Presents the mobility patterns in the Netherlands.	Table.	Centraal Bureau voor de Statistiek (CBS)
Onderweg in Nederland (ODiN)	2018-2019	Presents the mobility patterns in the Netherlands.	Table.	Centraal Bureau voor de Statistiek (CBS)
Bestand bodemgebruik (BBG)	2015	Land Use Map of the Netherlands.	Shapefile.	Centraal Bureau voor de Statistiek (CBS)
Postcode (pc4)	2020	Numeric part of the postcode.	Shapefile.	Centraal Bureau voor de Statistiek (CBS)
Groenkaart van Nederland	2017	Presents the percentage of greenery in the territory.	Tiff.	Rijksinstituut voor Volksgezondheid en Milieu (RIVM)
Natuurmeting op Kaart (NOK)	2010-2014	Ecological Network available in the Netherlands.	Shapefile.	BIJ12
Voortgangsrapportage Natuur (VRN)	2017-2020 (referent to 2016-2019)	Ecological Network available in the Netherlands.	Shapefile.	BIJ12

3.1.1.1. OViN and ODiN

OViN and ODiN are surveys about the mobility patterns of the Dutch population and are used by the authorities in the development of traffic and transport policy in the Netherlands (Centraal Bureau voor de Statistiek, 2020). Carried out from 2010 to 2017 through printed questionnaires, OViN was replaced, in 2018, for ODiN, a new and modernized version of the research that is filled out online. Despite the changes in the research design, the datasets contain compatible information and can be combined in order to provide a historical overview of the data.

Among the information available in the OViN and ODiN datasets it is possible to find general characteristics of the population (Sex, Age, Education, Income, Occupation, etc.), the postal code (PC4) of the place of departure and arrival for every trip and general information about the trip (motive, duration, means of transportation, etc.), information that was used in this research in order to identify the behavior of the population concerning leisure activities.

3.1.1.2. Bestand bodemgebruik

Bestand bodemgebruik presents the limits of the different land uses in the Netherlands. It is based on the digital topographic map, representing a scale of 1: 10.000 from the Land Registry (Centraal Bureau voor de Statistiek, 2021a). The 2015 version of the Land Use Map was chosen to be part of this investigation because it is the most recent version of this dataset. This information is important for the analysis because it shows the legal boundaries of the urban and rural green areas in the Netherlands.

3.1.1.3. Groenkaart van Nederland

It represents where the vegetation is located in the Netherlands in 2017, with all the trees, shrubs and low vegetation showed in a 10x10 meters resolution grid (National Institute for Public Health and the Environment, 2017). The green is represented by the percentage of vegetation in each grid. This dataset contains a general overview of the greenery in the territory despite its legal boundaries, which is important for the analysis because the availability of vegetation in people’s neighborhoods is a factor of encouragement for people to be more active outdoors.

3.1.1.4. NOK and VRN

NOK and VRN are reports that measure the EN in the Netherlands. This measurement system was created after the introduction of the Investment Budget for Rural Areas (ILG) in 2007 in order to help monitoring the agreements between the provinces and the national government concerning the development of the National Ecological Network in the Netherlands (BIJ12, 2021). The dataset contains information about the planned, acquired and restored areas of the National Ecological Network from 2007 to 2014 and from 2017 to 2020, the latest representing the results obtained on the years of 2016 to 2019. It is important to notice that there is no spatial information available for the year of 2015, which led to the exclusion of this particular year from the analysis. For this research, the Ecological Network of 2019, in general, and the restored areas per year, were selected. The latest were selected because of its change of use during the years. Therefore, it will be possible to see if when an area is restored, it directly influences the leisure patterns of the population that live in the neighborhood.

3.1.2. Data Analysis

The data analysis can be divided in two different phases: the Data Preparation of the GI and the EN in the territory and the Statistical Analysis that combined the greenery available in people's neighborhoods to their mobility patterns. The specification of the steps taken in each phase can be found in Figure 2.

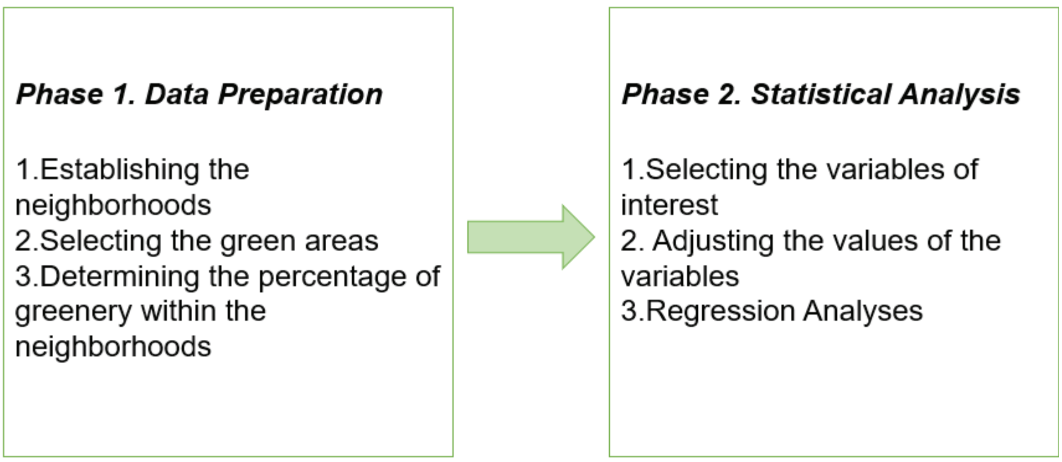

Figure 2. Phases of the Data Analysis

3.1.2.1. Phase 1. Data Preparation

The data analysis started with the data preparation because it was necessary to gather all the information about the GI and the EN before performing the Statistical Analysis. The procedures of each step will be detailed bellow.

3.1.2.1.1. Establishing the neighborhoods

The first step of the data preparation was to determine the limits of people's neighborhoods. Therefore, based on previous studies (Hogendorf, Groeniger, Noordzij, Beenackers, & Van Lenthe, 2020; Maas *et al.*, 2006, 2008), radiuses of 1 km and 3km around each postal code' centroid were drawn. The 1 km radius represents 12 minutes walking, while the 3 km radius represents 12 minutes cycling, distances that can be easily undertaken from people's homes (Maas *et al*., 2008). A radius of 5 km was also added to complement the analysis because it is a reasonable distance to be undertaken for cycling purposes, representing less than 30 minutes of cycling. The different radiuses distances are relevant for the analysis because they allow the identification of the Distance Decay phenomenon, revealing if green spaces closer to people's dwellings have stronger effect on people's leisure activities than green spaces further away.

To calculate the radiuses surrounding each postal code, ArcGIS (ESRI, Redlands, CA) software was used. Based on the Postcode (pc4) polygon archive, the centroids for each polygon were generated. After this procedure, Euclidian buffers of 1 km (area 314.15 ha), 3 km (area 2827.43 ha) and 5 km (area 7853.98 ha) were drawn around each centroid.

3.1.2.1.2. Selecting the green areas for the analysis

To identify the green areas present in the Dutch territory, three datasets of polygons shapefiles were used. From the Land Use Map (Bestand bodemgebruik), two main categories of green spaces relevant for walking and cycling were determined using the ArcGIS software, namely Rural Green Areas and Urban Green Areas. To compose the Rural Green Areas three categories of Land Use were selected: Forest, Dry Natural Terrain and Wet Natural Terrain. The categories Park and Public Garden and Sports Field, on the other hand, were chosen to compose the Urban Green Areas. The distinction between urban and rural areas was interesting for this research because it allowed the analysis of the importance of different types of green in people's leisure activities patterns.

From the NOK and VRN datasets, the restored and the nature areas within the National Ecological Network were selected in ArcGIS. The restored areas were specially selected because of their already documented influence on landscape defragmentation and biodiversity improvement (as presented in previous sections of this research). Therefore, there is an expectation that the increasement of these areas in people's neighborhoods can influence their daily lives and their leisure activities patterns as well. To determine the restored areas in the NOK dataset on ArcGIS, it was used the layer "Verwerving_Inrichting", selecting the option "Restored" for each year. In the VRN dataset, the restored areas were already separated from the acquired areas, and the layer "GebiedInrichting" was used for the analysis. To collect the most recent version of the nature areas in the Netherlands, the layer "GebiedNatuur", from the 2019 VRN dataset was used, to represent the totality of the Ecological Network currently available.

Lastly, the percentage of green provided by the Green Map of the Netherlands (Groenkaart van Nederland) is shown on map in a different way that the previous datasets due to its raster (more precisely, tiff) format. Accordingly, the archive presents the percentage of greenery within each pixel of the territory, varying from 0 to 100%. Therefore, it was not necessary to select the green areas from this dataset in advance, considering the entire map was already presenting these areas.

3.1.2.1.3. Determining the percentage of greenery within the neighborhoods

After the selection of the green areas from each dataset, the “Intersection” tool on ArcGis was used in order to identify common areas between the buffers and the “Urban Green Areas”, “Rural Green Areas”, “Restored Areas” and “Nature Areas”. This overlay tool was used because it results in one output layer containing the common areas in all input layers, which was useful to identify the green areas within each buffer. The derived areas from these procedures were then compared to the total area of the buffers, resulting in the percentage of green coverage per buffer, for each year.

For the calculation of the percentage of greenery within each buffer resulting from the Groenkaart van Nederland, the “Zonal Statistics” tool was used to combine the raster information with the buffer polygon layers. The output value used to determine the final percentage was the mean, that calculates the average of the input raster values within each polygon.

To conclude, the results obtained for each operationalization per year in ArcGIS were merged with the OViN and ODiN datasets to perform the Statistical Analysis.

3.1.2.2. Phase 2. Statistical Analysis

The results obtained during the Data Preparation were combined to the mobility survey dataset acquired from OViN and ODiN to create an unique dataset for the Statistical Analysis’ performance. The “Urban Green Areas”, “Rural Green Areas”, “Nature Areas” and “Percentage of green” were used as constant values for the entire period of 2010 to 2019, regardless the year of reference. The information about the “Restored Areas”, however, was combined according to the specific year of reference. As a result, the restored areas were combined with the mobility survey for the years 2010 to 2019, with the exception of the year of 2015, in which the information was not available. After the files’ merge, the Statistical Analysis started. The detailed steps of this phase will be presented below.

3.1.2.2.1. Selecting the variables of interest from OViN and ODiN datasets

As previously described in section 3.1.1., ODiN and OViN are mobility surveys that provide information about the Dutch population' mobility patterns. Both datasets were combined to provide information from 2010 to 2019, and the variables that were chosen for the present research were collected during the totality of the period of analysis.

Based on previous studies (Giles-Corti & Donovan, 2002; Maas *et al*., 2008; Sallis *et al*., 1997; Wendel-vos *et al*., 2004), socioeconomic characteristics of the participants have direct influence in their physical activity behavior and must be considered as control variables for this type of analysis. For this reason, the variables “Gender” (geslacht), “Age” (Leeftijdsklasse), “Social Participation/ Occupation” (Maatschappelijke participatie), “Education” (opleiding) and “Standardized disposable household income (10% groups)” (Gestandaardiseerd besteedbaar huishoudinkomen (10% groepen)) were added to the dataset. Other control variables such as “Number of cars in household” (Aantal auto's in huishouden) and “Participant has driver's license” (OP bezit rijbewijs) were also included, considering their influence in people’s choices concerning means of transportation.

The variable “Category of recreation” (recreatie_cat) was a variable created from the original surveys dataset and represents the different types of trips that were made. To create this variable, the trips whose motives were “10- Touring/walking” or “11- Sports/Hobby” in the original ODiN and OViN datasets were considered part of the leisure activities’ category. This variable was used to determine the number of trips with recreation as motive per postal code, to test the first hypothesis of this research.

To conclude, the variables “Active recreation time” (recreatieduur_actief), “Cycling recreation time” (recreatieduur_fiets) and “Walking recreation time” (recreatieduur_wandelen), measured in minutes, were also created from the original surveys’ datasets by the selection of the trips that presented recreation time relative to walking and cycling. The “active” variable represents trips that were made either by walking, cycling or both. These three variables were used for the analysis of the second hypothesis.

For the analysis of both hypotheses, the category of interest of the variable “Category of recreation” (recreatie_cat) was the “tour trips”, which means trips that started and ended at the person’s place of residence. These trips do not present specific destinations, and the trips are considered part of the recreation activity itself, which fits best with the purpose of this analysis. By shedding light to the tour trips, it is possible to have an overview of which neighborhoods encourage the individual to spend more time performing physical activities nearby, or increase the likelihood to perform these activities, and to identify if the existence of greenery is a factor that plays a role in this decision, regardless of public and private leisure equipment that are available in the region.

3.1.2.2.2. Adjusting the variables' categories and values

Some of the variables presented an extensive number of categories that were not relevant for the present analysis. Therefore, modifications in the categories needed to be made in order to obtain more representative categories. This was the case of the variables "Age", "Social Occupation", "Income" and "Education".

The variable "Age", that originally presented 18 categories, was compiled in 6 categories. In the variable "Social Occupation", the category "Worker" represents the original categories "1. Werkzaam 12-30 uur per week" and "2. Werkzaam >= 30 uur per week", and the category "Other" compiles the original categories "8. Overig", " 9. Onbekend" and "10. Niet gevraagd; OP jonger dan 15 jaar".

The variable "Income", that presented 11 categories, was compiled in 3 main categories, namely "High", "Middle" and "Low Income". The participants that presented an "Unknown" response for income were excluded of the analysis. Lastly, for the variable "Education", the participants that presented the responses "Unknown" "Other" or "Not asked/Younger than 15 years old", were also excluded of the analysis. The exclusion of these individuals was made because they are not relevant for the analysis and represent either the participants under 15 years old or participants with incomplete information.

Finally, all the categorical variables were prepared and transformed into dummy variables in order to be part of the regression analysis. These variables were "Sex", "Age", "Income", "Occupation", "Education", "Year", "Week Day", "Number of cars in the participant's household" and "Participant has driver's license". In each case, a reference category was used, and left out of the analysis to be compared to the other dummy variables created for each variable.

3.1.2.2.3. Regression Analyses

The two hypotheses of this research were tested through regression models in the *SPSS Statistics software*, version 25.0 (IBM Corp., Armonk, NY, EUA). In order to identify if people that live in greener neighborhoods are more likely to perform leisure activities than people who do not, a binary logistic regression was performed considering the presence of greenery within each one of the 1 km, 3 km and 5 km buffers. The amount of time spent cycling and walking during leisure activities within each one of the buffers was analyzed through a zero-inflated negative binomial regression model. The reasons for the choice of those models will be presented below.

For our first model, Urban Green Areas, Rural Green Areas, Restored Areas, Nature Areas and Green Percentage were established as independent variables. The dependent variable was “Category of recreation”, in which information about the different types of trips was presented. As control variables, the variables “Sex”, “Age”, “Occupation”, “Education”, “Income”, “Year”, “Week Day”, “Car Ownership” and “Driver’s License” were selected.

The logistic regression model requires that some assumptions are met in order to the model to be reliable in explaining the predictive capacity of the independent variables. These assumptions are: a) adequate size of the sample, b) absence of multicollinearity and c) absence of outliers (Laerd Statistics, 2021). Through the analysis of the data, it was possible to verify that all the assumptions were met, and the binary logistic regression was performed.

The second analysis, regarding the amount of time spent cycling and walking during leisure activities used the zero-inflated negative binomial regression. For this analysis, the same independent variables (Urban Green Areas, Rural Green Areas, Restored Areas, Nature Areas and Green Percentage) and the control variables “Sex”, “Age Class”, “Occupation”, “Education”, “Income”, “Year”, “Week Day” were selected. “Active recreation time”, “Cycling recreation time” and “Walking recreation time” were used as dependent variables.

Initially, it was observed that the dependent variables of the model presented three properties mentioned by Cameron and Trivedi (1998) as characteristics of counting variables: a) values belonging to the set of natural numbers; b) lowest possible value is zero; and c) strongly skewed and positive distribution. In addition, the adjustment of conventional linear regression models to these variables showed a distribution of residuals with a strong deviation from the normal curve, invalidating the parameters calculated for these models. Also, a large occurrence of values equal to 0 in the sample was observed. Thus, as suggested by Beaujean and Grant (2016) and Green (2021), regression models for counting variables seemed to be more adequate to use. Within these models, the most used are the models of Poisson and negative binomial.

The analysis of the data showed, however, overdispersion, that is variance much higher than the mean, and a high occurrence of zeros. Those characteristics led to the choice of the zero-inflated negative binomial regression model for the analysis, since it generates more reliable parameters for data with overdispersion and high occurrence of zeros compared to the Poisson regression model (Green, 2021). Finally, the model proved to be the most adequate for the data analysis as it presented the lowest AIC (Aikaike Information Criterion), value compared to other possible adjustments (Poisson and conventional negative binomial regression).

3.2. Reliability and Validity

The reliability of a research lays in two aspects: its accuracy and its consistency (Van Thiel, 2014). Accuracy refers to the instruments that are used to measure the phenomenon that is being investigated, and consistency refers to the repeatability of the study (Van Thiel, 2014). In surveys that collect information about a sample of the population, there is always a margin of inaccuracy, because the sample data usually are not equal to the actual values of the population (Centraal Bureau voor de Statistiek, 2021b). Because the present research is based on mobility information collected through sample surveys (ODiN and OViN), it is important to stress that these surveys' sampling margin of inaccuracy for the total number of passengers per kilometer per year is 1,9% (with a 95% confidence level) (Centraal Bureau voor de Statistiek, 2018), which represents a high level of accuracy of the data in general. Concerning to the consistency of the present study, the quantitative methods chosen to carry out this research during the data preparation and the statistical analyses support the repeatability of the results, if the study is carried under the same conditions.

The validity of a research can be determined by two different prisms of analysis: the internal and the external validity. The internal validity refers to the pertinence of the study, if the researcher was able to measure the effect that he intended to, and the external validity refers to the generalization of the study (Van Thiel, 2014). This research presents internal validity because it was able to identify that greenery directly influences in Dutch population' leisure activities patterns, although the strength of the relation was weak. The influence of the Ecological Network, specifically, was mostly non-significant for the analysis, however the influence of Green Infrastructure was verified. Concerning to external validity, the large scale and high level of standardization of the surveys facilitates the generalization (Van Thiel, 2014). The datasets used for this research present results that are representative of the Dutch population, allowing generalization, which justify the external validity of this research.

To conclude, in surveys, common problems relevant to the validity and reliability of the data are related to the willingness of the participants to respond truthfully and the proportional distribution of the population concerning important personal characteristics (Van Thiel, 2014). For the ODiN and OViN surveys, the sample is not exactly equal to the number of responses, presenting differences for each year. As explained by Centraal Bureau voor de Statistiek (2018), this occurs due to the non-responses and to the continuous survey and the mixed-mode observation method, that allows the participants to respond only three months after they were first approached. This situation can result in the respondent being considered only for the next year of the survey, for example. Concerning the personal characteristics of the participants, weighting factors were already calculated with a weighting to background characteristics, which also corrected for the selectivity in the sample (Centraal Bureau voor de Statistiek, 2018). Finally, the quality of the surveys responses is also verified and tested for usability, and if data inconsistencies are verified, the responses are removed from the results (Centraal Bureau voor de Statistiek, 2018). Hence, the results obtained can be considered valid and reliable, enhancing the validity and reliability of the present survey as well.

4. Results

This section will present the results obtained during the two phases of this research. In section 4.1., it will be possible to visually identify the different types of greenery in the Dutch territory through the analysis of maps. In section 4.2., the results obtained in the statistical analysis will be presented.

4.1. Data Preparation

The results of the selection of the green areas in the Netherlands, according to the dataset, are presented in Figures 3, 4, 5 and 6. Figure 3 exhibits the rural and urban green areas in the Netherlands according to the Land Use Map (2015), and Figures 4 and 5 exhibit the Ecological Network in the Netherlands in 2019 and the totality of the restored areas during the period of 2010 and 2019, according to the NOK and VRN datasets. It is possible to observe that the Veluwe, the largest forested and natural area in the lowlands of north-western Europe (Van der Heide, Van den Bergh, Van Ierland, & Nunes, 2008) is represented in the Restored Areas map, although this area was not restored during this specific period. This occurs because, in the years of 2016 and 2017, the province of Gelderland reported this as a restored area to BIJ12, probably because of an internal error. Before (from 2010 to 2014) and after (2018 and 2019) these years, this area is not considered in the map.

Finally, as observed in Figure 6, in which the green percentage is obtained through the Green Map (2017), it is possible to note that this dataset presents visible differences comparing to the previous ones. This occurs because the Green Map considers the totality of trees, shrubs, and low vegetation in the Netherlands to compose the dataset, including agricultural areas, elements that were not considered by the previous datasets. This explains the higher percentages of greenery in this dataset, comparing to the others.

Succeeding the selection of the areas, the buffers of 1 km, 3 km and 5 km surrounding the centroids of the postal codes were calculated, and the percentage of greenery within each one of them was determined. This data was merged with the survey dataset to perform the statistical analysis.

Figure 3. Green Areas in the Netherlands

Figure 4. Nature Areas

Figure 5. Restored Areas

Figure 6. Percentage of green

To demonstrate the differences between the types of greenery presented in this research, maps of two Dutch cities, namely Arnhem and Amstelveen, were elaborated. These cities were chosen because they present all the mentioned types of greenery within their territory, allowing comparisons.

The greenery in the city of Arnhem is represented by Figures 7, 8, 9 and 10. As previously discussed in section 1, the Ecological Network is part of the Green Infrastructure, and the similarities between the Green Areas and the Restored and Nature Areas are visible. The biggest differences are related to the Urban Green Areas, that do not appear in the other two maps because the NOK and VRN datasets only consider the Dutch network of existing and newly created nature reserves (Environmental Health Atlas, 2021), not considering urban parks. This representation confirms the affirmation that not all urban parks and recreation spaces provide ecological relevance, although very important for the ecosystem and for humans' quality of life. To conclude, the percentage of green summarizes all the types of greenery in the territory on map, allowing a broader view of the greenery available in the territory.

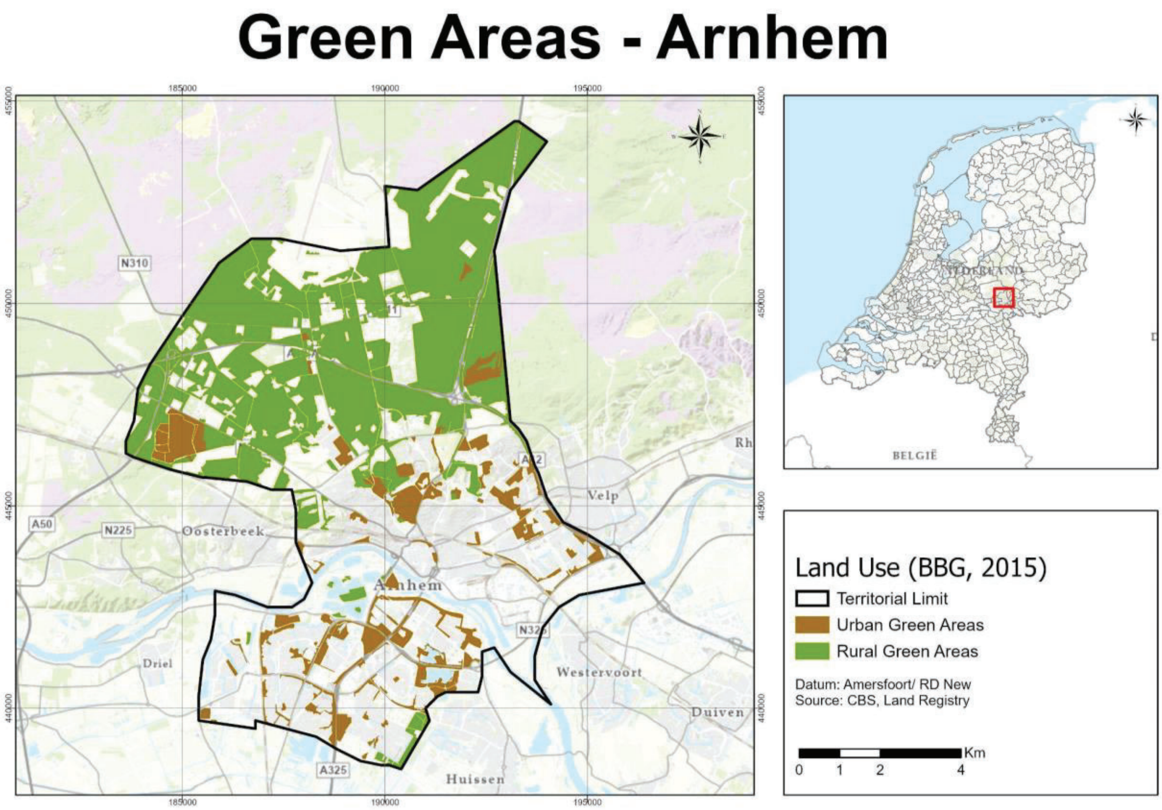

Figure 7. Green Areas in Arnhem

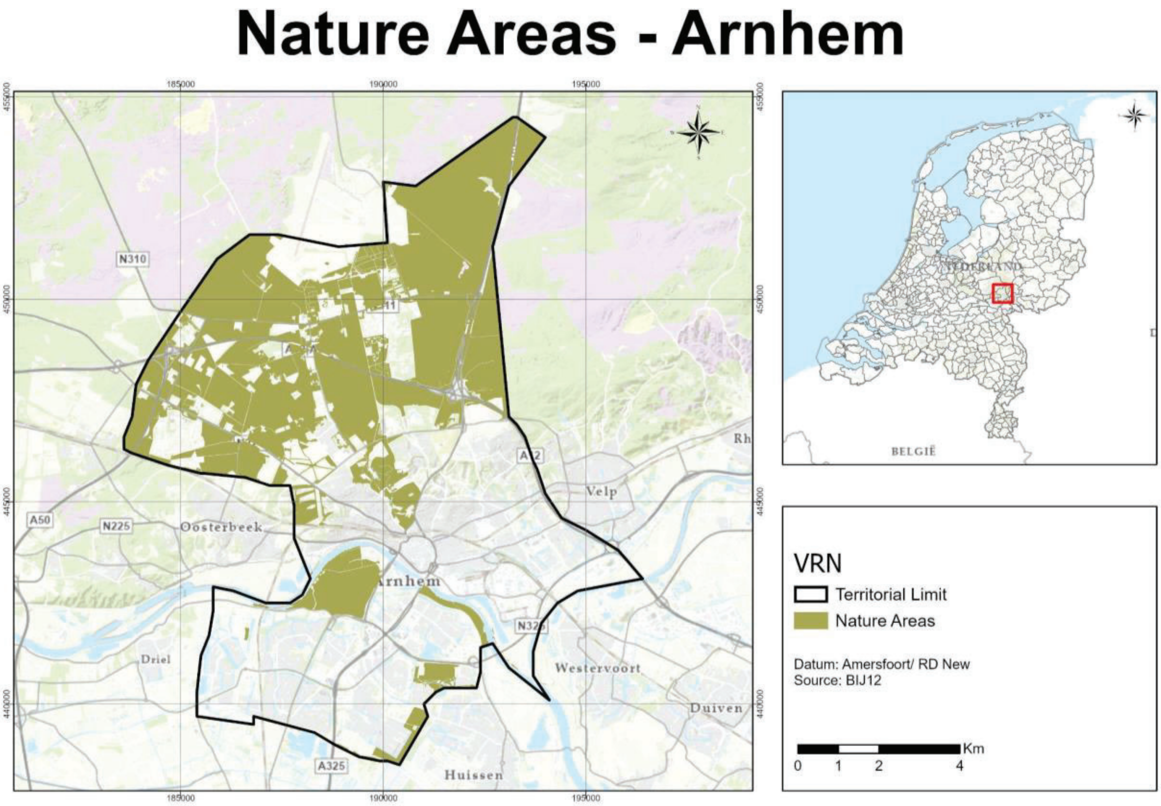

Figure 8. Nature Areas in Arnhem

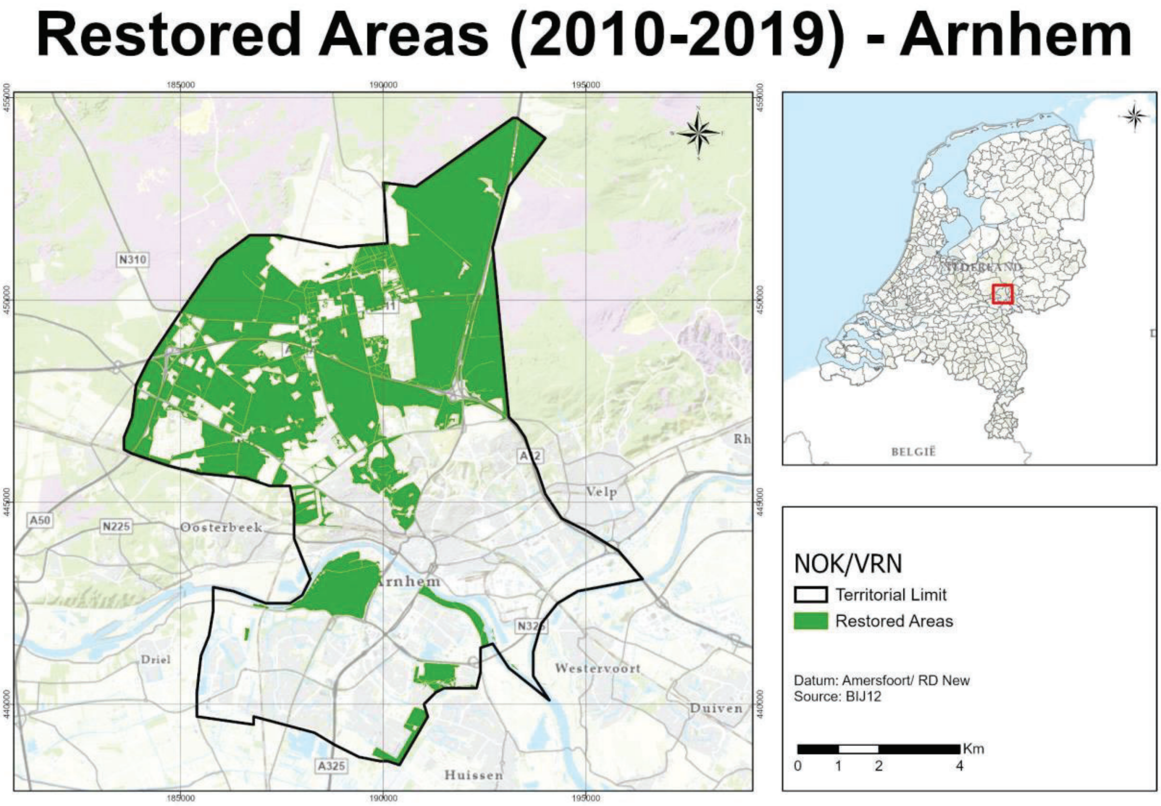

Figure 9. Restored Areas in Arnhem

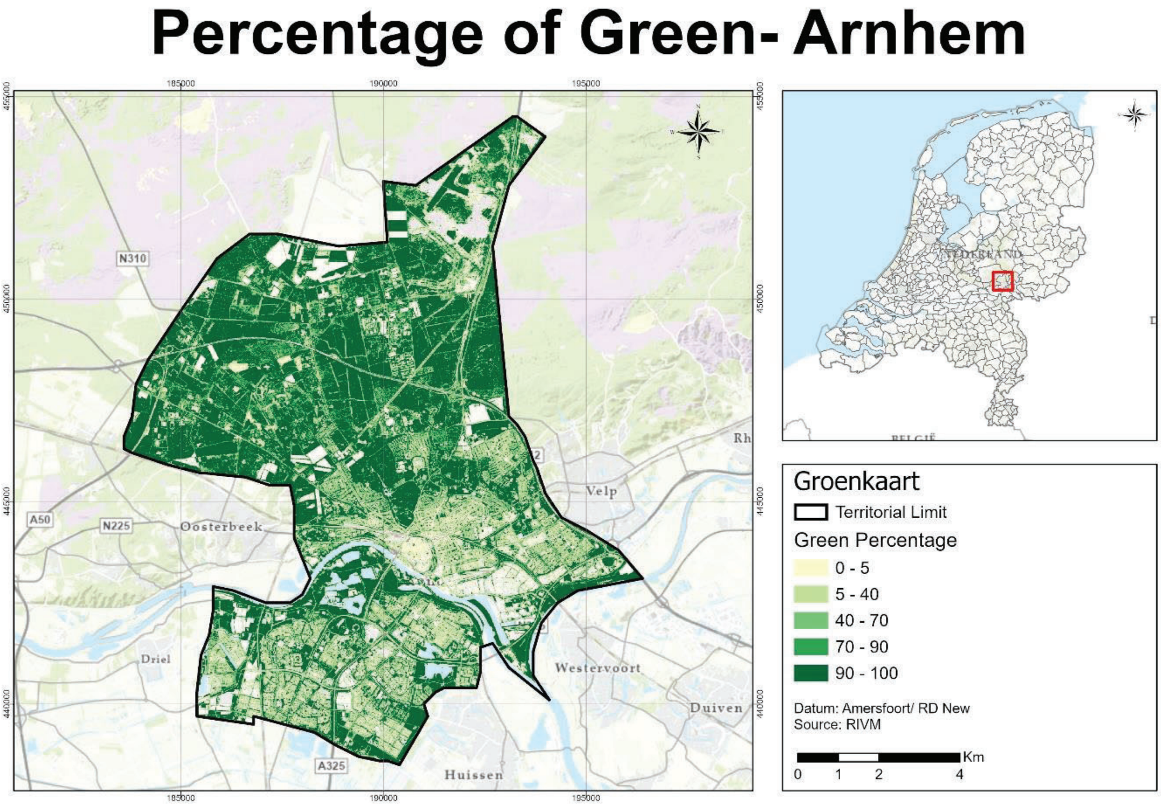

Figure 10. Percentage of green in Arnhem

The greenery in the city of Amstelveen is represented by Figures 11, 12, 13 and 14. Similarly to the pattern observed in the city of Arnhem, there are similarities between the representation of the Green Areas, particularly the Rural Green Areas, and the Nature Areas. In Amstelveen, the Restored Areas represent only part of the total Nature Areas of the city, indicating that some of the natural areas were already part of the city's Ecological Network. The percentage of green summarizes all the types of greenery in the territory on map.

Through the analysis of the greenery in Arnhem and Amstelveen, it is possible to identify the similarities and differences between the Green Infrastructure and the Ecological Network available within the cities, as previously discussed in section 1. In this context, the investigation of the influence of the different types of greenery in the performance of leisure activities within the neighborhoods is relevant to better understand the importance of these spaces for human population.

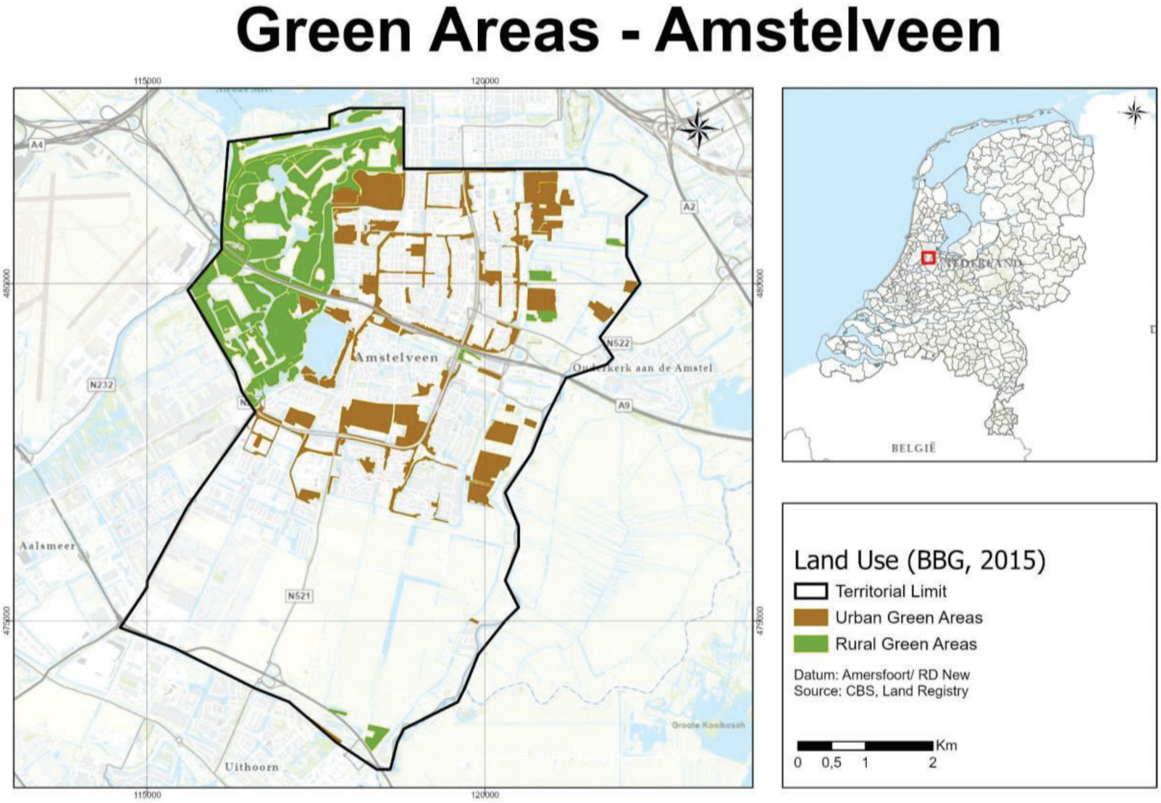

Figure 11. Green Areas in Amstelveen

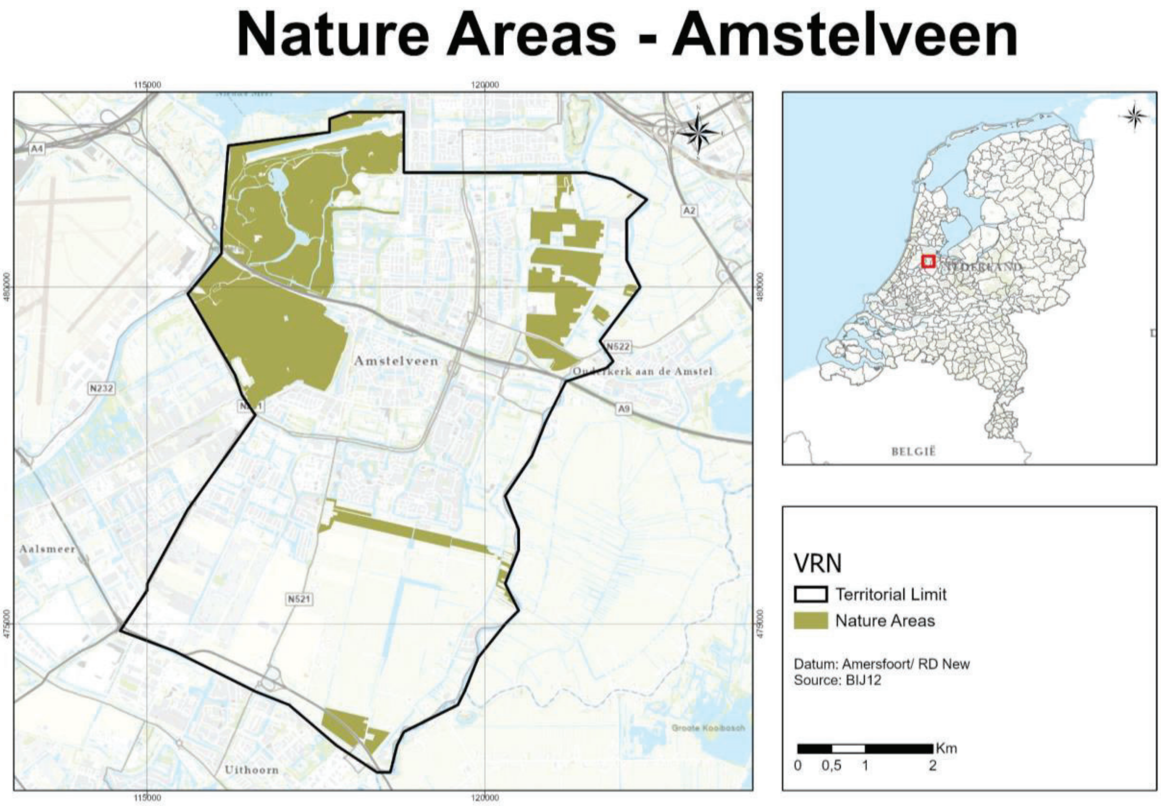

Figure 12. Nature Areas in Amstelveen

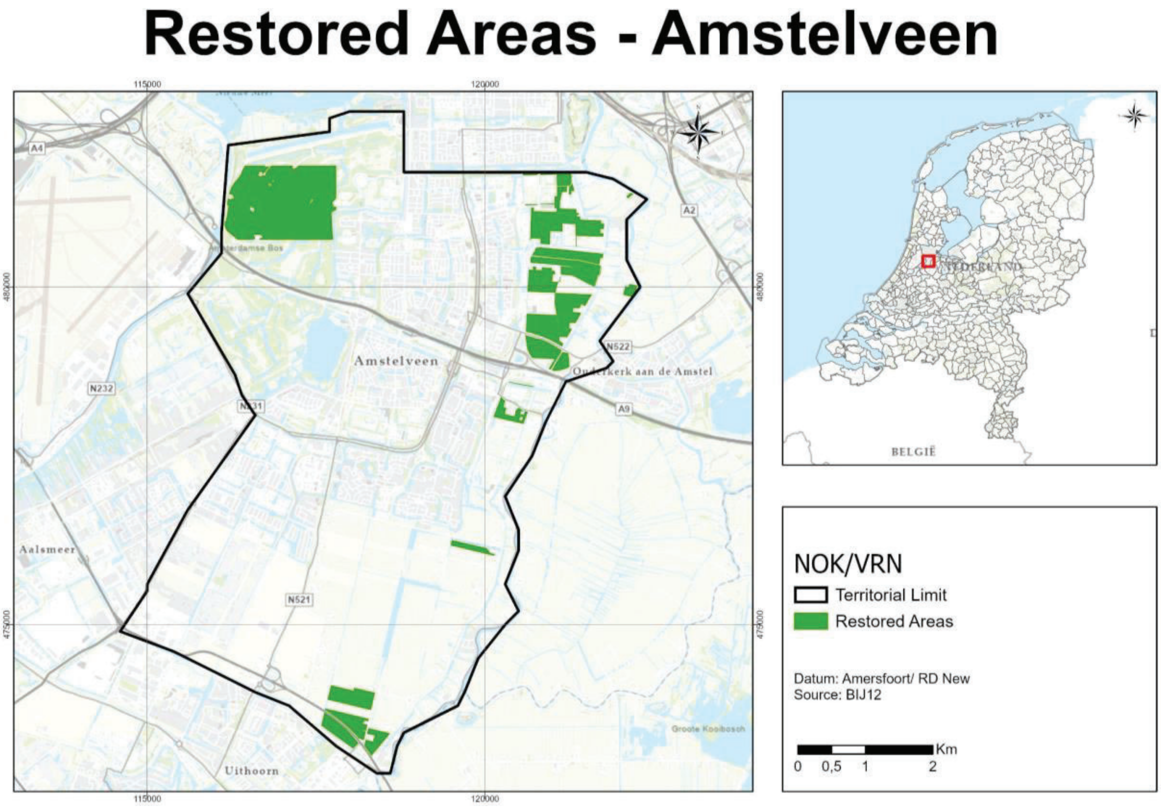

Figure 13. Restored Areas in Amstelveen

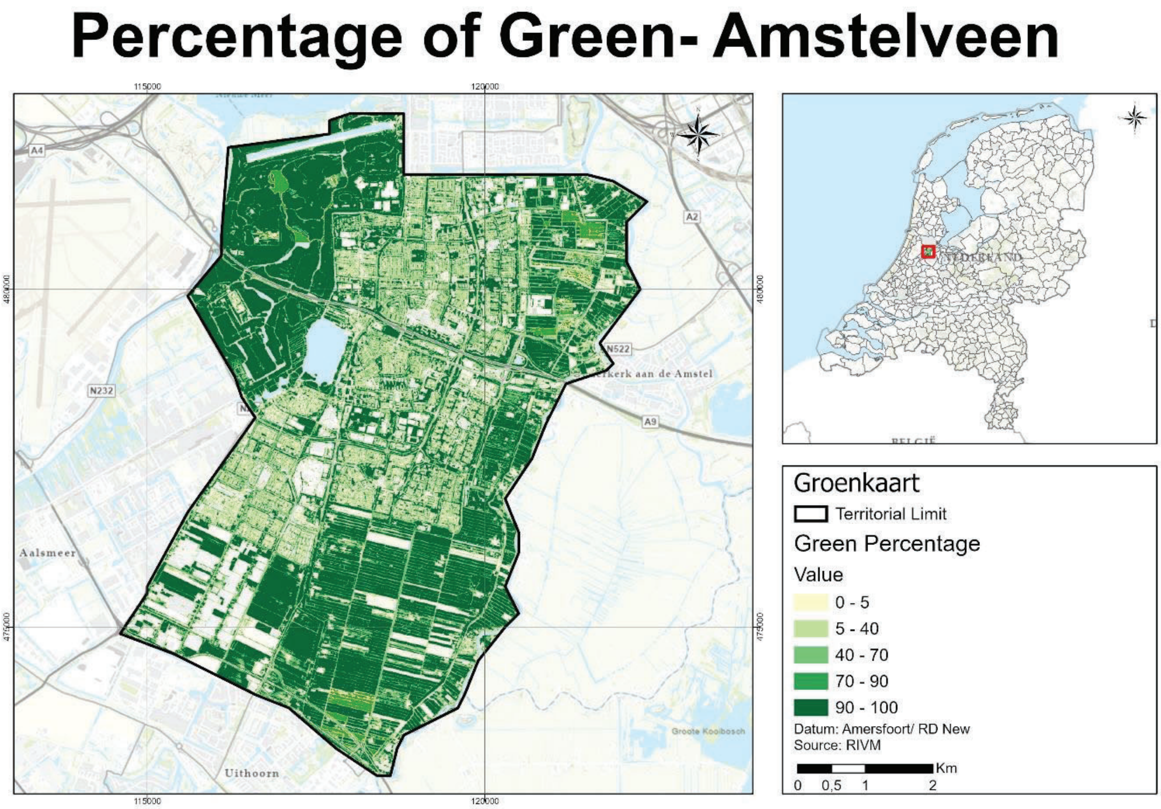

Figure 14. Percentage of green in Amstelveen

4.2. Statistical Analysis

4.2.1. Sample Characterization

The data acquired from the ODiN and OViN surveys concerning the mobility patterns of the Dutch population was compiled per person. Initially, there were 305,651 participants in the period of study, and the characterization of the entire sample can be found in Appendix 2. As already explained in section 3.1.2.2., it was necessary to exclude some observations (n= 49,592) from the initial sample due to the focus population of this research, resulting in a final sample of 256,059 individuals. From the 256,059 individuals selected for this research, 67,180 of them performed at least one recreation trip at a certain day, and only 25,279 of these recreation trips were classified as tour trips. To conclude, within the individuals that performed tour recreation trips, 1,553 of them did not use active means of transportation (walking and cycling) during their leisure time. An overview of the distribution of the individuals, according to the type of trip that was performed, is showed in Figure 15.

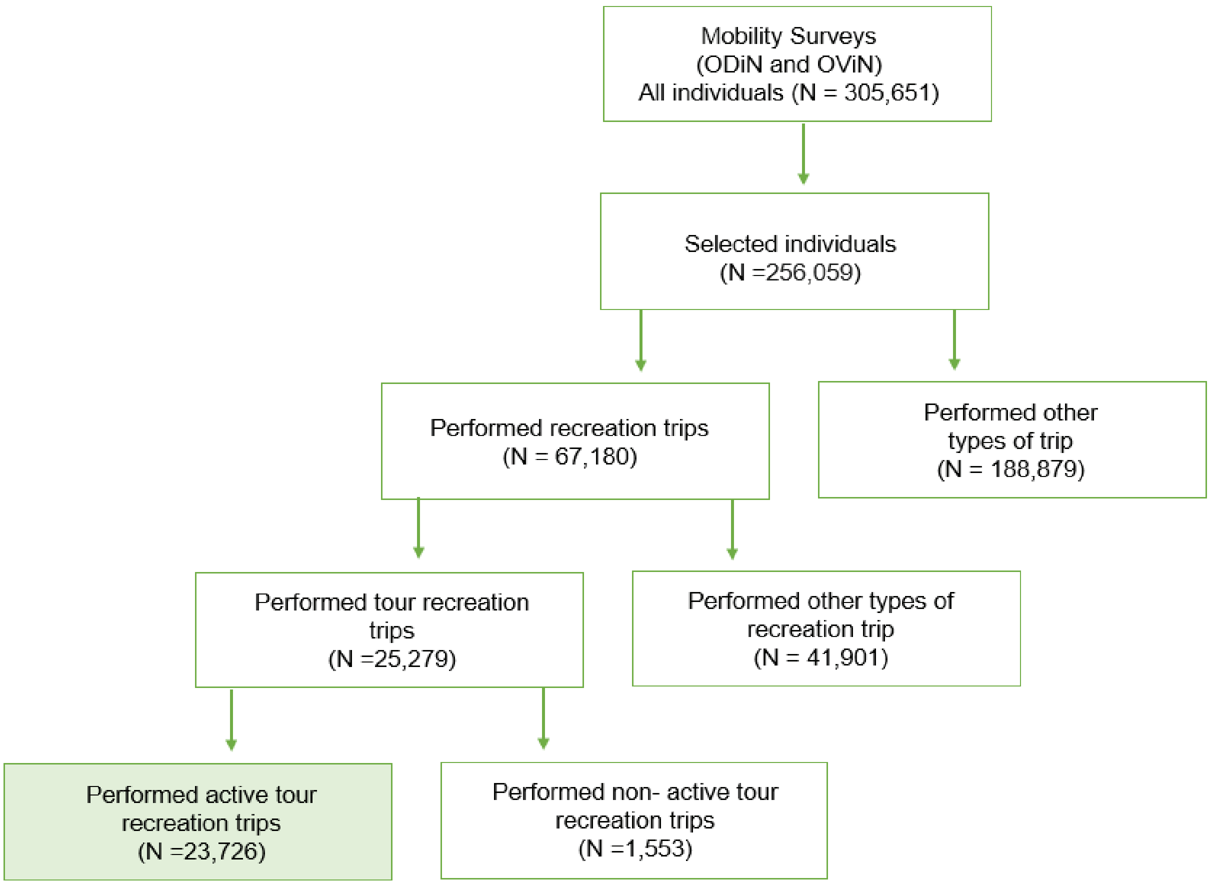

Figure 15. Flowchart of the individuals included in the analyses

An overview of the selected participants, by year (excluding the year of 2015, as mentioned before) and by week, can be found in Table 2, and it is possible to say that the sample is well distributed over the years. The years of 2016 (22,934) and 2017 (23,519) presented the smallest samples of the period, and the years of 2018 (40,385) and 2019 (38,211), the largest. Regarding the days of the week, it is possible to identify that Sunday (10.97%) and Saturday (12.30%) are the days with less participants. This can be explained by the fact that, during weekdays, people travel more (mostly for commuting purposes) than during the weekends.

Table 2. Number of participants, per year and per day of the week

Variable	Categories	Absolute frequency (n)	Relative frequency (%)
Year	2010	26271	10.26
	2011	25092	9.80
	2012	26967	10.53
	2013	26134	10.21
	2014	26546	10.37
	2016	22934	8.96
	2017	23519	9.18
	2018	40385	15.77
	2019	38211	14.92
Day of the week	Sunday	28101	10.97
	Monday	39509	15.43
	Tuesday	39651	15.49
	Wednesday	39019	15.24
	Thursday	39004	15.23
	Friday	39291	15.34
	Saturday	31484	12.30

The participants' personal characteristics, according to the time spent during active tour recreation trips, can be found in Table 3. Through this characterization, it is possible to identify the profile of the people that perform this type of leisure activity. The individuals that present values higher than zero performed active tour recreation trips (23,726), and the zeros correspond to individuals that: a) Did not perform tour recreation trips or b) Did not walked or cycled during their tour recreation trips.

Within the individuals that performed active tour recreation trips, 52.09% were women, and only 2.35% were under 18 years old. It is possible to identify that the most active groups were the people between 45 to 54 years old (21.43%) and between 55 to 64 years old (20.70%). The older population is also very active during tour recreation trips, and 27.7% of the individuals were above 64 years old. Accordingly, 27.77% of the individuals that performed active tour recreation trips were retired, and 48.47% were workers. Concerning the household income and the educational level, 41.54% of the participants were middle-income, and 70.57% completed a middle-to-high level of education. To conclude, the majority of the participants that performed active tour recreation trips possess driver's license (86.69%) and 88.65% of them have, at least, one car in the household. This information is critical because it shows that, despite the facility that people have in using the bicycle or public means of transportation in the Netherlands, the car is still a relevant mean of transportation for the population in diverse situations and plays an important role in people's mobility choices.

Comparing the two groups, the group of people that performed active tour recreation trips and the group that did not, it is possible to note that the percentages of women and older individuals are higher in the first group. Concerning the variables "Cars in the household", "Driver's License" and "Income", no significant differences were observed between the two groups.

Table 3. Description of the study population (n=256,059)

Variable	Categories	Active Tour Trip Recreation Time			
		0		>0	
		Absolute frequency (n)	Relative frequency (%)	Absolute frequency (n)	Relative frequency (%)
Sex	Male	114425	49.25	11367	47.91
	Female	117908	50.75	12359	52.09
Age group	Under 18 years old	12057	5.19	557	2.35
	18 to 24 years old	22841	9.83	1035	4.36
	25 to 34 years old	33136	14.26	2434	10.26
	35 to 44 years old	37991	16.35	3132	13.20
	45 to 54 years old	44143	19.00	5084	21.43

	55 to 64 years old	39195	16.87	4911	20.70
	65 to 74 years old	27931	12.02	4326	18.23
	Above 74 years old	15039	6.48	2247	9.47
Occupation	Worker	133101	57.29	11501	48.47
	Housewife/ husband	11900	5.12	1541	6.49
	Student	26132	11.25	1227	5.17
	Unemployed	4669	2.01	681	2.87
	Disabled	5428	2.34	1100	4.64
	Retired	43806	18.85	6589	27.77
	Other	7297	3.14	1087	4.59
Education	0. Incomplete education	2557	1.10	211	0.89
	1. Primary education	15010	6.46	1286	5.42
	2. Vocational education	48146	20.72	5486	23.12
	3. Secondary vocational education	85490	36.80	8262	34.82
	4. Higher education, University	81130	34.92	8481	35.75
Income	High income	54520	23.47	5396	22.74
	Middle income	93136	40.09	9855	41.54
	Low income	84677	36.44	8475	35.72
Cars in the Household	No	27589	11.87	2694	11.35
	Yes	204744	88.13	21032	88.65
Driver's license	No	32270	13.89	2956	12.46
	Yes	193859	83.44	20569	86.69
	Unknown	9	0.00	1	0.00
	Under 18 years old	6195	2.67	200	0.85

Concerning the distribution of the green percentages within the sample, for both groups the mean values of Rural Green Areas, Restored Areas, Nature Areas and Green Percentage increased with the increasement of the buffer' size, while the Urban Green Areas' percentage decreased. These results are related to the fact that the increasement of the buffer areas result in a larger area of influence, therefore, comprehending the outskirts of the city.

It is also relevant to note that in the three areas of influence (1 km, 3 km, and 5 km buffers) the Restored Areas present the lowest percentages of green when comparing to Urban Green Areas, Rural Green Areas, Nature Areas and Green Percentage. The majority of postal codes present less than 1% of restored areas within the areas of influence, which explains the low means observed of the sample.

The Nature Areas, on the other hand, represent the totality of the Ecological Network in the Netherlands, which also comprehends the Restored Areas. As a result, its percentages are, in general, higher than the first ones. To conclude, the Green Percentage, as explained previously in section 4.1, presents the highest values of greenery in all the units of analysis due to its broader classification of greenery in the territory. The mean and standard deviation (SD) values of each one of the green categories, according to the active tour recreation time, can be found in Table 4.

Table 4. Characterization of the sample according to the greenery variables

Radius (km)	Variable	Active Tour Trip Recreation Time					
		0			>0		
		n	Mean	SD	n	Mean	SD
1	Rural Green Areas	232333	6.34	13.82	23726	6.97	14.57
	Urban Green Areas	232333	6.99	6.98	23726	6.60	6.72
	Restored Areas	232333	1.00	5.00	23726	0.87	4.50
	Green Percentage	232333	61.92	16.45	23726	62.95	16.39
	Nature Areas	232333	8.22	16.29	23726	8.99	16.93
3	Rural Green Areas	232333	8.81	11.54	23726	9.42	11.94
	Urban Green Areas	232333	5.48	4.51	23726	5.02	4.29

	Restored Areas	232333	1.57	4.30	23726	1.40	3.87
	Green Percentage	232333	68.91	12.06	23726	69.94	11.82
	Nature Areas	232333	12.00	13.43	23726	12.86	13.73
5	Rural Green Areas	232333	9.95	10.66	23726	10.40	10.85
	Urban Green Areas	232333	4.54	3.70	23726	4.14	3.48
	Restored Areas	232333	1.79	4.07	23726	1.56	3.62
	Green Percentage	232333	71.88	10.35	23726	72.72	10.02
	Nature Areas	232333	13.67	12.21	23726	14.26	12.26

Note. SD: Standard deviation.

In the entire sample, only 26.24% of people made at least one recreation trip (with the purpose of “Touring/walking” or “Sports/Hobby) at a certain day, with the remaining 73.76% of them doing one or more trips with other purposes, as presented in Table 5. Within the recreation trips, 9.87% of them are related to tour trips, which means that the trip does not present a specific destination, and people’s point of departure and arrival were their own residence. The focus of the regression analyses of this research will be precisely this specific type of trip, that better represents the leisure activities that are made in people’s immediate neighborhoods. In this particular case, it is possible to infer that the trip itself can be considered the leisure activity, since the trip did not present a specific destination.

Table 5. Characterization of the sample regarding the category of recreation

Variable	**Categories**	**Absolute frequency (n)**	**Relative frequency (%)**
Category of Recreation	0. No recreation	188879	73.76
	1. Recreation, but not leaving or returning to the place of residence	4484	1.76
	2. Recreation, leaving from the place of residence	37417	14.61

	3. Recreation, leaving from the place of residence and returning to the place of residence (round-trip/tour)	25279	9.87

Within the individuals that performed tour recreation trips, 93.86% of them walked or cycled during the trip (Table 6). These results show that this type of trip is directly related to physical activity, justifying the importance of studying specifically this type of trip for people's health.

Table 6. Characterization of the sample regarding the performance of recreation activities

Variable	**Categories**	**Active Tour Trip Recreation Time**			
		0		**>0**	
		Absolute frequency (n)	**Relative frequency (%)**	**Absolute frequency (n)**	**Relative frequency (%)**
Recreation activity	0. No recreation	188879	100	0	0
	1. Recreation, but not leaving or returning to the place of residence	4484	100	0	0
	2. Recreation, leaving from the place of residence	37417	100	0	0
	3. Recreation, leaving from the place of residence and returning to the place of residence (round-trip/tour)	1553	6.14	23726	93.86

To conclude, people spent, on average, 64 minutes performing active tour recreation trips. Considering walking and cycling separately, on average people spend more time walking (42 minutes) than cycling (24 minutes) during tour recreation trips (Table 7).

Table 7. Characterization of the sample regarding the types of active recreation

Active Recreation	Active Tour Trip Recreation Time					
	0			>0		
	n	Mean	SD	n	Mean	SD
Total	232333	0.00	0.00	23726	64.03	62.19
Cycling	232333	0.00	0.00	23726	24.03	63.31
Walking	232333	0.00	0.00	23726	42.32	44.32

Note. SD: Standard deviation.

4.2.2. Binary Logistic Regression

To verify the likelihood of the green areas' variables to predict the performance of leisure activities, a binary logistic regression was performed, as previously explained in section 3.1.2.2. Three different models were developed, considering the percentage of greenery within the radiuses of 1 km, 3 km and 5 km, and the differences among the results are presented in Table 8. For these models, all the cases were considered (n= 256,059). The dependent variable was the Category of Recreation, and within this variable, the trips were reclassified into two categories, the active tour recreation trips (1) and other trips (that includes the trips with other purposes and the non-active tour recreation trips) (0). As previously explained in section 3.1.2.2., this selection was made because tour recreation trips do not present specific destinations and can be considered the recreation activity itself. The focus on active tour recreation trips also fits the aim of this analysis, focusing on physical activity and health. To summarize, the active tour recreation trips will be type of leisure activity analyzed in this analysis.

Independent variables (Urban Green Areas, Rural Green Areas, Restored Areas, Nature Areas and Green Percentage) were added to the model simultaneously in a single step, and the effects were controlled for the variables related to sex, age, occupation, education, income, year, day of the week, car ownership and ownership of driver's license.

Table 8. Binary Logistic Regression Models for the influence of different types of greenery in the performance of leisure activities

Variable	Radius (Km)					
	1		3		5	
	Parameters					
	b	p	b	p	b	p
Intercept	1.963	0.076	1.919	0.084	1.938	0.081
Rural Green Areas	0.000	0.704	0.000	0.983	0.002	0.226
Urban Green Areas	-0.009	**0*** **	-0.023	**0*** **	-0.034	**0*** **
Restored Areas	-0.003	0.077	-0.003	0.111	-0.004	**0.038***
Green Percentage	0.003	**0*** **	0.005	**0*** **	0.004	**0*** **
Nature Areas	0.000	0.813	0.000	0.985	-0.002	0.099

1 km Model: $r^2 = 0.042$ (Cox-Snell), 0.092 (Nagelkerke). $\chi^2\ (5) = 170.170$. $p < 0.001$.

3 km Model: $r^2 = 0.043$ (Cox-Snell), 0.094 (Nagelkerke). $\chi^2\ (5) = 386.764$. $p < 0.001$.

5 km Model: $r^2 = 0.043$ (Cox-Snell), 0.094 (Nagelkerke). $\chi^2\ (5) = 435.883$. $p < 0.001$.

Note. Controlled for sex, age, occupation, education, income, year, week day, car ownership and driver's license ownership.
Significance levels: *$p \leq 0.05$; **$p \leq 0.01$; ***$p = 0$.

The results in Table 8 show that the three models, for 1 km, 3 km and 5 km radius presented highly statistically significant results ($p < 0.001$) and can predict the performance of leisure activities (represented by tour recreation trips) based on the independent variables. For the 1 km, 3 km and 5 km models, the independent variables can predict, respectively, 9.2%, 9.4% and 9.4% of the variance of the performance of leisure activities. The remaining variances in the models are explained by different variables that were not considered in this analysis, due to the focus of this research in the influence of greenery.

Regarding the predictive capacity of the variables individually, highly statistically significant results ($p=0$) were found for the independent variables Green Percentage and Urban Green Areas for all the three models, and statistically significant results ($p<0.05$) were found regarding the variable Restored Areas for the 5 km model. The variables Rural Green Areas and Nature Areas, on the other hand, did not present statistically significant results in any of the models ($p > 0.05$), therefore, their capacity of predicting the performance of leisure activities could not be determined.

Through the analysis of the model considering the green areas within the 1 km buffer, it was verified that an increase of 1% in the Urban Green Areas reduced by 0.009 times (OR: 0.991, 95% CI: 0.989, 0.994) the odds of performing leisure activities in the neighborhood, and an increase of 1% in the Green Percentage increased in 0.003 times (OR: 1.003, 95% CI:1.003, 1.004) the odds of engaging in leisure activities. For the 3 km model, an increase of 1% in Urban Green Areas reduced by 0.023 times (OR: 0.977, 95% CI: 0.973, 0.981) the odds of performing leisure activities, and the 1% increase in Green Percentage increased the odds of engaging in leisure activities by 0.005 times (OR: 1.005, 95% CI: 1.003, 1.006). To conclude, within the 5km radius, an 1% increase in Urban Green Areas reduced by 0.034 times (OR: 0.967, 95% CI: 0.961, 0.973) the odds of performing leisure activities, an 1% increase in Restored Areas reduced by 0.004 times (OR: 0.996, 95% CI: 0.992, 1.000) the odds of performing leisure activities, and an 1% increase in Green Percentage increased the odds of engaging in leisure activities by 0.004 times (OR: 1.004, 95% CI: 1.002, 1.007).

In short, the results of this analysis suggest that greenery' availability, in general, exert significant influence in people's leisure activities patterns, independently of the radius of influence around the individuals' dwelling. Concerning the number of active tour recreation trips, the influence of green areas varied, according to the type of greenery considered for the analysis.

Rural Green Areas and Nature Areas did not present statistically significant results in any of the models. The influence of Restored Areas was statistically significant only for the 5 km model, therefore, the combination of the results obtained for Nature Areas and Restored Areas did not provide sufficient evidence to determine the influence of the Ecological Network in people's leisure activities patterns. For the Restored Areas, particularly, the presence of the Veluwe in the classification, as already discussed in section 4.1., can be a factor that might have influenced the significance of the results, considering the effect that the area has in the percentage of Restored Areas of some of the postal codes. Oppositely to the previous categories, the Percentage of Green and the Urban Green Spaces presented statistically significant results for all the models, being influent in people's behavior. The Percentage of Green showed a weak, although positive, influence in people's chances to perform leisure activities, while the Urban Green Spaces presented a weak negative influence on it.

The negative influence of Urban Green Spaces (parks, public gardens and sports field), on population' active leisure activities was already observed in previous studies in the Netherlands, such as in Maas and colleagues (2008) and in Den Hertog, Bronkhorst, Moerman and Van Wilgenburg (2006), in which the authors found a negative relation between green space' availability and walking and cycling during leisure time. According to Maas and colleagues (2008), green spaces in urban areas are often set out more spaciously, which reduces the facilities density and increases the possibility of parking near people's homes. Similarly, Den Hertog and colleagues (2006) also showed that the density of the facilities and the parking possibilities are determinant for people's level of physical activity, and in places where there are more green spaces available and less possibilities of parking nearby, more people choose to walk or cycle for leisure. Although the parking possibilities were not considered in the present research, it is possible that this element exerted a direct influence on the results obtained, especially considering that most of the studied individuals in this research own, at least, one car (88%), as previously presented in section 4.2.1. In addition to this, environmental influences also play a role in people's choices to perform active leisure activities, such as the sensation of safety in the neighborhood, aesthetics, and quality of the facilities available (Hogendorf *et al*., 2020; Kaczynski, Potwarka, & Saelens, 2008; Stewart, Moudon, Littman, Seto, & Saelens, 2018). Therefore, the presence of urban green spaces in the neighborhood might have negative influence on people's behavior if these spaces are considered unsafe or aesthetically unpleasant. These elements were not measured during the present research but must be considered in future analysis.

Notwithstanding, as verified by Stewart and colleagues (2018) in their study about park proximity and physical activity, the direct effect of urban green spaces in physical activities is limited, and the proximity to parks only has effect in physical activities that are performed in parks, not having direct influence in physical activities that are not performed in these spaces. This finding can be related to our results, since the trips that were analyzed had leisure as purpose, not being directly related to the green areas in the neighborhood.

In opposition to the negative influence of Urban Green Spaces, it was discovered in this research that the Percentage of Green exerts a weak positive influence in people's odds to perform leisure activities. These results can be explained by the fact that the Green Percentage considers different types of vegetation in its calculus, which also includes most of the trees and the agriculture areas that exist in the neighborhood, comprehending a broader classification. These elements influence the attractiveness of the streetscapes, cited by Maas and colleagues (2008) as equally relevant for people being physically active.

In summary, the findings of this research do not entirely support our first hypothesis that people who live in greener neighborhoods are more likely to perform leisure activities than people who do not. The availability of greenery in the neighborhood, in general, proved to be significant in explaining people's leisure activities behavior in all the studied radiuses (1 km, 3 km and 5 km), although the exact effect of these spaces was inconclusive, depending on the type of greenery and its characteristics.

4.2.3. Zero-inflated Negative Binomial Regression

For the analysis of the time spent during leisure activities, only tour trips from and to the place of residence were considered (n = 25,279). The choice of this category was made because, by selecting and comparing only the people who already performed this type of activity, the influence of greenery in the time spent can be isolated from other factors and be better understood in this specific context. Models were developed considering the presence of different types of greenery within the radiuses of 1, 3 and 5 km as well as the total recreation time, cycling recreation time and walking recreation time. Independent variables were added to the model simultaneously in a single step, and the effects of variables related to sex, age, occupation, education, income, year and day of the week were controlled.

Tables 9, 10 and 11 present the zero-inflated negative binomial regressions for the total, cycling and walking recreation time. The zero-inflated model is a two-step model, in which it: 1) portraits the additional zeros, determining the odds of a person to not engage in determined behavior, and 2) performs a negative binomial model for modelling the level of engagement in the behavior (Green, 2021). In zero-inflated models there are two reasons for a participant to score zero, that might be either if the participant usually does not engage in the behavior or if the participant did not engage in the behavior in that specific period of time (Green, 2021). The interpretation of the results must consider the two steps of the model.

The results in Tables 9, 10 and 11 show that the three models, for 1 km, 3 km and 5 km radius presented highly statistically significant results ($p < 0.001$) and can predict the time spent walking, cycling and in total during leisure activities based on the independent variables. Differences were observed regarding the predictive capacity of the variables individually, according to the radius of influence. These differences will be presented below, for the variables that presented statistically relevant results ($p < 0.05$).

Table 9. Zero-Inflated Negative Binomial Models for the total time spent during leisure activities

Variable	Radius (km)											
	1				3				5			
	Negative binomial regression part		Logistic regression part		Negative binomial regression part		Logistic regression part		Negative binomial regression part		Logistic regression part	
	b	p	b	p	b	p	b	p	b	p	b	p
Intercept	3.929	**0*** **	-2.138	0***	**3.989**	**0*** **	-2.208	**0*** **	**3.918**	**0*** **	**-1.884**	**0*** **
Rural Green Areas	0	0.835	-0.003	0.382	0	0.583	0.002	0.623	-0.002	**0.035***	0	0.983
Urban Green Areas	-0.002	**0.011** **	-0.006	0.183	0	0.768	-0.005	0.523	0.005	**0.021***	-0.013	0.240
Restored Areas	0	0.666	0.005	0.440	0.001	0.461	0.008	0.234	0.001	0.660	0.008	0.281
Green Percentage	-0.001	**0*** **	0.002	0.294	-0.002	**0*** **	0.003	0.423	-0.002	**0.032***	-0.002	0.603
Nature Areas	0	0.938	-0.001	0.763	0.001	0.278	-0.003	0.498	0.002	**0.010** **	0.001	0.780

1 km model: χ^2 (10) = 30.551, p = 0.001.

3 km model: χ^2 (10) = 29.905, p = 0.001.

5 km model: χ^2 (10) = 38.943, p < 0.001.

Note. Controlled for gender, age, occupation, education, income, year and week day.

Significance levels: *p ≤ 0.05; **p ≤ 0.01; ***p= 0.

Considering the total time spent during leisure activities, for the 1 km model, the negative binomial regression part of the analysis reported that for 1% increase in Urban Green Areas, the expected log count of the total time spent during leisure activities decreases by 0.002, and for 1% increase in Green Percentage, the expected log count of the total time spent during leisure activities decreases by 0.001. For the 3 km model, for 1% increase in Green Percentage, the expected log count of the total time spent during leisure activities decreases by 0.002. To conclude, for the 5 km model, for 1% increase in Rural Green Areas, the expected log count of the total time spent during leisure activities decreases by 0.002, same result obtained for Green Percentage. Oppositely, for 1% increase in Urban Green Areas, the expected log count of the total time spent during leisure activities increases by 0.005, and for 1% increase in Nature Areas, the expected log count of the total time spent during leisure activities increases by 0.002. For all the models, the results obtained by the logistic regression part of the analysis were not significant.

These results showed that an increase in the Green Percentage reduces the chances of observing an increase in the total time spent during leisure activities in the three distances, and for the 5 km radius, the chances of observing an increase in the total time spent during leisure activities heighten with the increase in the percentages of Urban Green Areas and Nature Areas. Initially, these results appear to differ from the previous results obtained through the binary logistic regression, but there are two important observations to be made. First, the populations considered for the analyses were different, because for the binary regression analysis, all the individuals (n= 256,059) were considered, and for the zero-inflated negative binomial regression, only the individuals that performed tour trips (n = 25,279) were studied. Second, the dependent variables were also different, and while in the first analysis we studied the likelihood of the performance of active tour trips, in this analysis the focus was on the total time spent during the trips. Therefore, it is possible to interpret that although an increasement in the Green Percentage enhances the odds of performing active leisure activities, its effect is negative for the total time spent during these activities. The opposite occurs with Urban Green Areas, which increasement diminishes the odds of performing leisure activities, but also positively affects the total time spend during these activities.

Table 10. Zero-Inflated Negative Binomial Models for the walking time during leisure activities

Variable	Radius (km)											
	1				3				5			
	Negative binomial regression part		Logistic regression part		Negative binomial regression part		Logistic regression part		Negative binomial regression part		Logistic regression part	
	b	p	b	p	b	p	b	p	b	p	b	p
Intercept	3.821	**0*****	-1.629	**0*****	3.882	**0*****	-1.548	**0*****	3.794	**0*****	-1.423	**0*****
Rural Green Areas	0.001	0.316	-0.002	0.329	0.000	0.823	0.001	0.812	-0.003	**0.007****	-0.001	0.669
Urban Green Areas	-0.001	0.325	-0.009	**0*****	0.002	0.266	-0.017	**0*****	0.008	**0*****	-0.025	**0*****
Restored Areas	0.000	0.827	0.005	0.178	0.000	0.887	0.010	**0.020***	-0.002	0.149	0.011	**0.015****
Green Percentage	-0.002	**0*****	0.002	0.141	-0.003	**0*****	0.001	0.757	-0.002	**0.008****	-0.001	0.590
Nature Areas	0.000	0.820	-0.002	0.241	0.001	0.150	-0.003	0.226	0.003	**0.001****	0.000	0.923

1 km model: χ^2 (10) = 66.155, $p < 0.001$.

3 km model: χ^2 (10) = 81.069, $p < 0.001$.

5 km model: χ^2 (10) = 107.004, $p < 0.001$.

Note. Controlled for gender, age, occupation, education, income, year and week day.

Significance levels: *$p \leq 0.05$; **$p \leq 0.01$; ***p= 0.

Considering the time spent walking during leisure activities, for all the three models (1 km, 3 km and 5 km) the results of the logistic regression part of the analysis suggest that an increase in the Urban Green Areas reduced the odds of not engaging in walking during these activities. For the 1 km model, an 1% increase in the Urban Green Areas reduced the odds of not engaging in walking during leisure activities by 0.009 times (OR: 0.991, 95% CI:0.987, 0.005), for the 3 km model, an 1% increase in the Urban Green Areas reduced the odds of not engaging in walking during leisure activities by 0.017 times (OR: 0.983, 95% CI: 0.974, 0.993), and, to conclude, for the 5 km model, an 1% increase in the Urban Green Areas reduced the odds of not engaging in walking during leisure activities by 0.025 times (OR: 0.975, 95% CI:0.964, 0.987). Oppositely, for the 3 km and 5 km models, an 1% increase in the Restored Areas enhanced the odds of not engaging in walking during leisure activities by 0.010 times (OR: 1.010, 95% CI:1.002, 1.018) and by 0.011 times (OR: 1.011, 95% CI:1.003, 1.019), respectively. The negative binomial regression part of the analysis suggests that, for all the three models, an increase in the Green Percentage results in a decrease in the expected log count of the time spent walking during leisure activities. For 1% increase in Green Percentage, the expected log count of the time spent walking during leisure activities reduces by 0.002, 0.003 and 0.002 for 1 km, 3 km and 5 models, respectively. For the 5 km model, specifically, for 1% increase in Rural Green Areas the expected log count of the time spent walking during leisure activities reduces by 0.003, for 1% increase in Urban Green Areas the expected log count of the time spent walking during leisure activities enhances by 0.008, and for 1% increase in Nature Areas, the expected log count of the time spent walking during leisure activities enhances by 0.003.

To conclude, for the time spent walking, the results were similar to the total time spent during active leisure activities, and an increase in the Green Percentage reduced the chances of observing an increase in the total time spent during leisure activities within the three distances, while an increase in the Urban Green Areas positively influenced the chances of observing an increase in the time spent walking in the 3 km and 5 km models.

Table 11. Zero-Inflated Negative Binomial Models for the cycling time during leisure activities

Variable	Radius (km)											
	1				3				5			
	Negative binomial regression part		**Logistic regression part**		**Negative binomial regression part**		**Logistic regression part**		**Negative binomial regression part**		**Logistic regression part**	
	b	**p**	**b**	**p**	**b**	**p**	**b**	**p**	**b**	**p**	**b**	**p**
Intercept	4.643	**0*****	2.262	**0*****	4.637	**0*****	2.131	**0*****	4.618	**0*****	2.147	**0******
Rural Green Areas	-0.001	0.378	0.000	0.877	-0.001	0.751	0.000	0.941	0.000	0.997	0.002	0.645
Urban Green Areas	0.001	0.752	0.010	**0*****	0.007	**0.035***	0.020	**0*****	0.012	**0.008****	0.027	**0*****
Restored Areas	0.000	0.853	-0.003	0.413	0.001	0.820	-0.007	0.149	0.001	0.726	-0.008	0.108
Green Percentage	-0.001	0.244	-0.001	0.549	-0.001	0.357	0.001	0.663	-0.001	0.512	0.001	0.785
Nature Areas	0.000	0.690	0.002	0.375	0.001	0.531	0.001	0.616	0.001	0.583	-0.001	0.858

1 km model: χ^2 (10) = 22.364, p = 0.013;

3 km model: χ^2 (10) = 37.247, p < 0.001;

5 km model: χ^2 (10) = 52.081, p < 0.001.

Note. Controlled for gender, age, occupation, education, income, year and week day.

Significance levels: *p ≤ 0.05; **p ≤ 0.01; ***p= 0.

Considering the time spent cycling during leisure activities, for all the three models (1 km, 3 km and 5 km) the results of the logistic regression part of the analysis suggest that an increase in the Urban Green Areas enhances the chances of not engaging in cycling during leisure activities, in corroboration to the results found in the section 4.2.2. For the 1 km model, an 1% increase in the Urban Green Areas enhanced the odds of not engaging in cycling during leisure activities by 0.010 times (OR: 1.010, 95% CI:1.004, 1.016), for the 3 km model, an 1% increase in the Urban Green Areas enhanced the odds of not engaging in cycling during leisure activities by 0.020 times (OR: 1.020, 95% CI:1.010, 1.030), and, to conclude, for the 5 km model, an 1% increase in the Urban Green Areas enhanced the odds of not engaging in cycling during leisure activities by 0.027 times (OR: 1.027, 95% CI:1.013, 1.042). The analysis of the negative binomial regression part, on the other hand, suggests that even though an increase in the Urban Green Areas reduces the chances of cycling during leisure activities, it enhances the chances of observing an increase in the time spent cycling within the people who choose to perform these activities. For 3 km model, the model provides the information that for 1% increase in Urban Green Areas, the expected log count of the time spent cycling during leisure activities increases by 0.007, and for the 5 km model, for 1% increase in Urban Green Areas, the expected log count of the time spent cycling during leisure activities increases by 0.012.

It is possible to conclude that the results obtained for cycling were less significant when compared to the total time spent and the walking time spent during leisure activities, and only Urban Green Areas presented a weak positive influence for the radiuses of 3 km and 5 km. The logistic part of the analysis is in accordance with the results obtained previously in section 4.2.2., and for all the models, the Urban Green Spaces also presented negative influence in the odds of performing cycling leisure activities.

In summary, greenery proved to be statistically significant for the prediction of the time spent cycling and walking during leisure activities, for all the three radiuses. The particularities in the influence of each type of greenery varies according to the radius and the categories of physical activities considered, but in general, it is possible to confirm a stronger influence of the Percentage of Green and the Urban Green Spaces in these activities.

It is important to note that for all the categories of analysis, the influence of the Restored Areas in the time spent during leisure activities could not be verified, due to its statistically non-relevant results. The Nature Areas presented similar results, excluding the weak positive influence that those areas presented in the total time spent during leisure activities for the 5 km radius. Consequently, it was not possible to verify the influence of the Ecological Network in the time spend cycling and walking during leisure activities, and one of the contributions that this research intended to provide, related to the importance of these specific areas to human daily lives and health, could not be achieved.

To conclude, the second hypothesis of this research, that assumed that people who live in greener neighborhoods spend more time walking and cycling for leisure was not confirmed in this research, and the mixed results obtained suggest that a more detailed analysis of this relation should be performed in the future.

5. Conclusion

This study analyzed the influence of different types of greenery in Dutch population' leisure activities patterns for the period of 2010 to 2019. By distinguishing the Green Infrastructure from the Ecological Network available in the country, it was possible to investigate their specific relevance in people's behavior, filling a gap that was previously identified in the literature.

In the beginning of this research, two main hypotheses were made. First, that people who live in greener neighborhoods are more likely to perform leisure activities than people who do not, and second, that people who live in greener neighborhoods spend more time walking and cycling when performing leisure activities. The results obtained showed that although the availability of greenery, in general, is a significant element to predict the likelihood of performing leisure activities and the time spent during these activities, this relation is weak and differs according to the type of greenery.

The influence of the Ecological Network, represented by the categories Restored Areas and Nature Areas did not present statistically relevant results, thus no strong evidence was found of the direct influence of Ecological Network in people's likelihood to perform leisure activities. The influence of the Green Infrastructure, on the other hand, could be measured mainly by two categories, Urban Green Spaces and Percentage of Green. While the influence of Urban Green Spaces was negative in people's odds to perform leisure activities, the Percentage of Green showed an opposite effect. The reasons for these differences can be explained by interpersonal and environmental aspects, and the findings of this research are in accordance with the theory of Social Ecology, that assumes that human behavior is influenced by social, physical, and interpersonal environments (Sallis *et al*., 1997).

As demonstrated, greenery does have significant influence in the Dutch population' leisure activities patterns, although it is not the only aspect that is relevant for this analysis. Individual's preferences, house composition, social support, and other characteristics of the physical environment such as sensation of safety, parking spaces' availability, aesthetics and the quality of the public facilities also directly influence people's behavior. Therefore, the availability of greenery in people's neighborhoods does not explain, by itself, the willingness of people to perform leisure activities, and should not be analyzed separately from the interpersonal context in which the individual is inserted.

The time spent cycling and walking during leisure activities showed some similarities and some differences from the results obtained in the analysis of the likelihood of performing leisure activities, that can be partially explained by the differences between the studied populations and the dependent variables. At the same time that the effect of greenery was significant for the analysis, its influence was weak. Overall, only Urban Green Spaces presented a weak positive influence in the time spent during cycling, whilst for walking and the total time spent during leisure activities Green Percentage presented a weak negative influence and Urban Green Areas presented a weak positive influence on it.

The outcomes of this analysis can be related to the results obtained in Hogendorf and colleagues (2020), that found weak evidence of the effects of green space in walking, and Maas and colleagues (2008), whose results showed that people who lived in greener neighborhoods walked and cycled less often and fewer minutes during leisure time. As suggested by Hogendorf and colleagues (2020), these results demonstrate that physical activity, such as walking and cycling, highly depend on personal preferences and constraints, elements that were not measured during the present analysis.

It is also important to consider that there are elements of the Dutch culture that directly influence the results obtained in this research. As previously identified by Hogendorf and colleagues (2020) and Maas and colleagues (2008), the prioritization of walking and cycling over driving and the high degree of urbanization also play an important role in people’s behavior. The vast availability and use of bike lanes and footpaths, and the high density of sports facilities promote the performance of physical activity in the most different environments, and do not restrict these activities to people’s immediate neighborhoods, and consequently, to the green spaces that are available in the surroundings.

The design of this research also influenced the results obtained. The choice for the use of mobility surveys restrained the collected information, and no specificities related to people’s preferences and perceptions about their immediate neighborhoods were acquired. The choice of the buffer sizes, although justified by the literature, also might play a role in the strength and significance of the results, because it was used as the basis for the entire analysis.

To conclude, the results obtained did not provide enough evidence to confirm the two hypotheses of this research, nevertheless the investigation of the influence of different types of green in leisure activities’ patterns confirmed to be relevant, especially in the context of the Netherlands, a country that encourages the use of active means of transportation and the performance of physical activity through urban planning. Future research, focused on the individual’s perception towards physical activity and the quality of his immediate environment, is recommended in order to complement this analysis, and shed light to the interpretations of the results.

6. Reflection

The contribution of this research is its investigation of the influence of different types of greenery in the population' leisure activities patterns, a focus that is not common for most of the studies performed in the Netherlands and abroad. The attempt to identify the types of green spaces that have higher influence on people' behavior provides relevant information for planning. Additionally, the use of different datasets avoided single source bias, and the size of the sample used for the research enhances its external validity, allowing generalizations about the entire Dutch population. The limitations of the research and the recommendations for future studies will be presented below.

6.1. Limitations of the Research

This research presents some limitations that will be presented in this section, and the first one is related to the datasets. To identify the Rural and Urban Green Areas in the Dutch territory, the Land Use Map for the year of 2015 was used as reference for all the years of analysis, from 2010 to 2019. This map was chosen since it is the most recent available version of the information, although it does not show the changes in the territory over the years. Similarly, the Percentage of Green is a map from the year of 2017 and does not show the changes that occurred in the territory in the entire period of 2010 to 2019. In both cases, the percentages of the different types of green in the territory are considered the same for the entire period of analysis, which might have cause imprecisions of calculus.

The second limitation of this research is the fact that important objective environmental measures, such as the population' perceptions about their neighborhood, and specific information about their leisure activities and routines were not available, which limited the interpretation of the results and the determination of the real relevance of green spaces in people's daily lives. Weather conditions, that directly influence in the performance of physical activities outside were not collected, even though they play an important role in this context.

The third limitation identified is that the level of urbanicity was not considered in the analysis, and this information brings important insights that can help explain the observed behavior patterns of the population. By analyzing the level of urbanicity, it is possible to determine the differences in the behavior of rural and urban population, for example, and also identify the importance of the availability of green spaces for different groups of individuals.

To conclude, this research focused on the tour trips with the purpose of leisure around people's immediate dwellings, which also can represent a limitation in the general analysis of the influence of green spaces in leisure activities patters. By selecting the population' houses as unique departure and arrival points of analysis, the research excludes other spaces that might be recurrent departure points for the performance of leisure activities as well, such as their workplaces and schools.

6.2. Recommendation for Future Research

During the process of construction of this research, it was possible to identify the complexity of the studied subject. The comprehension and the prediction of human behavior is intricate, and diverse important elements, beyond greenery' neighborhood availability, were recognized during the data analysis. Due to the restrictions of time and resources for this research, the aspects that were not properly addressed will be recommended for consideration in future opportunities.

The first recommendation is the collection of data related to people's lifestyle, social context and preferences concerning green spaces, elements that directly influence on behavior patterns. In this context, the improvement of the measurement strategies is also welcome, and the collection of self-reported data, in addition to directly measured data, can be useful because it allows comparisons between the way that people perceive the environment and the reality that is observed in those spaces.

The second recommendation is to consider environmental elements such as weather conditions and level of urbanicity in future analysis. By collecting and analyzing the environment conditions, it will be possible to build a comprehensive overview of the importance of these elements on people's choices, and to determine to which extent they have influence in the level of the population' physical activity and health.

Concerning the information obtained through the OViN and ODiN datasets, it is recommended that in future research the utilization of the category "2. Recreation, leaving from the place of residence" of the variable Motive of Recreation in the analysis. This category complements the tour trips and might have positive influence in the results.

Improvements in the research design are also recommended, and a longitudinal analysis might be an option to better understand the influence of the changes in greenery in people's behavior concerning leisure activities over the years. By following the same individual through the years, the isolation of the direct influence of greenery in his behavior can become clearer. In this context, a fixed-effect analysis is also recommended, and could be used to separate the effects of the person' personal characteristics to the effects that are being measured, enhancing the basis for causal inference when analyzing the results.

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Appendices

Table of Content

1. SPSS Codebook

Variable	Position	Label	Measurement Level	Role	Column Width	Alignment	Print Format	Write Format
pc4	1	Postal Code	Nominal	Input	6	Right	F4	F4
opid	2	Unique ID per person	Scale	Input	13	Right	F11	F11
prov	3	Province	Nominal	Input	6	Right	F2	F2
kleeft	4	Age Class	Nominal	Input	19	Right	F2	F2
geslacht	5	Sex	Nominal	Input	19	Right	F1	F1
leeftijd	6	Age	Scale	Input	10	Right	F2	F2
onbbez	7	Unpaid Occupation	Nominal	Input	8	Right	F1	F1
maatspart	8	Social Participation/Ocupation	Nominal	Input	11	Right	F2	F2
opleiding	9	Education	Ordinal	Input	11	Right	F2	F2
hhgestinkg	10	Income (10% group)	Nominal	Input	12	Right	F2	F2
hhauto	11	Number of cars in the household	Nominal	Input	8	Right	F2	F2
rijbewijs	12	Participant has driver's license	Nominal	Input	11	Right	F1	F1

hhander	13	Number of other means of transport in the household	Nominal	Input	9	Right	F2	F2
maand	14	Month	Nominal	Input	7	Right	F2	F2
week	15	Week	Scale	Input	6	Right	F2	F2
dag	16	Day	Scale	Input	5	Right	F2	F2
weggeweest	17	Participant left	Nominal	Input	12	Right	F1	F1
redennw	18	Reason not to leave	Scale	Input	9	Right	F1	F1
wopc4_cons	19	Postal Code return	Nominal	Input	14	Left	A12	A12
recreatieduur_actief	20	Active recreation time	Scale	Input	22	Right	F3	F3
recreatieduur_fiets	21	Cycling recreation time	Scale	Input	21	Right	F3	F3
recreatieduur_wandelen	22	Walking recreation time	Scale	Input	24	Right	F3	F3
reisduur_missing	23	Recreation time_missing	Nominal	Input	18	Right	F1	F1
recreatie_cat	24	Category of recreation	Nominal	Input	30	Right	F1	F1
Age_Reviewed	25	<none>	Ordinal	Input	23	Right	F8.2	F8.2
Age_1824	26	<none>	Nominal	Input	8	Right	F8	F8
Age_2534	27	<none>	Nominal	Input	8	Right	F8	F8
Age_3544	28	<none>	Nominal	Input	8	Right	F8	F8
Age_4554	29	<none>	Nominal	Input	8	Right	F8	F8
Age_5564	30	<none>	Nominal	Input	8	Right	F8	F8
Age_6574	31	<none>	Nominal	Input	8	Right	F8	F8
Age_Above74	32	<none>	Nominal	Input	8	Right	F8	F8
Occupation_Reviewed	33	<none>	Nominal	Input	21	Right	F8.2	F8.2
Housewife	34	<none>	Nominal	Input	8	Right	F8	F8
Student	35	<none>	Nominal	Input	8	Right	F8	F8
Unemployed	36	<none>	Nominal	Input	8	Right	F8	F8
Disabled	37	<none>	Nominal	Input	8	Right	F8	F8
Retired	38	<none>	Nominal	Input	8	Right	F8	F8
Occupation_Other	39	<none>	Nominal	Input	8	Right	F8	F8
Income_Reviewed	40	<none>	Ordinal	Input	16	Right	F8.2	F8.2
Middle_income	41	<none>	Nominal	Input	8	Right	F8	F8
Low_income	42	<none>	Nominal	Input	8	Right	F8	F8
Unknown_income	43	<none>	Nominal	Input	8	Right	F8	F8

Jaar	44	Year	Ordinal	Input	6	Right	F4	F4
Year2011	45	<none>	Nominal	Input	8	Right	F8	F8
Year2012	46	<none>	Nominal	Input	8	Right	F8	F8
Year2013	47	<none>	Nominal	Input	8	Right	F8	F8
Year2014	48	<none>	Nominal	Input	8	Right	F8	F8
Year2016	49	<none>	Nominal	Input	8	Right	F8	F8
Year2017	50	<none>	Nominal	Input	8	Right	F8	F8
Year2018	51	<none>	Nominal	Input	8	Right	F8	F8
Year2019	52	<none>	Nominal	Input	8	Right	F8	F8
weekdag	53	Week Day	Nominal	Input	9	Right	F1	F1
Maandag	54	Monday	Nominal	Input	8	Right	F8	F8
Dinsdag	55	Tuesday	Nominal	Input	8	Right	F8	F8
Woensdag	56	Wednesday	Nominal	Input	8	Right	F8	F8
Donderdag	57	Thursday	Nominal	Input	8	Right	F8	F8
Vrijdag	58	Friday	Nominal	Input	8	Right	F8	F8
Zaterdag	59	Saturday	Nominal	Input	8	Right	F8	F8
BBG_Rural_1	60	Land Use_Rural_1	Scale	Input	21	Right	F8.2	F8.2
BBG_Urban_1	61	Land Use_Urban_1	Scale	Input	21	Right	F8.2	F8.2
BBG_Rural_3	62	Land Use_Rural_3	Scale	Input	21	Right	F8.2	F8.2
BBG_Urban_3	63	Land Use_Urban_3	Scale	Input	21	Right	F8.2	F8.2
BBG_Rural_5	64	Land Use_Rural_5	Scale	Input	21	Right	F8.2	F8.2
BBG_Urban_5	65	Land Use_Urban_5	Scale	Input	21	Right	F8.2	F8.2
GreenPercentage_1	66	NOK_VRN_1	Scale	Input	18	Right	F19.15	F19.15
GreenPercentage_3	67	NOK_VRN_3	Scale	Input	17	Right	F18.15	F18.15
GreenPercentage_5	68	NOK_VRN_5	Scale	Input	17	Right	F18.15	F18.15
Restored_1	69	VRN_1	Scale	Input	20	Right	F8.2	F8.2
Restored_3	70	VRN_3	Scale	Input	20	Right	F8.2	F8.2
Restored_5	71	VRN_5	Scale	Input	20	Right	F8.2	F8.2
Nature_Areas_1	72	<none>	Scale	Input	24	Right	F8.2	F8.2
Nature_Areas_3	73	<none>	Scale	Input	24	Right	F8.2	F8.2
Nature_Areas_5	74	<none>	Scale	Input	24	Right	F8.2	F8.2
Primary_education	75	<none>	Nominal	Input	21	Right	F8	F8

Vocational_education	76	<none>	Nominal	Input	30	Right	F8	F8
Scondary_vocational_education	77	<none>	Nominal	Input	34	Right	F8	F8
University	78	<none>	Nominal	Input	16	Right	F8	F8
Other_education	79	<none>	Nominal	Input	10	Right	F8	F8
Unknown_education	80	<none>	Nominal	Input	14	Right	F8	F8
Not_asked_education	81	<none>	Nominal	Input	16	Right	F8	F8
Car_household	84	<none>	Nominal	Input	10	Right	F8.2	F8.2
Drivers_license_yes	85	<none>	Nominal	Input	14	Right	F8.2	F8.2
Drivers_license_unknown	86	<none>	Nominal	Input	23	Right	F8.2	F8.2
Drivers_license_Under18	87	<none>	Nominal	Input	23	Right	F8.2	F8.2

2. Characterization of the entire sample (n = 305,651)

Sociodemographics

Variable	Categories	Absolute frequency (n)	Relative frequency (%)
Sex	Male	150853	49.35
	Female	154798	50.65
Age group	Under 18	55605	18.19
	18 to 24 years old	24527	8.02
	25 to 34 years old	36791	12.04
	35 to 44 years old	42081	13.77
	45 to 54 years old	50327	16.47
	55 to 64 years old	45103	14.76
	65 to 74 years old	33185	10.86

	Over 74 years old	18032	5.90
Occupation	Worker	147529	48.27
	Housewife/husband	20777	6.80
	Student	49800	16.29
	Unemployed	5556	1.82
	Disabled	6745	2.21
	Retired	52000	17.01
	Other	23244	7.60
Education	0. Incomplete education	2822	0.92
	1. Primary education	16404	5.37
	2. Vocational education	53789	17.60
	3. Secondary vocational education	94214	30.82
	4. Higher education, university	90503	29.61
	5. Other	4627	1.51
	6. Unknown	462	0.15
	7. Not asked; under 15 years old	42830	14.01
Income	High income	74282	24.30
	Middle income	123107	40.28
	Low income	106011	34.68

	Unknown income	2249	0.74
Cars in the household	No	34826	11.39
	Yes	270825	88.61
Driver's license	No	49082	16.06
	Yes	219045	71.67
	Unknown	16	0.01
	Under 18 years old	37508	12.27

Year and Week Day

Variable	**Categories**	**Absolute frequency (n)**	**Relative frequency (%)**
Year	2010	31732	10.38
	2011	30161	9.87
	2012	32264	10.56
	2013	31320	10.25
	2014	31630	10.35
	2016	27303	8.93
	2017	27679	9.06
	2018	48720	15.94
	2019	44842	14.67

	Sunday	33334	10.91
	Monday	47405	15.51
	Tuesday	47506	15.54
Day of the week	Wednesday	46537	15.23
	Thursday	46627	15.25
	Friday	46947	15.36
	Saturday	37295	12.20

3. Regressions results (including control variables)

a. Binary Logistic Regression

	Radius								
	1 km			3 km			5 km		
	b	SE	p	b	SE	p	b	SE	p
Sex_Male	-.068	.014	**.000***	-.067	.014	**.000***	-.068	.014	**.000***
Age	.136	.007	**.000***	.134	.007	**.000***	.134	.007	**.000***
Housewife/husband	-.399	.032	**.000***	-.396	.032	**.000***	-.396	.032	**.000***
Student	.264	.039	**.000***	.262	.039	**.000***	.260	.039	**.000***
Unemployed	-.586	.044	**.000***	-.596	.044	**.000***	-.597	.044	**.000***
Disabled	-.820	.037	**.000***	-.822	.037	**.000***	-.819	.037	**.000***
Retired	-.222	.025	**.000***	-.222	.025	**.000***	-.222	.025	**.000***
Other occupation	-.295	.036	**.000***	-.290	.036	**.000***	-.291	.036	**.000***
Education	.010	.008	.252	.019	.008	**.026***	.022	.008	**.010***
Income	-.037	.010	**.000***	-.037	.010	**.000***	-.033	.010	**.002***
Year_2011	.364	.051	**.000***	.362	.051	**.000***	.361	.051	**.000***
Year_2012	-.662	.040	**.000***	-.665	.040	**.000***	-.667	.040	**.000***

	Year_2013	-.741	.040	**.000***	-.744	.040	**.000***	-.745	.040	**.000***
	Year_2014	-.802	.039	**.000***	-.803	.039	**.000***	-.805	.039	**.000***
	Year_2016	-.771	.041	**.000***	-.783	.041	**.000***	-.792	.041	**.000***
	Year_2017	-.638	.041	**.000***	-.651	.041	**.000***	-.659	.041	**.000***
	Year_2018	-1.563	.035	**.000***	-1.575	.035	**.000***	-1.579	.035	**.000***
	Year_2019	-1.579	.035	**.000***	-1.601	.035	**.000***	-1.609	.036	**.000***
	Monday	.492	.025	**.000***	.497	.025	**.000***	.499	.025	**.000***
	Tuesday	.585	.025	**.000***	.590	.025	**.000***	.592	.025	**.000***
	Wednesday	.520	.025	**.000***	.526	.025	**.000***	.529	.025	**.000***
	Thursday	.598	.026	**.000***	.604	.026	**.000***	.606	.026	**.000***
	Friday	.646	.026	**.000***	.651	.026	**.000***	.653	.026	**.000***
	Saturday	.567	.026	**.000***	.570	.026	**.000***	.570	.027	**.000***
	Car_Yes	-.133	.025	**.000***	-.086	.025	**.001***	-.077	.025	**.002***
	Driver's_License_No	-.076	.025	**.002***	-.066	.025	**.008***	-.065	.025	**.009***
	Driver's_License_Unknown	-.246	1.069	.818	-.242	1.070	.821	-.212	1.068	.843
	Driver's_License_Under_18	-.249	.081	**.002***	-.240	.081	**.003***	-.242	.081	**.003***
	Rural Green Areas	.000	.001	.704	.000	.001	.983	.002	.001	.226
	Urban Green Areas	-.009	.001	**.000***	-.023	.002	**.000***	-.034	.003	**.000***
	Restored Areas	-.003	.002	.077	-.003	.002	.111	-.004	.002	**.038***
	Green Percentage	.003	.000	**.000***	.005	.001	**.000***	.004	.001	**.000***
	Nature Areas	.000	.001	.813	.000	.001	.985	-.002	.001	.099
	Intersect	1.963	1.107	.076	1.919	1.109	.084	1.938	1.109	.081

Dependent Variable: Recreatie_cat
*: Statistically significant value at the 5% level ($p \leq 0.05$).

b. Zero-inflated negative binomial regression

Model for the walking time during leisure activities

Variable	Radius																	
	1 km						3 km						5 km					
	Negative binomial regression part			Logistic regression part			Negative binomial regression part			Logistic regression part			Negative binomial regression part			Logistic regression part		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p
Intercept	3.821	.045	**.000***	-1.629	.154	**.000***	3.882	.059	**.000***	-1.548	.194	**.000***	3.794	.071	**.000***	-1.423	.229	**.000***
Sex_Female	-.009	.010	.371	-.550	.032	**.000***	-.009	.010	.385	-.551	.032	**.000***	-.009	.010	.367	-.551	.032	**.000***
Age	.025	.005	**.000***	.079	.016	**.000***	.025	.005	**.000***	.077	.016	**.000***	.026	.005	**.000***	.077	.016	**.000***
Housewife/ husband	.129	.021	**.000***	.148	.076	**.052***	.127	.021	**.000***	.150	.076	**.048***	.128	.021	**.000***	.150	.076	**.049***
Student	-.010	.026	.694	.580	.084	**.000***	-.011	.026	.688	.577	.084	**.000***	-.009	.026	.718	.578	.084	**.000***
Unemployed	.188	.029	**.000***	.226	.098	**.021***	.181	.029	**.000***	.225	.098	**.022***	.180	.029	**.000***	.228	.098	**.021***
Disabled	.052	.024	**.029***	.051	.082	.538	.048	.024	.044	.048	.082	.559	.049	.024	**.039***	.048	.082	.555
Retired	.209	.017	**.000***	.544	.055	**.000***	.208	.017	**.000***	.544	.055	**.000***	.206	.017	**.000***	.545	.055	**.000***
Other occupation	.117	.024	**.000***	.235	.078	**.003***	.116	.024	**.000***	.236	.078	**.003***	.115	.024	**.000***	.237	.078	**.002***
Education	.001	.006	.873	-.090	.018	**.000***	.000	.006	.944	-.088	.018	**.000***	-.001	.006	.855	-.087	.018	**.000***
Income	.003	.007	.634	.006	.023	.776	.004	.007	.593	.002	.023	.920	.004	.007	.574	.003	.023	.911
Year_2011	-.045	.036	.213	.281	.134	**.036***	-.045	.036	.217	.284	.134	**.035***	-.047	.036	.195	.285	.134	**.034***
Year_2012	.085	.028	**.002***	.221	.108	**.040***	.084	.028	**.003***	.223	.108	**.038***	.081	.028	**.004***	.224	.108	**.038***
Year_2013	.077	.028	**.005***	.148	.107	.169	.077	.028	**.005***	.150	.107	.163	.077	.028	**.005***	.150	.107	.164
Year_2014	.097	.027	**.000***	.209	.105	**.047***	.096	.027	**.000***	.211	.105	**.045***	.096	.027	**.000***	.210	.105	**.046***
Year_2016	.102	.028	**.000***	.121	.109	.269	.096	.028	**.001***	.119	.109	.277	.096	.028	**.001***	.116	.109	.287
Year_2017	.082	.029	**.004***	.307	.108	**.005***	.076	.029	**.009***	.305	.109	**.005***	.075	.029	**.010***	.299	.109	**.006***
Year_2018	.428	.025	**.000***	.878	.094	**.000***	.419	.025	**.000***	.890	.094	**.000***	.414	.025	**.000***	.893	.094	**.000***
Year_2019	.453	.025	**.000***	.771	.094	**.000***	.442	.025	**.000***	.786	.094	**.000***	.435	.025	**.000***	.792	.094	**.000***

Monday	-.315	.017	**.000***	-.466	.054	**.000***	-.313	.017	**.000***	-.466	.054	**.000***	-.315	.017	**.000***	-.465	.054	**.000***
Tuesday	-.317	.017	**.000***	-.455	.055	**.000***	-.314	.017	**.000***	-.457	.055	**.000***	-.315	.017	**.000***	-.459	.055	**.000***
Wednesday	-.306	.017	**.000***	-.424	.054	**.000***	-.303	.017	**.000***	-.426	.054	**.000***	-.302	.017	**.000***	-.427	.054	**.000***
Thursday	-.333	.018	**.000***	-.490	.056	**.000***	-.331	.018	**.000***	-.490	.056	**.000***	-.330	.018	**.000***	-.491	.056	**.000***
Friday	-.286	.018	**.000***	-.400	.056	**.000***	-.283	.018	**.000***	-.401	.056	**.000***	-.283	.018	**.000***	-.401	.056	**.000***
Saturday	-.174	.019	**.000***	-.073	.054	.172	-.173	.019	**.000***	-.074	.054	.167	-.173	.019	**.000***	-.076	.054	.158
Rural Green Areas	.001	.001	.316	-.002	.002	.329	.000	.001	.823	.001	.003	.812	-.003	.001	**.007***	-.001	.003	.669
Urban Green Areas	-.001	.001	.325	-.009	.002	**.000***	.002	.001	.266	-.017	.005	**.000***	.008	.002	**.000***	-.025	.006	**.000***
Restored Areas	.000	.001	.827	.005	.004	.178	.000	.001	.887	.010	.004	**.020***	-.002	.001	.149	.011	.004	**.015***
Green Percentage	-.002	.000	**.000***	.002	.001	.141	-.003	.001	**.000***	.001	.002	.757	-.002	.001	**.008***	-.001	.002	.590
Nature Areas	.000	.001	.820	-.002	.002	.241	.001	.001	.150	-.003	.002	.226	.003	.001	**.001***	.000	.003	.923

Dependent variable: recreatieduur_wandelen.
SE: Standard Error.
*: Statistically significant value at the 5% level (p ≤ 0.05).

Model for cycling during leisure activities

	Radius																	
	1 km						**3 km**						**5 km**					
	Negative binomial regression part			**Logistic regression part**			**Negative binomial regression part**			**Logistic regression part**			**Negative binomial regression part**			**Logistic regression part**		
Variable	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p
Intercept	4.643	.116	**.000***	2.262	.168	**.000***	4.637	.144	**.000***	2.131	.209	**.000***	4.618	.168	**.000***	2.147	.246	**.000***
Sex_Female	-.065	.023	**.004***	.566	.034	**.000***	-.063	.023	**.005***	.567	.034	**.000***	-.063	.023	**.006***	.567	.034	**.000***
Age	.049	.011	**.000***	-.115	.017	**.000***	.051	.011	**.000***	-.114	.017	**.000***	.052	.011	**.000***	-.112	.017	**.000***
Housewife/husband	-.028	.055	.613	-.200	.080	**.013***	-.032	.055	.563	-.204	.080	**.011***	-.034	.055	.535	-.203	.080	**.011***
Student	-.018	.063	.778	-.475	.093	**.000***	-.017	.063	.791	-.476	.093	**.000***	-.018	.063	.780	-.476	.093	**.000***
Unemployed	.093	.070	.184	-.233	.104	**.025***	.087	.070	.216	-.236	.104	**.023***	.079	.070	.261	-.241	.104	**.021***

Disabled	.070	.062	.263	.079	.090	.381	.071	.062	.254	.079	.090	.378	.073	.062	.242	.078	.090	.386
Retired	.067	.038	.076	-.510	.058	**.000***	.062	.038	.097	-.512	.058	**.000***	.063	.038	.093	-.513	.058	**.000***
Other occupation	.047	.054	.382	-.313	.081	**.000***	.044	.054	.419	-.314	.081	**.000***	.042	.054	.431	-.314	.081	**.000***
Education	-.020	.012	.105	.041	.019	**.031***	-.024	.012	**.055***	.038	.019	**.048***	-.026	.013	**.036***	.037	.019	**.055***
Income	-.007	.016	.641	.037	.024	.124	-.006	.016	.720	.041	.024	.089	-.006	.016	.701	.040	.024	.098
Year_2011	-.118	.104	.257	-.432	.150	**.004***	-.125	.104	.232	-.436	.150	**.004***	-.134	.104	.198	-.436	.150	**.004***
Year_2012	-.064	.084	.451	-.475	.120	**.000***	-.076	.084	.366	-.481	.120	**.000***	-.078	.084	.356	-.482	.120	**.000***
Year_2013	-.116	.084	.169	-.376	.121	**.002***	-.126	.084	.135	-.380	.121	**.002***	-.127	.084	.131	-.380	.121	**.002***
Year_2014	-.050	.084	.550	-.357	.119	**.003***	-.061	.084	.464	-.361	.119	**.002***	-.063	.084	.450	-.361	.119	**.002***
Year_2016	.063	.086	.469	-.276	.123	**.025***	.047	.087	.588	-.278	.123	**.024***	.043	.087	.618	-.280	.123	**.023***
Year_2017	-.010	.087	.906	-.362	.123	**.003***	-.028	.087	.744	-.365	.124	**.003***	-.033	.087	.704	-.363	.124	**.003***
Year_2018	.214	.075	**.004***	-1.099	.107	**.000***	.195	.075	**.009***	-1.113	.107	**.000***	.191	.075	**.011***	-1.120	.107	**.000***
Year_2019	.283	.075	**.000***	-.987	.107	**.000***	.261	.075	**.001***	-1.005	.107	**.000***	.255	.075	**.001***	-1.016	.107	**.000***
Monday	-.342	.038	**.000***	.403	.057	**.000***	-.341	.038	**.000***	.404	.057	**.000***	-.340	.038	**.000***	.403	.057	**.000***
Tuesday	-.372	.039	**.000***	.393	.058	**.000***	-.368	.039	**.000***	.395	.059	**.000***	-.365	.039	**.000***	.397	.059	**.000***
Wednesday	-.307	.038	**.000***	.331	.057	**.000***	-.308	.038	**.000***	.333	.057	**.000***	-.307	.037	**.000***	.335	.057	**.000***
Thursday	-.280	.039	**.000***	.395	.059	**.000***	-.278	.039	**.000***	.396	.059	**.000***	-.275	.039	**.000***	.397	.059	**.000***
Friday	-.302	.039	**.000***	.330	.059	**.000***	-.299	.039	**.000***	.331	.059	**.000***	-.298	.038	**.000***	.332	.059	**.000***
Saturday	-.149	.036	**.000***	.059	.057	.299	-.148	.036	**.000***	.060	.057	.295	-.148	.036	**.000***	.061	.057	.287
Rural Green Areas	-.001	.001	.378	.000	.002	.877	-.001	.002	.751	.000	.003	.941	.000	.002	.997	.002	.003	.645
Urban Green Areas	.001	.002	.752	.010	.003	**.000***	.007	.003	**.035***	.020	.005	**.000***	.012	.005	**.008***	.027	.007	**.000***
Restored Areas	.000	.003	.853	-.003	.004	.413	.001	.003	.820	-.007	.005	.149	.001	.003	.726	-.008	.005	.108
Green Percentage	-.001	.001	.244	-.001	.001	.549	-.001	.001	.357	.001	.002	.663	-.001	.002	.512	.001	.002	.785
Nature Areas	.000	.001	.690	.002	.002	.375	.001	.002	.531	.001	.003	.616	.001	.002	.583	-.001	.003	.858

Dependent variable: recreatieduur_fiets.
SE: Standard Error.
*: Statistically significant value at the 5% level ($p \leq 0.05$).

Model for the total time spent during leisure activities

Variable	**Radius**																	
	1 km						**3 km**						**5 km**					
	Negative binomial regression part			**Logistic regression part**			**Negative binomial regression part**			**Logistic regression part**			**Negative binomial regression part**			**Logistic regression part**		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p
Intercept	3.929	.046	**.000***	-2.138	.255	**.000***	3.989	.059	**.000***	-2.208	.331	**.000***	3.918	.071	**.000***	-1.884	.384	**.000***
Sex_Female	-.106	.010	**.000***	-.244	.056	**.000***	-.106	.010	**.000***	-.244	.056	**.000***	-.106	.010	**.000***	-.243	.056	**.000***
Age	.049	.005	**.000***	-.055	.026	**.038***	.049	.005	**.000***	-.056	.026	**.033***	.050	.005	**.000***	-.056	.026	**.034***
Housewife/husband	.112	.021	**.000***	.193	.128	.133	.111	.021	**.000***	.193	.128	.133	.111	.021	**.000***	.191	.128	.136
Student	.024	.027	.362	.420	.132	**.001***	.024	.027	.358	.411	.132	**.002***	.024	.027	.364	.415	.132	**.002***
Unemployed	.179	.030	**.000***	.072	.179	.686	.173	.030	**.000***	.066	.179	.711	.172	.030	**.000***	.066	.179	.712
Disabled	.045	.024	.067	.417	.127	**.001***	.042	.024	.082	.412	.127	**.001***	.043	.024	.076	.410	.127	**.001***
Retired	.235	.017	**.000***	.374	.097	**.000***	.234	.017	**.000***	.373	.097	**.000***	.233	.017	**.000***	.372	.097	**.000***
Other occupation	.120	.024	**.000***	.013	.144	.930	.120	.024	**.000***	.012	.144	.931	.120	.024	**.000***	.014	.144	.923
Education	-.015	.006	**.009***	-.111	.031	**.000***	-.016	.006	**.005***	-.112	.031	**.000***	-.017	.006	**.003***	-.112	.031	**.000***
Income	-.001	.007	.858	.070	.039	.074	-.001	.007	.837	.067	.039	.089	-.001	.007	.874	.066	.039	.093
Year_2011	-.002	.037	.962	-.195	.233	.402	-.002	.037	.954	-.193	.232	.407	-.004	.037	.908	-.190	.232	.414
Year_2012	.121	.029	**.000***	-.212	.178	.234	.120	.029	**.000***	-.214	.178	.230	.117	.029	**.000***	-.214	.178	.230
Year_2013	.087	.029	**.003***	-.233	.177	.188	.086	.029	**.003**	-.233	.177	.188	.087	.029	**.003***	-.234	.177	.187
Year_2014	.115	.028	**.000***	-.171	.172	.320	.113	.028	**.000***	-.173	.173	.316	.112	.028	**.000***	-.174	.173	.315
Year_2016	.140	.029	**.000***	-.301	.182	.098	.134	.029	**.000***	-.305	.182	.094	.132	.029	**.000***	-.311	.182	.088
Year_2017	.117	.030	**.000***	-.030	.175	.865	.111	.030	**.000***	-.035	.176	.842	.109	.030	**.000***	-.044	.176	.803
Year_2018	.517	.025	**.000***	.300	.147	**.041***	.511	.026	**.000***	.306	.147	**.037***	.507	.026	**.000***	.299	.147	**.042***
Year_2019	.540	.026	**.000***	.306	.147	**.038***	.532	.026	**.000***	.313	.148	**.034***	.528	.026	**.000***	.307	.148	**.038***
Monday	-.386	.017	**.000***	-.569	.094	**.000***	-.384	.017	**.000***	-.569	.094	**.000***	-.384	.017	**.000***	-.567	.094	**.000***
Tuesday	-.391	.017	**.000***	-.542	.096	**.000***	-.389	.017	**.000***	-.542	.096	**.000***	-.388	.017	**.000***	-.542	.096	**.000***
Wednesday	-.360	.017	**.000***	-.492	.093	**.000***	-.358	.017	**.000***	-.494	.093	**.000***	-.357	.017	**.000***	-.493	.093	**.000***
Thursday	-.383	.017	**.000***	-.529	.096	**.000***	-.381	.017	**.000***	-.529	.096	**.000***	-.380	.017	**.000***	-.529	.096	**.000***
Friday	-.351	.018	**.000***	-.539	.097	**.000***	-.349	.018	**.000***	-.539	.097	**.000***	-.349	.018	**.000***	-.537	.097	**.000***
Saturday	-.176	.018	**.000***	-.174	.088	**.048***	-.175	.018	**.000***	-.176	.088	**.047***	-.175	.018	**.000***	-.177	.088	**.045***

Rural Green Areas	.000	.001	.835	-.003	.004	.382	.000	.001	.583	.002	.005	.623	-.002	.001	**.035***	.000	.006	.983
Urban Green Areas	-.002	.001	**.011***	-.006	.004	.183	.000	.001	.768	-.005	.008	.523	.005	.002	**.021***	-.013	.011	.240
Restored Areas	.000	.001	.666	.005	.006	.440	.001	.001	.461	.008	.007	.234	.001	.001	.660	.008	.008	.281
Green Percentage	-.001	.000	**.000***	.002	.002	.294	-.002	.001	**.000***	.003	.003	.423	-.002	.001	**.032***	-.002	.004	.603
Nature Areas	.000	.001	.938	-.001	.003	.763	.001	.001	.278	-.003	.004	.498	.002	.001	**.010***	.001	.005	.780

Dependent variable: recreatieduur_actief.
SE: Standard Error.
*: Statistically significant value at the 5% level (p ≤ 0.05).

4. Odds Ratio and Confidence Intervals

a. Binary Logistic Regression

	Radius		
Variable	**1 km**	**3 km**	**5 km**
	Odds Ratio	**Odds Ratio**	**Odds Ratio**
Intercept	--	--	--
Rural Green Areas	1.000 [0.999. 1.002]	1.000 [0.998. 1.002]	1.002 [0.999. 1.005]
Urban Green Areas	0.991 [0.989. 0.994]	0.977 [0.973. 0.981]	0.967 [0.961. 0.973]
Restored Areas	0.997 [0.994. 1.000]	0.997 [0.993. 1.001]	0.996 [0.992. 1.000]
Green Percentage	1.003 [1.003. 1.004]	1.005 [1.003. 1.006]	1.004 [1.002. 1.007]
Nature Areas	1.000 [0.998. 1.001]	1.000 [0.998. 1.002]	0.998 [0.995. 1.000]

b. Zero-inflated negative binomial regression

Results for the total time spent during leisure activities

Variable	Radius					
	1 km		3 km		5 km	
	Negative binomial regression part	Logistic Regression Part	Negative binomial regression part	Logistic Regression Part	Negative binomial regression part	Logistic Regression Part
	Exp (B)	Odds Ratio	Exp (B)	Odds Ratio	Exp (B)	Odds Ratio
Intercept	--	--	--	--	--	--
Rural Green Areas	1.000 [0.998. 1.002]	0.997 [0.989. 1.005]	1.000 [0.998. 1.002]	1.002 [0.992. 1.012]	0.998 [0.996. 1.000]	1.000 [0.988. 1.012]
Urban Green Areas	0.998 [0.996. 1.000]	0.994 [0.986. 1.002]	1.000 [0.998. 1.002]	0.995 [0.980. 1.011]	1.005 [1.001. 1.009]	0.987 [0.966. 1.009]
Restored Areas	1,000 [0.998. 1.002]	1.005 [0.993. 1.017]	1.001 [0.999. 1.003]	1.008 [0.994. 1.022]	1.001 [0.999. 1.003]	1.008 [0.992. 1.024]
Green Percentage	0.999 [0.999. 0.999]	1.002 [0.998. 1.006]	0.998 [0.996. 1.000]	1.003 [0.997. 1.009]	0.998 [0.996. 1.000]	0.998 [0.990. 1.006]
Nature Areas	1.000 [0.998. 1.002]	0.999 [0.993. 1.005]	1.001 [0.999. 1.003]	0.997 [0.989. 1.005]	1.002 [1.000. 1.004]	1.001 [0.991. 1.011]

Results for the walking time during leisure activities

Variable	Radius					
	1 km		3 km		5 km	
	Negative binomial regression part	Logistic Regression Part	Negative binomial regression part	Logistic Regression Part	Negative binomial regression part	Logistic Regression Part
	Exp (B)	Odds Ratio	Exp (B)	Odds Ratio	Exp (B)	Odds Ratio
Intercept	--	--	--	--	--	--

Rural Green Areas	1.001 [0.999. 1.003]	0.998 [0.994. 1.002]	1.000 [0.998. 1.002]	1.001 [0.995. 1.007]	0.997 [0.995. 0.999]	0.999 [0.993. 1.005]
Urban Green Areas	0.999 [0.997. 1.001]	0.991 [0.987. 0.995]	1.002 [1.000. 1.004]	0.983 [0.974. 0.993]	1.008 [1.004. 1.012]	0.975 [0.964. 0.987]
Restored Areas	1.000 [0.998. 1.002]	1.005 [0.997. 1.013]	1.000 [0.998. 1.002]	1.010 [1.002. 1.018]	0.998 [0.996. 1.000]	1.011 [1.003. 1.019]
Green Percentage	0.998 [0.998. 0.998]	1.002 [1.000. 1.004]	0.997 [0.995. 0.999]	1.001 [0.997. 1.005]	0.998 [0.996. 1.000]	0.999 [0.995. 1.003]
Nature Areas	1.000 [0.998. 1.002]	0.998 [0.994. 1.002]	1.001 [0.999. 1.003]	0.997 [0.993. 1.001]	1.003 [1.001. 1.005]	1.000 [0.994. 1.006]

Results for the cycling time during leisure activities

	Radius					
	1 km		3 km		5 km	
Variable	Negative binomial regression part	Logistic Regression Part	Negative binomial regression part	Logistic Regression Part	Negative binomial regression part	Logistic Regression Part
	Exp (B)	Odds Ratio	Exp (B)	Odds Ratio	Exp (B)	Odds Ratio
Intercept	--	--	--	--	--	--
Rural Green Areas	0.999 [0.997. 1.001]	1.000 [0.996. 1.004]	0.999 [0.995. 1.003]	1.000 [0.994. 1.006]	1.000 [0.996. 1.004]	1.002 [0.996. 1.008]
Urban Green Areas	1.001 [0.997. 1.005]	1.010 [1.004. 1.016]	1.007 [1.001. 1.013]	1.020 [1.010. 1.030]	1.012 [1.002. 1.022]	1.027 [1.013. 1.042]
Restored Areas	1.000 [0.994. 1.006]	0.997 [0.989. 1.005]	1.001 [0.995. 1.007]	0.993 [0.983. 1.003]	1.001 [0.995. 1.007]	0.992 [0.982. 1.002]

Green Percentage	0.999 [0.997. 1.001]	0.999 [0.997. 1.001]	0.999 [0.997. 1.001]	1.001 [0.997. 1.005]	0.999 [0.995. 1.003]	1.001 [0.997. 1.005]
Nature Areas	1.000 [0.998. 1.002]	1.002 [0.998. 1.006]	1.001 [0.997. 1.005]	1.001 [0.995. 1.007]	1.001 [0.997. 1.005]	0.999 [0.993. 1.005]