LANDSCAPE PERCEPTION TOWARD GREEN SPACES AND THE PHYSIOLOGICAL AND PSYCHOLOGICAL BENEFITS OF GREEN SPACE THERAPY – A CASE STUDY OF MATSUDO CITY, JAPAN

July 2020

PRITA INDAH PRATIWI

Graduate School of Horticulture

CHIBA UNIVERSITY

LANDSCAPE PERCEPTION TOWARD GREEN SPACES AND THE PHYSIOLOGICAL AND PSYCHOLOGICAL BENEFITS OF GREEN SPACE THERAPY – A CASE STUDY OF MATSUDO CITY, JAPAN

Approved by:
Advisor. Prof. Katsunori FURUYA
Landscape Architecture Program, Field of Landscape Planning
Graduate School of Horticulture, Chiba University

Chief of Examiner. Prof. Takahide KAGAWA
Department of Forest Management
Forestry and Forest Products Research Institute

Examiner. Prof. Tatsuaki KOBAYASHI
Landscape Science Program, Field of Landscape Resource Science
Graduate School of Horticulture, Chiba University

Examiner. Assoc. Prof. Takeshi KINOSHITA
Landscape Architecture Program, Field of Landscape Design
Graduate School of Horticulture, Chiba University

Examiner. Assoc. Prof. Yutaka IWASAKI
Environmental and Human Health Sciences Program
Graduate School of Horticulture, Chiba University

ABSTRACT

With concerns about urbanization diminishing contact between humans, nature, and public health, urban dwellers seek effective and convenient methods to resolve urban stress. Forest therapy is a set of practices that involve exposure to natural stimuli by practicing physical activity or relaxation in and around the forest. Therefore, I explored the Perceived and Experienced UGS (PE UGS) framework as a tool for evidence-based park planning and design from perception, preference, physiological, and psychological perspective. This study was conducted in four main stages: 1) mail-back perception survey, 2) on-site psychophysiological experiment, 3) analysis-synthesis, and 4) formulation-interpretation; and discussed in five papers.

The first paper showed that the significant differences in merits of nature and green spaces between Tokiwadaira housing complex and apartment residents were related to distance from green spaces and environmental benefit by controlling dust. Attitudes toward green spaces was categorized by knowing the names of creatures, feeling affection for nature, and perceiving nature and green spaces as well-managed and convenient places. Residents of Tokiwadaira housing complex had a higher level of perception than apartment residents. There were only one factor related to residents' awareness in merits of UGS: multifunctional UGS (ecological, aesthetic, and social function); two factors related to residents' awareness in reasons for reluctance to use UGS: 1) property and security, 2) sanitation, design, and maintenance; three factors related to residents' attitudes toward green space: 1) high attitude level, 2) moderate attitude level, and 3) low attitude level toward green space. The difference between housing complex and apartment residents was their willingness to spend money on nature.

The second paper exhibited three significant differences between housing complex and apartment residents (i.e., neighbourhood park preference, length of park visit, and park element. There are seven factors of park preferences, namely 1) the existence of shared green space in residence, 2) engagement in green volunteering activity, 3) employment status of residents, 4) a willingness to spend time in volunteering activity, 5) frequency of green space visit, management experience, and length of park visit, 6) gender of residents, 7) disturbances in the park. This information may help urban planners conduct participatory planning with the community and optimize local features through consideration of elderly residents' needs.

The third paper provided significant scientific evidence for the physiological and psychological relaxation effects of walking in urban parks, correlating park therapy images accordingly. Walking in urban parks resulted in: 1) significant decreases in heart rates during winter, spring, and early summer; 2) significant decreases in blood pressure during spring; 3) significant decreases in confusion–bewilderment in winter and early summer, depression–dejection in winter and spring, and anger–hostility, fatigue–inertia, and tension–anxiety only in early summer; 4) significant decreases in total mood disturbance in winter and spring; 5) significant increases in vigor–activity in spring; and 6) significant decreases in state anxiety in winter, spring, and early summer. In winter, park therapy images exhibited the people-nature relationship with "trees," "relaxation," and "comfort," describing good feelings as psychological benefits of park therapy. In spring, park therapy image exhibited landscape elements, self-orientation, and social meaning of place, namely "water," "activity," "people," "surrounding place," and "recreational space," wherein cherry blossom-viewing became significant as a traditional Japanese way of appreciating nature. In early summer, park therapy image exhibited landscape openness such as "greenery," "lawn," and "broadness," in which beautiful fresh greenery, thick grass, and green lawn display intense color. The correlation among park therapy images and physiological-psychological responses were high in "birds" as indicator creatures in landscapes. A "bird's eye view" was a middle distance to view the landscapes. Greenery was an important park feature to experience relaxation. Other components such as flowers, activity, water, people existence, tranquility, sideways view, and surrounding place were also important. Evidence-based special features of the park landscape include: (1) accessible walking course among tree stands or thinned forest; (2) medium distance as suitable views of distance zone; and (3) diversity of seasonal landscape changes (e.g., greenery, flowers, birds, water, lawn, physical activity) are suggested for park therapy roads.

The fourth paper investigated the physiological and psychological relaxation effects associated with viewing park landscape. Viewing urban parks in spring and early summer resulted in (1) significantly lower blood pressures, 2) significantly increased vigor–activity in spring, 3) significantly decreased total mood disturbance in spring, and 4) significantly decreased anxiety levels in early summer. These findings could be used for park therapy programs for middle-aged and older adults in urban parks during spring and early summer. The composition of park therapy scenes might be arranged by considering the significant natural elements (e.g., flowers, water

bodies, and maintained greenery) as input for therapeutic park design to provide higher value of relaxation benefits. In this way, nearby urban park usage is promoted, and lifestyle diseases are prevented.

The fifth paper exhibited that walking by the edge of a forest in the autumn led to a lower heart rate and more effectively decreased systolic blood pressure than walking in the city. Mean heart rate was significantly lower in Japanese than in Indonesian participants. Moreover, the scores of tension–anxiety and Total Mood Disturbance were significantly lower in all adults; depression–dejection was significantly lower and vigor–activity was significantly higher in Indonesian adults after walking in the park than in the city. All negative and positive mood states were significantly different in Japanese adults; the scores of confusion–bewilderment, tension–anxiety, and Total Mood Disturbance were significantly lower and vigor–activity was significantly higher in Indonesian adults; and the state-anxiety level was significantly lower in Indonesian adults after walking and after viewing forests in urban parks in all adults than those in the city. The results of this study suggest that walking and viewing forests in urban parks can be useful outdoor activities for foreign adults to reduce academic or work stress and enhance physical and mental health.

In conclusion, these findings employing Perceived and Experienced UGS framework as tools for evidence-based park planning and design might help urban planners to conduct participatory planning and design in various contexts and at different scales. These studies also offer a method of identifying experienced spatial conditions forming the image of park therapy in adults. In addition, this study also gives cross-cultural comparison showing a significant possibility of park therapy effect in tropic young adults to urban planners for managing academic or work stress.

Keywords: urban green space, perception, neighbourhood park, park therapy, heart rate, blood pressure, mood states, anxiety level, urban park.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

A-H	Anger–hostility
ART	Attention Restoration Theory
AT	Attitude toward Urban Green Space
C-B	Confusion–bewilderment
CVDs	Cardiovascular diseases
D-D	Depression–dejection
DK	Dining-kitchen
EP	Exposure to Urban Green Space
F-I	Fatigue–inertia
FPC	Forest and Park for the 21st Century
GHLC	Government Housing Loan Corporation
HRV	Heart Rate Variability
JHC	Japan Housing Corporation
LIST	Landscape Image Sketching Technique
LMIC	Low- and middle-income countries
ME	Merits of Urban Green Space
NCDs	Non-communicable Diseases
PA	Potential Activity
PD	Disturbance in the park
PE	Park Element
PE UGS	Perceived and Experienced Urban Green Space
POMS	Profile of Mood States
PP	Spatial Park Preference
PV	Park Visit
RE	The reason why reluctant to use Urban Green Space
SRT	Stress Reduction Theory

STAI	State-Trait Anxiety Inventory
T-A	Tension–anxiety
TMD	Total Mood Disturbance
TNP	Tokiwadaira Neighbourhood Parks
UGS	Urban Green Space
V-A	Vigor–activity

LIST OF ABBREVIATIONS

Ac	Activity
Al	Autumn leaves
Be	Bench
Bi	Bird
Br	Broad
Bv	Bird’s eye view
Co	Comfortable
Fe	Fence
Fl	Flowers
Gr	Greenery
Hp	Herbaceous plants
La	Lawn
Os	Objective scene
Pc	Park center
Pe	People
Qu	Quiet
Re	Relaxed
Rs	Recreational space
Sp	Surrounding place
Sv	Sideway view
Th	Tea house
Tr	Tree
Wa	Water

CHAPTER 1. INTRODUCTION

1.1 Research Background

Nowadays, the urban area becomes the highest populated area and it is still progressing by 2050 that 66% of the world population is projected to be urban. The city planners propose such kind of sustainable landscape planning and designs. People sometimes lose their sense of place especially their special localities, social connection, and direction. In 2014, Japan is one of the most highly urbanized countries in the world (93 % urban) after Belgium (98 % urban), followed by Argentina (92 %) and the Netherlands (90 %). By 2050, 89 countries are expected to become more than 80 percent urban. During the eighteenth century, Tokyo was the largest city in the world, with an estimated 1 million inhabitants. There are seven countries which become home to a half of the world's urban population, China (758 million), followed by India (410 million), the United States of America (263 million), Brazil (173 million), Indonesia (134 million), Japan (118 million) and the Russian Federation (105 million). In a few countries, the urban population will decrease, despite projected increases in the level of urbanization. The largest declines between 2014 and 2050 are projected for Japan (a decline of 12 million) and the Russian Federation (decline of 7 million). In 2018, Tokyo Metropolitan Area, as opposed to the city of Tokyo, is the largest population size and the first ranking of urban agglomerations in the world with approximately 37 million inhabitants (UN 2019). In Japan, the majority of the population comprises elderly people, leading to a lack of workers, inadequate care for elderly people, lower birthrate, abandonment of local areas, and lack of community. Several major tasks include realigning the urban structure, especially supplying housing in good residential districts, and improving the infrastructure. To this end, Japan must tackle the urgent problem of residential development. Explorations are now underway to institute a more community-led model of urban planning in which local residents can participate. Cities need to be more innovative and take advantage of local strengths. Second, urban redevelopment needs to place more emphasis on cultural perspectives, emphasizing the distinctive local or regional personality. Third, Japanese cities must prepare for the coming "aging society".

Several studies have already addressed this problem by examining green-space perceptions, preferences, and behaviors in Japan. Mutiara and Kinoshita (2011) described that low-level neighbourhood attachments are positively correlated with decreased park activity. Infrequent community involvement in park management is also a primary factor contributing to the decreased sense of community belonging. The challenge is thus to increase public trust by offering access to urban green spaces as well as participation in park planning and management. In Japan, there is a strong focus on economic growth. However, there has been significant economic stagnation over the past generation. This has damaged both families and communities, resulting in a society problematized by increasing age and a declining birth rate. The lonely-death phenomenon is also rarely discussed. The emergency of *Kodokushi* may also be explained as a result of an increase in single-person households such as elderly people (Tamaki 2014).

Considering Maslow's motivational model, these aesthetic benefits should be considered in landscape development, and urban planners should prioritize the input of residents. Further, urban planners can meet the needs of local residents and consider the next generation's input for longer-term city planning. Public participation should be considered for the support of outdoor activities and healthy socialization to avoid isolation in old age. This effort might support the second level of Maslow's motivational model, self-actualization. Finally, the goal of life need in urban society is not only self-actualization but also the possibility of transcendence in the quality of life. Human perception and preference and human psychological and physiological health have been considered factors of life satisfaction (Diener and Diwas-Diener 2009; Abdullah and Zulkifli 2016). The human-nature relationship and its impact on health studies have been increasing in importance over the past four decades. Evidence is emerging to suggest that connectivity to nature can have positive impacts on human health.

To enhance physiological and psychological health, forest bathing is one of the alternative health-promotion approaches by conducting outdoor activity in forest landscape (Lee et al 2011; Tsunetsugu 2010). Forest bathing brings up engaging in nature and undergoing a forest's atmosphere to regenerate physical and mental health (Park et al 2010; Lee et al. 2012; Miyazaki et al. 2015; Song et al. 2017). Many studies on healthy young adults in high-income countries demonstrated that brief forest walks and views could decrease heart rate, pulse rate, blood pressure, shift sympathetic/parasympathetic balance and improve mood state among young adults, such as Japan, United States, China, South Korea, United Kingdom, Finland, and Canada (Song et al. 2013, 2014, 2015, 2019; Goto et al. 2016; Mao et al. 2017; Hassan et al. 2018; An et al. 2019; Kim et al. 2012; Song et al. 2019; Cameron et al. 2020; Tyrväinen et al. 2014; Ojala et al. 2019; Elsadek et al. 2019). Forest bathing in bamboo forest landscape decreased blood pressure and induced positive effects on brain activity (Hassan et al. 2018); three- day forest bathing session in bamboo forest increased positive mood such as vigor and decreased negative moods such as tension and anxiety, anger and hostility, depression, fatigue, and confusion among Chinese (Lyu et al. 2019).

Many studies have proposed evidence-based physiological and psychological effects of forest therapy. In a study of older adults, it resulted in physiological and psychological relaxation in forest therapy. Chen et al. (2018) investigated the effects of the two-day forest therapy program and reported that it decreased systolic blood pressure and negative mood states (e.g., confusion, fatigue, anger-hostility, tension) among the middle-aged female group. Ochiai et al. (2015) examined the effects of conducting various activities of forest therapy for 4 hours decreased systolic and diastolic blood pressure, urinary adrenaline, and serum cortisol. Li et al. (2016) investigated the effects of forest bathing of 80-minute walking each in the morning and afternoon and reported that urinary dopamine after forest bathing was lower than that after urban area walking and serum adiponectin after the forest bathing was greater than that after urban area walking. Yu et al. (2017) reported decreased pulse rate, systolic and diastolic blood pressure, and reduced negative mood states (e.g., tension, anger, fatigue, depression, confusion) and anxiety as well as improve positive emotion through 2-hour short walk in the forest. Song et al. (2017) also reported the effects of viewing a forest environment on middle-aged hypertensive men for only 10 minutes women and reported the high-frequency component of heart rate variability (HRV) was higher and heart rate was lower in participants viewing the forest area than in those viewing the urban area. Furthermore, middle-aged and elderly as subjects engaged park therapy (Matsunaga et al. 2011; Goto et al. 2011; Pratiwi et al. 2019) horticulture therapy (Ng et al. 2018) and gardening (Hofmann et al. 2018), community-based physical activity at parks (Uijtdewilligen et al. 2019) due to lack of mobility, opportunity, and time.

Not all urban inhabitants have access to a natural forest. However, most cities and urban areas have a pocket of nature, such as a block park, neighbourhood park, urban park, or urban forest, where there are plants that offer a relaxation benefit to people. Parks are valuable natural environments within a city. Most citizens across all ages have access to their preferred nearby parks (Pratiwi & Furuya 2018). In a study of real-time park therapy, Igarashi et al. (2015) described that viewing a kiwifruit orchard landscape for 10 minutes resulted in induced physiological and psychological relaxation, such as a significant increase in the parasympathetic nerve activity; a significant decrease in heart rate; a significant increase in comfortable, relaxed, and natural feelings; and significant improvements in mood states for adult females. Viewing a hospital rooftop forest for 12 minutes led to autonomic sensitivity to the forest's natural elements and sufficiently relaxed older female patients (Matsunaga et al. 2011). Viewing a Japanese garden for 15 minutes of reduced heart rate and improved the behavioral system in Japanese patients with dementia (Goto et al. 2016). In another cross-cultural study, viewing different garden styles (e.g., Japanese garden, architectural garden, and landscape garden) induced psychological, emotional, and healing values among young Canadian and Japanese university students. Parasympathetic nervous activity increased in viewing the landscape garden, as the most natural-looking (Elsadek et al. 2019). Most of the evidence-based studies have shown that the physiological and psychological benefits of walking or viewing in a forest and park landscape with varied environmental factors, including the type of natural environment, landscape design, as well as cultural differences, play a role in human interaction with the landscape.

Despite the history of Shinrin-yoku has been well-known in different cultures of sub-tropical countries, it has remained poorly understood whether the therapeutic park design can similarly influence healthy people from different cultures, for example, young adults from tropical countries. Cultural differences in spatial perception revealed that Japan had different forest images with Russia and Indonesia. The forest images were represented as an aesthetically cultural landscape in Germany (Ueda 2009, 2014), as aesthetic scenery in Russia, as a practical place in Japan (Ueda et al. 2012), and as a wildlife reserve in Indonesia (Pratiwi et al. 2014). While, in Southeast Asia, Indonesia is one of the low-middle income countries with high biodiversity and located along the equator line. Indonesia with its biodiversity and multiethnicity which was stretched along the equator lines has potential health effects through forest bathing. Moreover, there is little literature comparing Japanese and tropical countries young adults such as Indonesian, responses to therapeutic parks in Japan, which suggests that scientific evidence to park therapy effect could be effective for foreign people to reduce techno-stress due to daily life work or culture shock. It would be necessary to promote the development of programs that can be effectively applied in urban nature, such as urban parks. We developed the Perceived and Experienced Urban Green Space (PE UGS) approach based on a survey of residents' perception, preference, and experience urban green space through park therapy. In the present study, we focused on how residents perceive and prefer UGS, what factors influencing their perception and preference, what kind of therapeutic effect of UGS in Japanese middle-aged and older adults in the early stage of lifestyle diseases and between Japanese and Indonesian young adults due to academic stress, what the best time to do park therapy, what green space characters perceived seasonally by residents and students, what the difference of therapeutic effects on Japanese and Indonesian young adults, and what correlation between psychophysiological effect and park images.

1.2 Statement of The Problem

With the increase of the aging population in most of the countries, in which Japan as the highest aging population, activation of green open space usage is important for a public the participatory program for quality of life and well-being. The understanding of human perception, preference towards urban green space, and how to link their needs into an experiential landscape and to realize that nature exposure would bring a greater impact rather than having no physical activity.

1. What are local residents perceive their surrounding urban green space?
2. What is local residents' preference regarding their neighbourhood parks?
3. What kind of health effects that middle-aged and older adults get from the green space?
4. When the best time to get a great impact from the green space?
5. How is the Japanese and Indonesian young adults' willingness to participate in park therapy?
6. What are the differences in health effects between Japanese and Indonesian young adults?
7. Is there any significant difference in the green space characters perceived seasonally by residents?
8. Is there any correlation between landscape cognition and physiological and psychological responses?
9. Is there any significant difference in the green space characters perceived by Japanese and Indonesian young adults?
10. What is the implication for urban planning for creating healthy and accessible green space for middle-aged and older adults?

1.3 Benefit of Research

This result of this study might be useful for urban park design in Japan. Local residents need-based design and the evidence through experiencing urban park therapy program would bring greater effect to urban green space activation and human health and well-being. After conducting perceptional and experiential research in Japan as a subtropical country, this research would be the first phase of basic research, then it would be developed into a tropical country like Indonesia in order to measure and compare the perception and benefit of urban parks.

1.4 Research Hypothesis

The first hypothesis was that there is a significant difference in perception between local residents based on the existence of green space in dwelling type towards urban green space. Second, there is a significant difference in preference of local residents based on the existence of green space in dwelling type towards their neighbourhood parks. Third, there is a significant difference in the psychological and physiological responses of walking and seated viewing in urban parks in different seasons among middle-aged and older adults. Fourth, there is a significant difference in the physiological and psychological responses of walking and seated viewing in urban parks in autumn among Japanese and Indonesian young adults. Fifth, there is a correlation between park images and psychophysiological responses.

1.5 Aim and Objectives

The aim of the research to investigate the Perceived and Experienced UGS (PE UGS) framework as a tool for evidence-based park planning and design from perception, preference, and health benefits of green space. This framework was applied from different UGS scales, subjects, and contexts through five papers. The aim was further broken down in the following objectives:

- To clarify the differences in green space perception between housing complex and apartment residents, residents' attributes influencing their green space management experience, and factors inducing residents' awareness and attitude toward green spaces.

- To investigate the neigbourhood park preference, length of park visit, activities, park elements, disturbances in the park between housing complex and apartment residents, and factors inducing preferences.
- To clarify the physiological and psychological effects of walking, park therapy images, and correlations between park therapy images and physiological-psychological responses in urban parks in winter, spring, and early summer.
- To clarify the physiological and psychological relaxation effects of remaining sedentary while viewing cherry blossoms in spring and fresh greenery in early summer.
- To determine whether there were significant differences in physiological and psychological responses between Japanese and Indonesian young adults, attractiveness of specific elements of the experienced parks, and the correlations between park images and psycho-physiological responses.

1.6 Scope of Research

The scope limits of the research included the scope of research and research object. The scope of research was limited to the study of residents' perception, preference, and the psychophysiological and cognition responses of park therapy experienced by adults. The scope of the research object of perception and preference study was residents' living in Tokiwadaira, Matsudo city. The scope of the research object of psychophysiological study was physiological and psychological outcomes of middle-aged and older adults living in Tokiwadaira, Koganehara, and Mabashi Areas, Matsudo city and Japanese and Indonesian students of Chiba University and beyond living in Matsudo city and surroundings.

CHAPTER 2. LITERATURE REVIEW

2.1 Public Health Worldwide

According to the World Health Organization (WHO), more than half of the earth's population lives in cities. In Asia alone, 48% of the population lives in urban areas. The urbanization rate in Asia is faster than in other regions and is projected to reach 64% by 2050. The urban population of the world has grown rapidly from 746 million in 1950 to 3.9 billion in 2014. Asia, despite its lower level of urbanization, is home to 53% of the world's urban population, followed by Europe (14%) and Latin America and the Caribbean (13%). Tokyo is the world's largest city with an agglomeration of 38 million inhabitants, followed by Delhi with 25 million, Shanghai with 23 million, and Mexico City, Mumbai, and São Paulo, with around 21 million inhabitants each. Tokyo is projected to remain the world's largest city in 2030 with 37 million inhabitants, followed closely by Delhi where the population is projected to rise swiftly to 36 million (UN 2018).

Aging and population growth have led to a growing number of people living with the atherosclerotic vascular disease worldwide, despite the decrease in incident myocardial infarction and ischemic stroke in high-income regions. In Japan, since 2015, the percentage of the population aged 65 and above was 26.6%, exceeding that of the U.S. (14.8%), France (19.1%), Sweden (19.9%), and Italy (22.4%). This indicates that the aging population of Japan is progressing rapidly as compared to the U.S. and European countries (UN 2018). In 2050, 37.7% of the Japanese population will be 65 and above in age. Health systems will need to improve the delivery of cost-effective treatments, such as blood pressure and cholesterol-lowering drugs, while efforts continue to focus on decreasing tobacco smoking, improving diet, and increasing physical activity (GBD 2015a, 2015b). Since the 20th century, strokes have been considered to be the number one killer in Japan. The main trigger for strokes is raised blood pressure or hypertension (WHO 2010). With concerns about urbanization having diminished the contact between humans and nature and public health, the urgency of experiencing nature and its effects have to be investigated. It is crucial to examine the environmental impact on human body function and its effect on health.

2.2 Human and Nature Relationship

The study on the benefit of nature for human mental and physical health has been increasing in the recent 3 decades (Clark et al. 2014; Hartig et al. 2014). Nature connectedness revealed positive health and it was derived from Biophilia, which stresses the fundamental evolutionary relationship between humans and nature (Wilson 1984; Kellert and Wilson 1993). Many evidence-based studies on psychological and physiological benefits of nature exposure were commanded. The restorative potential of nature has been often used as a theoretical framework describing these benefits (Kaplan, 1995). Psychological restoration refers to the potential of natural environments to recover cognitive resources from mental fatigue and stress level through fascinating stimuli and to reduce measures of sympathetic outflow, according to the Attention Restoration Theory (ART, Kaplan and Kaplan, 1989) and the Stress Reduction Theory (Ulrich, 1983), respectively.

2.3 Perceived and Experienced Nature

Because 70% of the world population lives in urban nowadays, people are disconnected from nature and its experience (Soga and Gaston 2016). People's perception of nature is known to be a powerful predictor of their willingness to support and conserve nature (de Pinho et al. 2014). People, especially the young generation should be encouraged to experience a natural neighbourhood environment due to decreased public appreciation of the value of the natural environments and creatures for relaxation, aesthetics, an indicator of seasonality, and opportunities for education (Soga et al 2016). Humans are multi-sensory organisms; nature experiences do not only provide benefits on the visual sense, but also non-visual senses, and other pathways. Many benefits that people receive from nature increase through the five senses as well as at least three non-sensory avenues: sight, sound, smell, taste, touch, phytoncides, negative air ions, and microbes. (Franco et al. 2017). The multi-sensory aspect of nature experiences is crucial because the monotony of stimulation can become a source of stress (Stuster 2011) and multimodal sensory input itself can drive positive mental states such tranquility (Hunter 2010). It has been shown that stimulating multiple senses at the same time may lead to additive beneficial effects of nature experiences (Dijk and Breathe 2010).

2.4 Urban Green Space Awareness and Preference

Awareness among Danes shows that green spaces may be of importance in managing stress and that green spaces may play an important role in health-promoting environments. Dwellers living more than 1 km away from a green space have 1.42 higher odds of experiencing stress than dwellers living less than 300 m from a green space (Stigsdotter 2010). Furthermore, people living within 20 min from the reference site are willing to contribute a significant amount of money to support this greening project (Paul and Nagendra 2017). As the growth of public awareness of the importance of green spaces and the benefits of the planned park, study responding to the needs and preferences of urban communities can help to better plan and design urban green spaces. However, urban green governance has main challenges include (a) increasing development pressure from population growth and financial constraints on the municipal budget, (b) loss of expertise, and (c) low awareness of green benefits among different actors through insufficient communication. Salmond et al. (2016) reinforced that the concept of ecosystem services may provide a useful argument to promote the conservation of existing urban green spaces and to communicate the benefits that urban nature provides for citizens to all levels of green space governance.

2.5 Neighbourhood Green Space

A neighbourhood is characterized by the significance of the physical change, physical boundaries, and local landmarks in creating a sense of belonging and quality of life among the dwellers (Omar et al. 2016). A neighbourhood environment can be divided into three major features; the physical, social, and environmental services. The physical environment is the structures and buildings. The social environment is the relationship among residents such as honesty, trust, and cooperation. Meanwhile, the service environment is resources like institutions, transportation, recreational area, and many others (Pearson et al. 2014). Neighbourhood areas supply rich geographical, sociological, economic, and psychological benefits (Cox et al. 2013).

The growing elderly population is a major concern, not only financially, but socially as well. Performing recreational activities for the elderly is a must for them to age successfully. Activities performed within a nearby park are one of the simplest forms of recreation. A successful park is categorized as one that satisfies the physical, psychological and social needs of the elderly people. The design of the park must compensate for the physical limitations that the elderly clients have and also meet those needs of the elderly as well. Identifying specific environmental concerns and their related design criteria will assist the designer in providing design solutions that will encourage the elderly to use the outdoor spaces (Othman and Fadzil 2017).

2.6 Physical Activity in Urban Green Space

The human-nature relationship and its impact on health have increased in importance in the past four decades. Evidence suggests that connectivity to nature can have a positive impact on human health. One hundred and fifty minutes of moderate-intensity physical activity, such as brisk walks, jogging, cycling, or swimming. For adults belonging to the 18-64 age group and the 65 years and above age group, physical activities include recreational or leisure-time activities, transportation (e.g., walking or cycling), occupational activities (e.g., if the person is still engaged in work), household chores, games, sports, or planned exercises, in the context of daily, family, and community activities (WHO 2010). Walking is cost-effective and easy to implement for people of all ages. An accessible, attractive, safe, and low-cost environment influences people—at least, children and younger adults—to move and engage in physical activities, to have social cohesion, to earn economic benefit, and to achieve environmental benefit. Such environments include neighbourhood and community parks, safe and usable sidewalks, hiking and biking trails, swimming pools, community recreation centers, and stairways that are a safe, convenient, and attractive alternative to the use of elevators and escalators. Furthermore, areas relatively free from crime have been identified as important factors.

Experiencing the environment has not only a psychological but also a physiological benefit. Alabbasi and Said (2018) described that environmental exposure means visiting urban parks and open spaces, could encouraging people to be physically active. It is essential that physical activity like walking, jogging, cycling or swimming be acknowledged as a necessary daily intervention to increase the quality of life of individuals with health problems including obesity, metabolic syndrome, diabetes, and heart disease (Janicas 2014). Furthermore, another typical physical activity, forest walking generated a significant decrease in physiological response, such as pulse rate and systolic and diastolic blood pressure. Besides that, it also can reduce psychological responses like tension, anger, fatigue, depression, confusion, and anxiety as well as improve positive emotion (Yu et al. 2017). It is proven that outdoor physical activity causes a more positive mood and attitude than indoor activity (Sandifer et al. 2015).

2.7 Shinrin-yoku (Forest bathing)

With concerns about urbanization diminishing contact between humans, nature, and public health, urban dwellers seek effective and convenient methods to resolve urban stress. Forest therapy (Shinrin-yoku) is a set of practices that involve exposure to natural stimuli by practicing physical activity or relaxation in and around the forest. This approach is believed to improve immunocompetence through plant-derived physiological relaxation and aims at ”preventative medical effects” that induce physiological relaxation and improve immune functions to prevent diseases (Park et al. 2009; Lee et al. 2009; Park et al. 2010; Lee et al; 2012; Ochiai et al. 2015; Miyazaki et al. 2015; Song et al. 2017).

2.8 Urban Green Space Therapy

Not all urban inhabitants have access to a natural forest. However, most cities and urban areas have a pocket of nature, such as a block park, neighbourhood park, urban park, or urban forest, where there are plants that offer a relaxation benefit to people. Parks are valuable natural environments within a city. Most citizens across all ages have access to their preferred nearby parks (Pratiwi and Furuya 2019). Urban green space therapy is ranging from having sedentary activity using horticultural plants or viewing the urban green space as natural stimuli and experiencing physical activity in the urban green spaces that induce physiological and psychological relaxation to prevent lifestyle disease for young and old adults (Matsunaga et al. 2011; Igarashi et al. 2015; Goto et al. 2016; Hofmann et al. 2017; Ng et al. 2018; Xie et al. 2018; Uijtdewilligen et al. 2019; Elsadek et al. 2019).

Almost two decades since a positive association between exposure to urban green space and the perceived general health of residents (Takano et al. 2002). In last one decade, park as valuable source has been attracting attention as setting for relaxation by investigating heart rate, heart rate variability, and subjective feelings seasonally. The participants were all young adults and divided into two groups, urban park and city street group (Matsuba et al. 2011; Song et al.

2013, 2014, 2015). Recently, middle-aged and older adults have been used as subjects for hospital garden therapy by investigating eye movement, heart rate, and behavior under four conditions (Goto et al. 2016), urban gardening by investigating heart rate, heart rate variability, subjective feelings (Igarashi et al. 2015), stressors, well-being status, and hair cortisol levels (Hofmann et al. 2018), horticultural therapy in improving mental well-being and modulating biomarker levels (Ng et al. 2018), and community-based physical activity at park (Uijtdewilligen et al. 2019). Park therapy studies in adults was developing very rapidly by examining salivary cortisol, restorativeness, vitality, and mood (Tyrväinen et al. 2014), eye movement and heart rate variability in cross-cultural comparison (Elsadek et al. 2019), perceived restorative outcomes, vitality, and blood pressure (Ojala et al. 2019), association between greenness exposure and depressive symptoms (Song et al. 2019). Nowadays, integrating big data in park therapy study was in order to get avian biodiversity and abundance, emotional responses and perceptions of geo-fenced 945 green spaces (Cameron et al. 2020). Furthemore, employing virtual reality (VR) will become a possible surrogate measure to real scenes evaluating human physiological and psychological restoration in the future (Calogiuri et al. 2018; Gao et al. 2019).

2.9 Benefits of Green Space Therapy

There are five health outcomes and three measures of nearby nature dose. These five health outcomes had plausible mechanistic pathways linking nature with health: mental health (self-reported depression), physical health (self-assessment of general health), social health (perceptions of social cohesion), positive physical behavior (level of physical activity), and nature orientation (nature relatedness scale) (Cox et al. 2017). Research has been conducted on the benefits of nature therapy in the last two decades, but there is still very little data that can clarify its real-time benefits on the human body with the help of evidence-based medicine (EBM), which focuses on physiological indications such as brain activity, autonomic nervous system activity, endocrine activity, and immune activity (Song et al. 2016).

In a study of park and garden landscape, Hofmann et al. (2017) described that gardening as model activity was an effective means of mitigating the harmful effects of chronic stress among Swiss citizens. Ng et al. (2018) suggested that horticultural therapy could potentially be useful for reducing inflammation and protecting neuronal functions for healthy Asian elderly adults. Xie et al. (2018) enforced the role of parks in supporting healthy aging, finding that older adults with the best access to parks experienced lower odds of cardio-cerebral vascular diseases, joint diseases, and endocrine diseases than other citizens with the least access to the parks. Additionally, the identified essential barriers to physical activity and park use (e.g., busy activity, lack of social support, weather-related concerns, and the fear of injuring oneself) will inform the design of a Park Prescription intervention in promoting physical activity, park use, as well as physical and mental well-being (Uijtdewilligen et al. 2019).

Most of the evidence-based studies have shown that the physiological and psychological benefits of walking or viewing in a forest and park landscape with varied environmental factors, including the type of natural environment, landscape design, as well as cultural differences, play a role in human interaction with the landscape. Igarashi et al. described that viewing a kiwifruit orchard landscape for 10 minutes resulted in induced physiological and psychological relaxation, such as a significant increase in the parasympathetic nerve activity; a significant decrease in heart rate; a significant increase in comfortable, relaxed, and natural feelings; and significant improvements in mood states for adult females (Igarashi et al. 2015). Viewing a hospital rooftop forest for 12 minutes led to autonomic sensitivity to the forest's natural elements and sufficiently relaxed older female patients (Matsunaga et al. 2011). Viewing a Japanese garden for 15 minutes of reduced heart rate and improved the behavioral system in Japanese patients with dementia (Goto et al. 2016). In another cross-cultural study, viewing different garden styles (e.g., Japanese garden, architectural garden, and landscape garden) induced psychological, emotional, and healing values among young Canadian and Japanese university students. Parasympathetic nervous activity increased in viewing the landscape garden, as the most natural-looking (Elsadek et al. 2019).

CHAPTER 3. METHODOLOGY

The chapter provides an overview of concept rationale, research design, location and time of research, data collection and sampling, data analysis procedure. The conceptual rationale is based on Maslow's Motivation Model. Adapting from Maslow's Motivation Model (Figure 1), the Perceived Green Space Therapy framework was developed through Stress Reduction Theory of affective/ arousal response to a natural environment (Ulrich 1983, Figure 2). Research design is generally structured as a preliminary perception survey, mail-back perception survey, local volunteer survey, on-site psychophysiological experiment, and formulation of perceived park therapy design guidelines.

3.1 Concept Rationale: Nature Exposure Needs

Exposure to nature is one method of experiencing direct impressions from the landscape and can result in physiological and psychological relaxation. The human-nature relationship and its impact on health study have been increasing in importance over the past four decades. Evidence is emerging to suggest that connectivity to nature can have positive impacts on human health. Most of the research focusing on the effects and preferences of natural landscapes studied healthy young adults (Lee et al. 2009; Matsuba et al. 2011; Park et al. 2011; Tsunetsugu et al. 2013; Takayama et al. 2014; Lyu et al. 2019; Song et al. 2019). Considering Maslow's motivation model, these aesthetic benefits should be considered in landscape development, and urban planners should prioritize the input of residents. Residents' behavioral responses might support the top two of Maslow's motivation model, self-actualization. Finally, the goal of life need in urban society is not only self-actualization but also the possibility of transcendence in the quality of life (Figure 3). Human perception, preference, and therapeutic effects of UGS have been considered factors of life satisfaction (Diener and Diwas-Diener, 2009; Abdullah and Zulkifli, 2016).

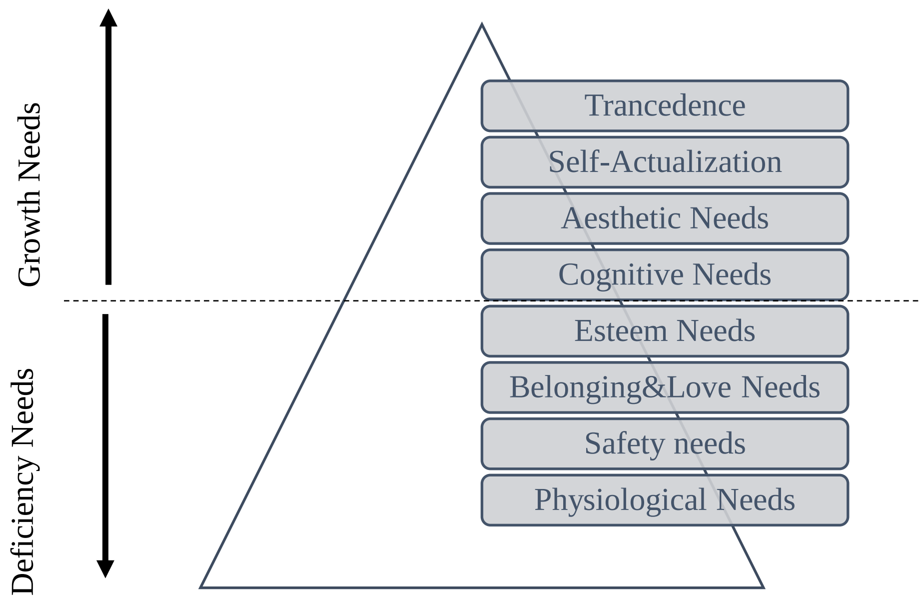


Figure 1. Maslow's motivation model.

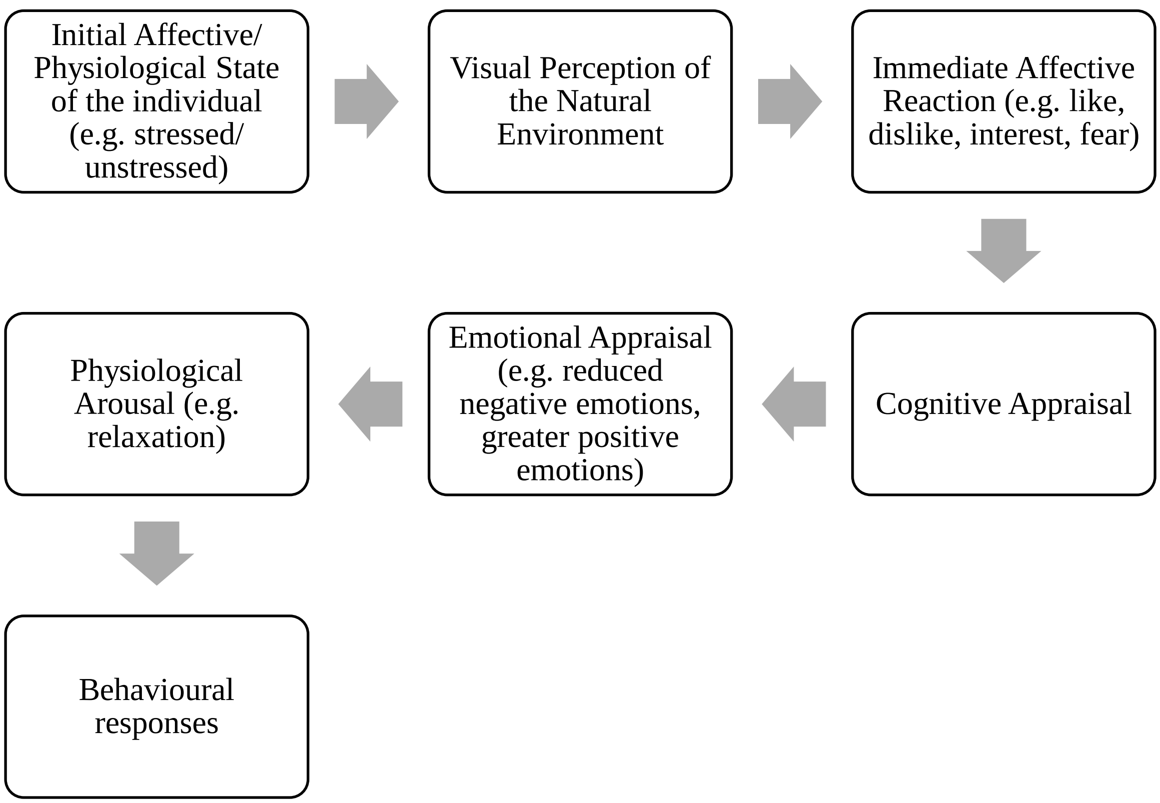


Figure 2. Stress reduction theory of affective response to a natural environment. (Ulrich 1983).

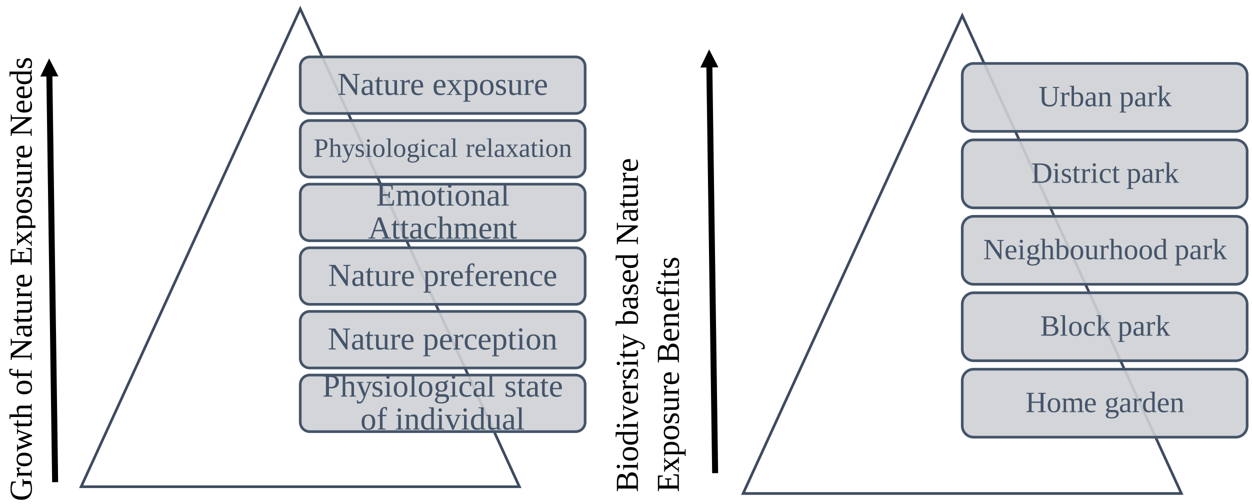


Figure 3. Perception and experience of UGS model.

3.2 Research Design

Research design is particularly structured as nature exposure needs-based three main studies consisting of varied scope and context in pursuing the general objectives and specific aims of this study, namely 1) urban green space (UGS) perception, 2) nearby parks preference, and 3) urban park experience. Before conducting UGS perception survey, preliminary survey in university students was commanded. In the first study, we focused on how residents perceived merits of urban green space, reasons for reluctance to use urban green space and their attitude toward urban green space. In order to observe their social attachment and participant in community, we differed two type of residents as respondents, public housing and private apartment. In this case, residents of detached house were not eligible to be selected as respondents. In the second study, we focused on how residents preferred block and neighborhood parks, length of visit, activities, park elements, and disturbances. From this survey, we could determine prioritized parks, time, activities, effective elements and threatening problem that might be found in the park. In the third study, we focused on how the effect in is experiencing urban parks with various environmental stimulus by investigating three aspects, 1) physical health, 2) mental health, and 3) social health. In this study, we recruited middle-aged and older adults of volunteer group (NPO Matsudo Creative) and non-volunteer group living nearby the experimental site (Forest and Park for the 21st Century) from Tokiwadaira, Mabashi, and Koganehara area, Matsudo City, as well as Japanese and Indonesian students of Chiba University and beyond living in Matsudo City and surroundings. In order to implement this study, there were three steps dealing with the study, such as research ethics proposal, task system management of investigator, and recruitment of the subjects through subject candidate meeting. The public participation strengthens by the local organization is the external factor potentials in this study. Moreover, the investigator's assignment system is the internal factor potentials to ensure the experimental design of the study is within the framework of the research protocol. Because this research applied the treatment to the human's physiological and psychological responses, Research Ethics approval should be received to collect the data, analysis, report, and publish the information about research subjects. The framework and workflow of overall research are shown in Figures 4 and 5; the workflows of each research are shown in Figures 6, 7, and 8.

3.3 Location and Time of Research

Matsudo city was located in North-west part of Chiba Prefecture and as a major suburb of Tokyo. The first and second study was commanded in Tokiwadaira area, an eastern part of Matsudo City encompassing residential area with plentiful green space. The survey was taken place during January until February 2018. While the third study was conducted on-site Forest and Park for the 21st Century, Matsudo City. This urban park comprising an area of 50.5 hectares built to protect and raise nature of Sendabori Area. Two walking routes, Midori no Sato (Village of Green)-Gathering Square in winter, early summer, and autumn, and one walking course, Park Center-Nature Observation in spring, were utilized in this study. Three viewing spots with the view of cherry blossoms in the viewpoint, pond in the short distance and forest in the medium distance in spring, fresh greenery (Katsura tree) in the viewpoint, pond in the short distance, and forest in the medium distance in early summer, as well as flower bed Ornamental cabbage in the viewingpoint, pond in the short distance, and forest in the medium distance in autumn. The experiment was performed from January to June 2019 and November to December 2019.

3.4 Data Collection and Sampling

Nowadays, the context of the multiple values of forests and parks, especially for conducting LIST, involves not only merely experts but also students (Ueda et al. 2012; Pratiwi et al. 2014a, 2014b) Pratiwi) and general society or local residents (Ueda 2009; Pratiwi et al. 2019, Pratiwi et al. 2020). The sampling method applied in the first and second research was stratified random sampling technique in 5 blocks of a housing complex (housing complex) and apartments which were located in 250 m from the main road. The determination of sample size in this research was 220 of 2020 distributed-mail-back questionnaires in Tokiwadaira (127 apartment residents and 93 housing complex residents). The questionnaire kit was distributed first within residential areas inside sample sites. If there are no residents in a housing complex or apartments or there is insufficient residence to distribute, the buffer is set to 50-100 m. The sampling method applied in the third research was a snowball sampling technique in middle-aged and older adults as well as young adults. The middle-aged and older adults consisted of volunteer and non-volunteer group in Tokiwadaira, Mabashi, and Koganehara Area, whereas young adults consisted of Japanese and Indonesian students in Chiba University (Matsudo City, Chiba City), Meito Japanese Language School (Matsudo City), and Reitaku University (Kashiwa City). Educational background has major influence on environmental perception, behavior, attitudes. As local residents, it was expected that we could extract more local knowledge as they experienced in surrounding green spaces. Furthermore students, it was expected that we could enrich clearly the spatial cognition through their park image sketches.

3.5 Data Analysis Procedure

The data were obtained through questionnaires and on-site sedentary and physical activities and tested to 2000 Tokiwadaira residents (mail-back questionnaire: 220 answers), 12 volunteers and non-volunteers Tokiwadaira in winter, spring, and early summer, and 30 students (11 Japanese, 9 Indonesian). Based on previous studies (Lucas 1991; Pratiwi et al. 2014; Gunawan and Pratiwi 2015; Pratiwi and Furuya 2019), the research procedure for developing a perceived green space therapy design concept consisted of perception and preference survey, on-site psychophysiological experiment, analysis, and model formulation of green space therapy design. There were quantitative and qualitative methods of data analysis involved in this study.

The quantitative data consisted of human perception and preference towards UGS, and human physiological responses, human psychological response. The analysis method applied was parametric analysis including Descriptive analysis, Chi-square test, paired t-test, non-paired t-test, Repeated Measure ANOVA; non-parametric analysis including Wilcoxon signed-Rank test, Mann Whitney U test, Spearman correlation, Cluster analysis, Principal Component Analysis. SPSS 26 (IBM Corporation, Armonk, NY, USA) was employed to determine the statistical significance. The qualitative data consisted of human appreciation of experienced urban parks as therapy space, especially the narrative description regarding park therapy. The KH coder 3 was employed to investigate the degree centrality of human appreciation towards urban green space using explanatory verbal data. The only significant variable at $p<0.05$ was discussed to characterize human perception, preference, and therapeutic effects in urban green spaces.

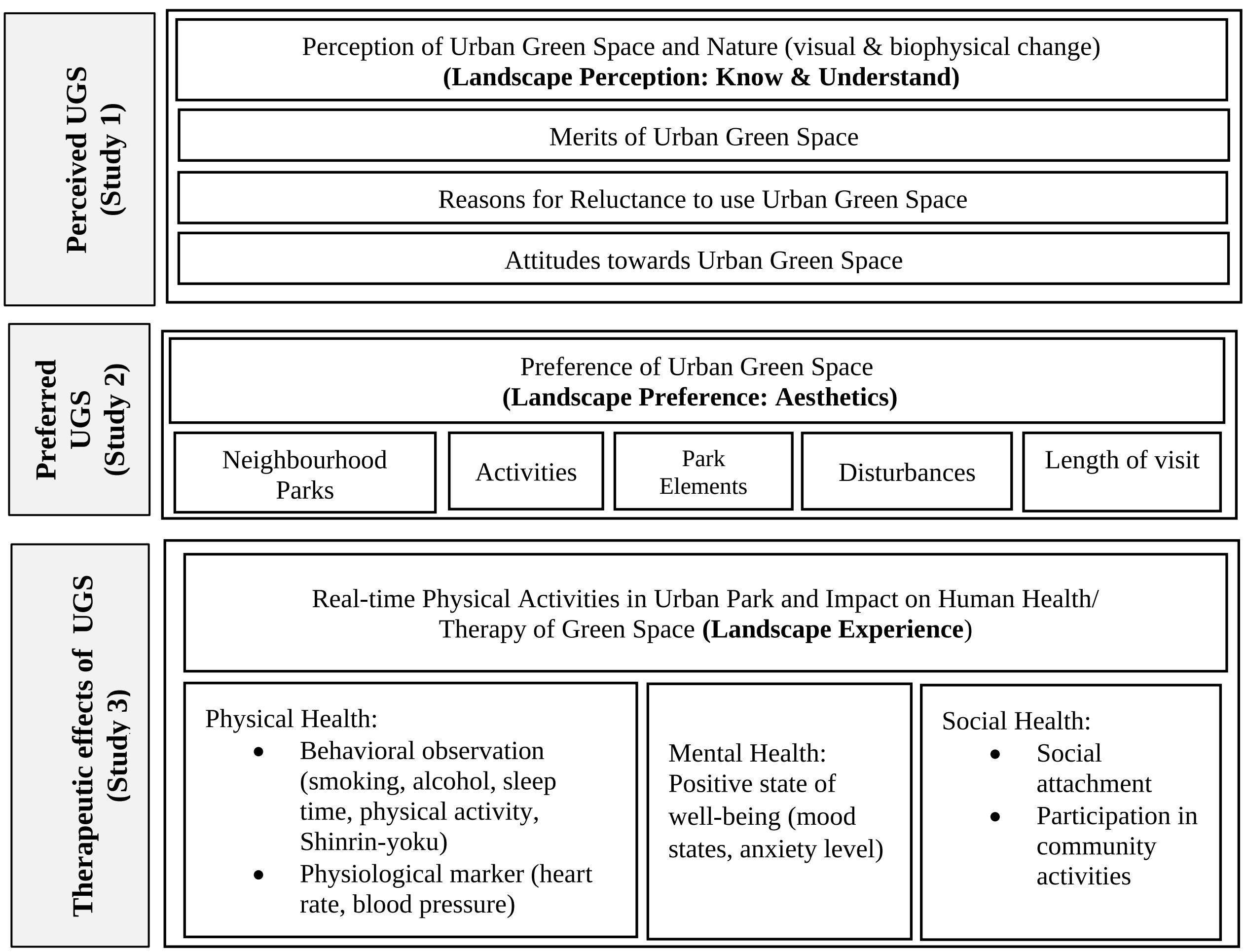


Figure 4. Framework of research.

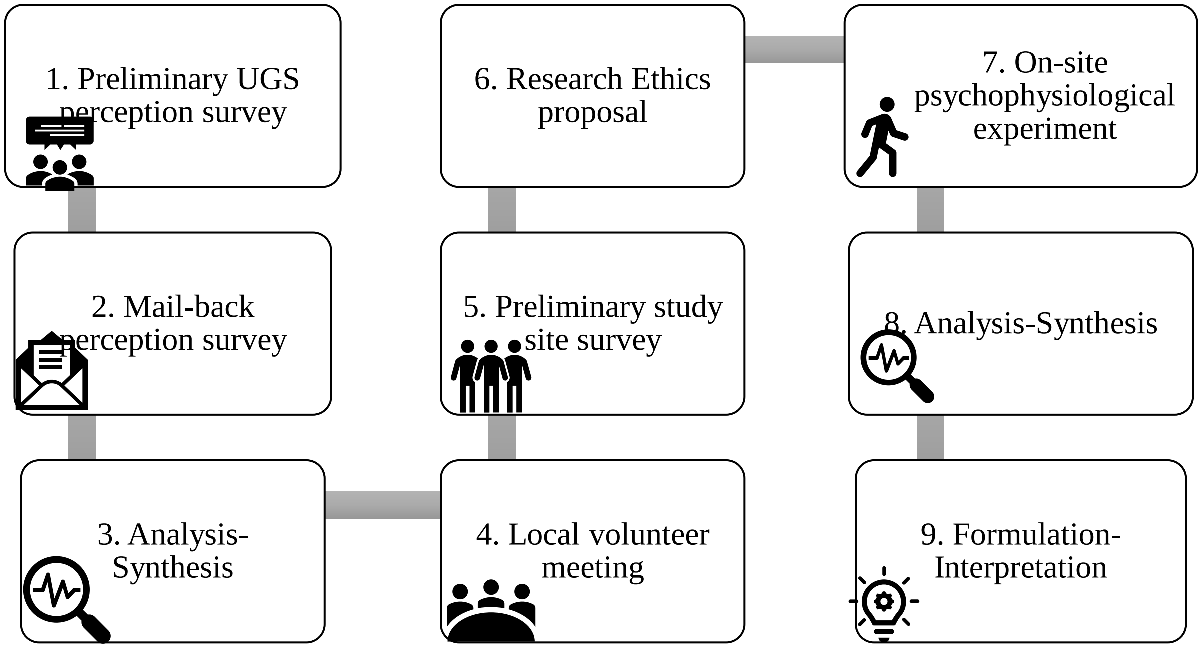


Figure 5. Flow of general research design.

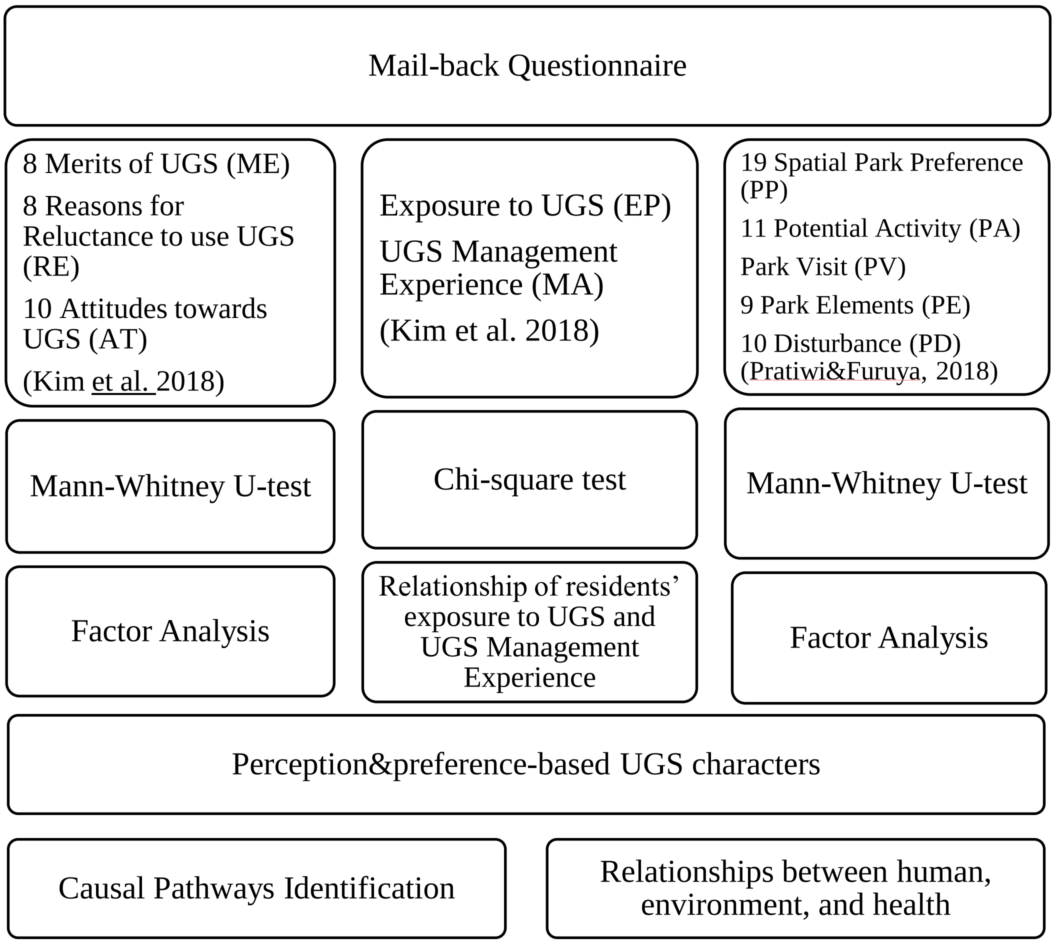


Figure 6. Workflow of the first and second research.

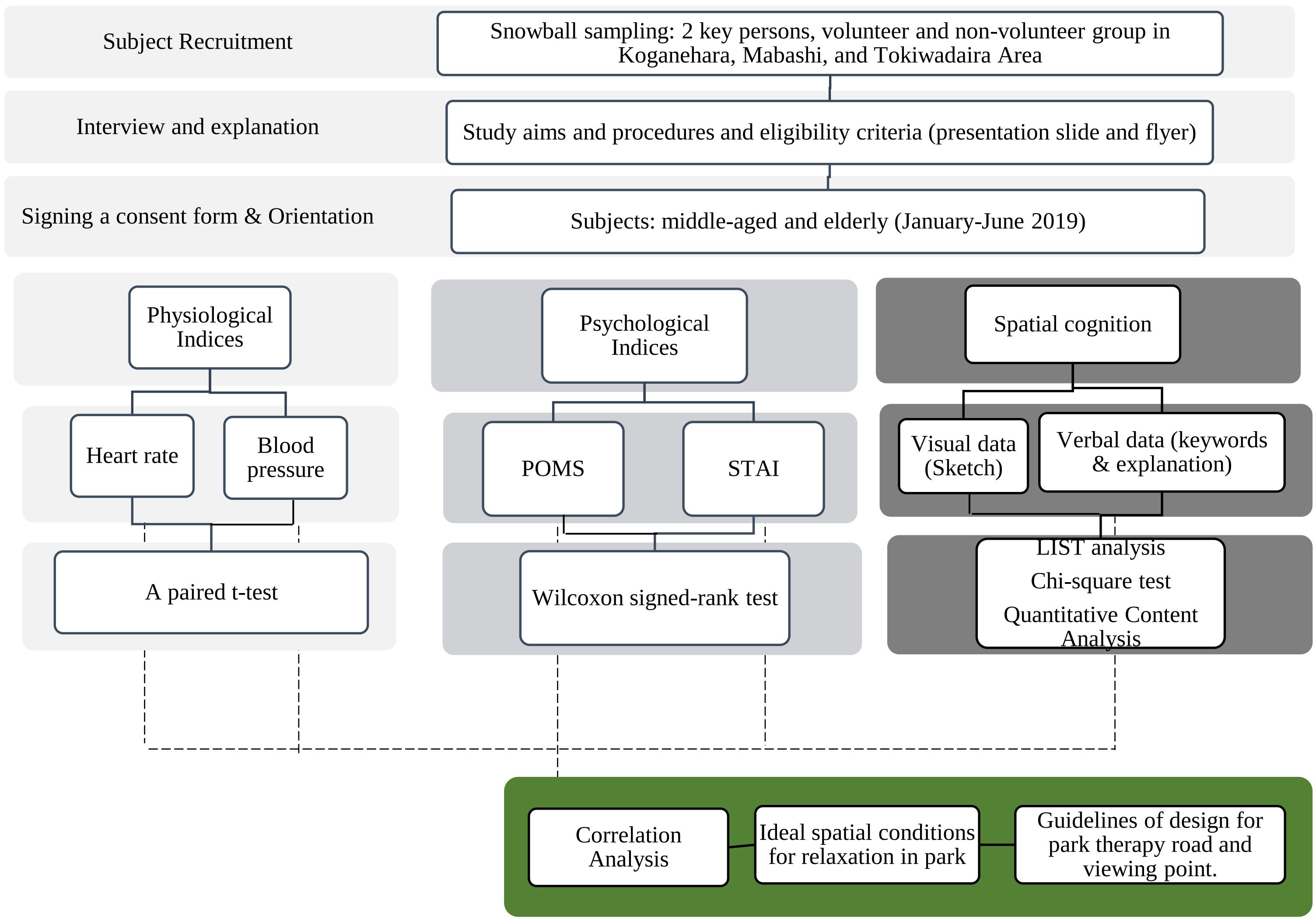


Figure 7. Workflow of the third research in middle-aged and older adults.

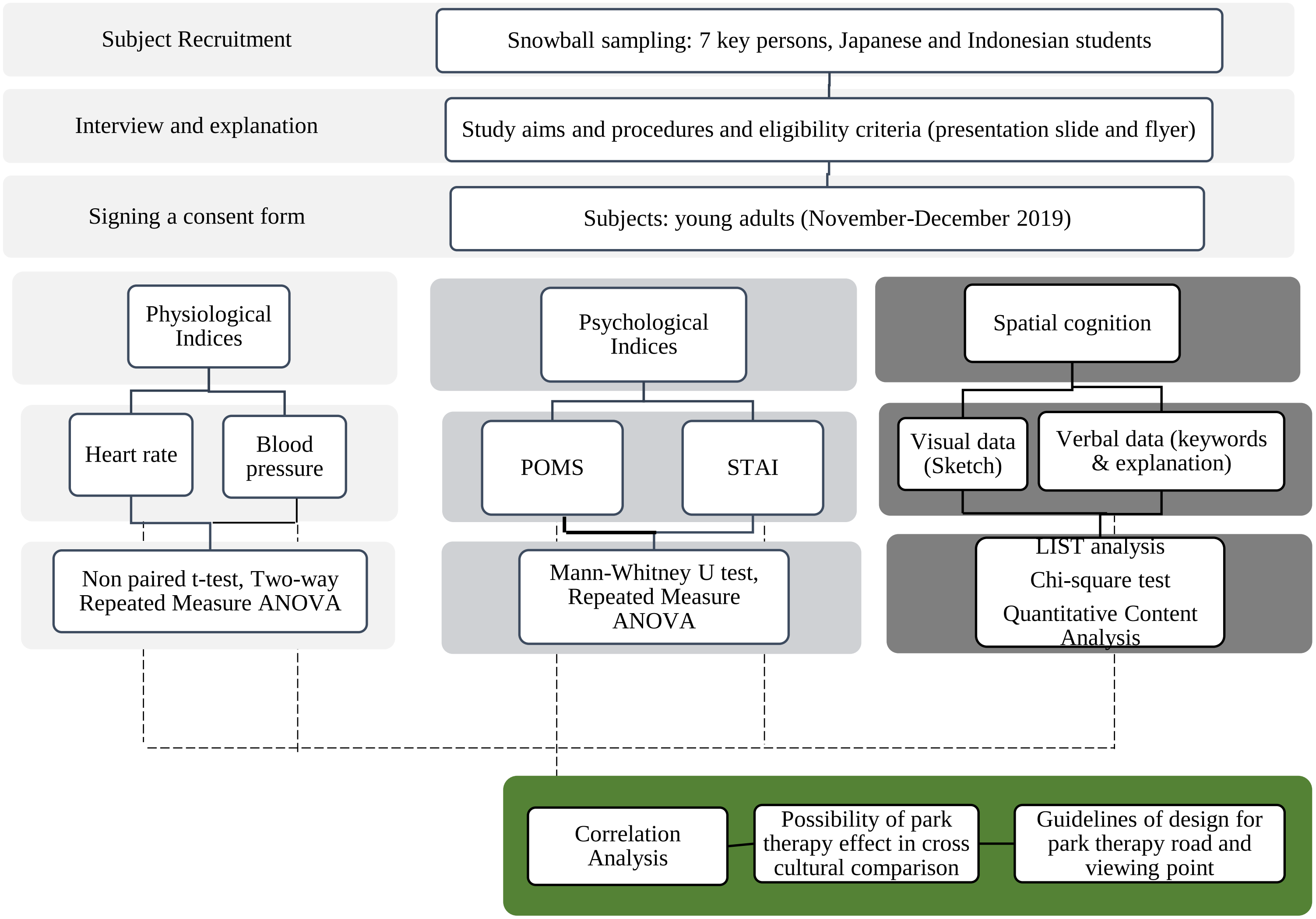


Figure 8. Workflow of the third research in young adults.

CHAPTER 4. DIFFERENCE IN PERCEPTION OF URBAN GREEN SPACES BETWEEN HOUSING COMPLEX AND APARTMENT RESIDENTS IN TOKIWADAIRA, MATSUDO CITY, JAPAN

4.1 Introduction

Urban areas are becoming increasingly populated and Japan is one of the most highly urbanized countries in the world. During the eighteenth century, Tokyo was the largest city in the world, with an estimated 1 million inhabitants. Today, Tokyo Metropolitan Area, as opposed to the city of Tokyo, is the largest in the world with approximately 39 million people (Masai 1990). In Japan, the majority of the population comprises elderly people, leading to a lack of workers, inadequate care for elderly people, lower birthrate, abandonment of local areas, and lack of community.

The post-war period was marked not only by an intensification of the economics in the industrial sphere, which advanced the development of new housing types, but also transformations in the role of the housing system. Recently, homes have undergone considerable atomization with a rapid proliferation of single-only and couple-only households. The new pillars of housing policy introduced in the 1950s began to redirect resources toward modernizing the housing system. These included, firstly, the Government Housing Loan Corporation Act (GHLC), which provided government funding for long-term, low interest mortgages; secondly, the Public Housing Act (Act No. 193 of 1951), which provided a limited amount of subsidies to the public housing private market; and third, the Japan Housing Corporation Act (JHC), which developed multi-family housing estates for middle income households in large cities. A notable innovation was the JHC’s construction of *danchi* complexes (housing complexes) from the mid-1950s (Nordin and Nakamura 2018; Chiavacci 2019). Housing complex are multi-family housing estates comprising concrete apartment structures. Their construction aimed to develop suburban neighbourhoods and promote modern family lifestyles orientated around compact apartment units. Buildings were initially 5–12 stories high and surrounded by parking areas and playgrounds. Inside, layouts were standardized around an N+DK formula in which N denoted the number of rooms other than the dining-kitchen (DK). The most typical layouts were the 2DK and 3-4DKs, which were produced for large families.

The first high-rise construction became possible after the 1965 restrictions on building heights to 31m. However, high-rise building initially proved problematic in terms of construction, adapting the existing infrastructure, as well as the impact on neighboring communities. Increasingly, smaller scale private sector apartments, or *manshon*, were constructed for rent in and around urban areas. *Manshon* properties were not only cheaper but often better connected to the city than many new housing developments, and over time designs were diversified to suit single and larger households, as well as wealthier consumers. In the post-bubble era of the 1980s, the production and consumption of apartments advanced even more rapidly. The landscape of urban housing had arguably entered a new era, stimulating the growth of taller buildings and more compact urban dwellings. Although dwelling has become highly individualized, it is argued that familial bonds remain even though the home as a communal family place has progressively lost salience (Kim and Omi 1994). The discourses surrounding baby boomers and retirement have deeply impacted on notions of individual lifestyles, concepts of ideal family relations, and housing, and have influenced the anticipatory negotiations of lifestyle and housing in old age. The most essential differences in the perceptions of informants depended on whether they lived in an old or new neighbourhood. The difference between old and new neighbourhoods comprises concern for the area in which they live and their attitude toward taking responsibility. A person’s degree of involvement in neighbourhood activities and local networks greatly influences their emotional attachment to the living area and thus influences their decisions about staying or moving after retirement or when their children marry (Ronald and Alexy 2001).

Several major tasks include realigning the urban structure, especially supplying housing in good residential districts, and improving the infrastructure. To this end, Japan must tackle the urgent problem of residential development. Explorations are now under way to institute a more community-led mode of urban planning in which local residents can participate. Cities need to be more innovative and take advantage of local strengths. Second, urban redevelopment needs to place more emphasis on cultural perspectives, emphasizing the distinctive local or regional personality. Third, Japanese cities must prepare for the coming “aging society.” Some housing projects for the elderly are going up in Tokyo and other cities, but urban development must be adapted to the needs of elderly people, by, for example, constructing more parks and replacing steps with slopes. Open space is a critical problem in Japanese cities; the ratio of parks to inhabitants is 10.8 square feet (1 sq m) per capita in Tokyo compared with 247.6 square feet (12 sq m) in London and 129.2 square feet (12 sq m) in New York (Karan 2004). Furthermore, research about the bonding features of elderly groups in housing complexes had been determined based on the existence of reliable persons, daily social contact with their neighbours, and high level of participation in social and community organizations (Nordin and Nakamura 2018), thus the investigation to strengthen the bonding and bridging social capital by characterizing in terms of physical neighbourhood environment would be necessary.

Recent studies show that nature provides many therapeutic benefits, both physically and psychologically. It provides an inner sense of serenity that facilitates healing and affects life satisfaction (Lyle 1985). According to Talbot and Kaplan (1991), life satisfaction scores were higher when their study participants felt that nature and places for outdoor recreation were nearby and accessible. With their decreased life space and infrequent trips away from home, the outdoor environment close to home may be the only opportunity for the elderly to contact nature (Grahn and Stigsdotter 2010). More recently, the WHO framed active ageing by the four pillars of security (dealing with vulnerability), activity (participation), health, and continuity of education. It is crucial that people effectively participate in green space planning and design by investigating the perception of green space in order to predict willingness to support and conserve nature (de Pinho et al. 2014). Public participation methods reflect the local conditions, carry a lower cost than other approaches, and are the key to unlocking this situation. In a European Commission report regarding quality of life in European cities, four issues were addressed: people's satisfaction with their cities, their views about their cities, the environment, and people's personal situation. However, in Asia, particularly in Japan, this has not been investigated.

Tokiwadaira area is located in the north-east of Tokyo where the concrete flats of the oldest semipublic housing were built in the early 1960s. Its demographics are changing rapidly. The latest data show that the total population in Tokiwadaira town in 2017 was 28,875 people, comprising 14,932 households (males: 14,231; females: 14,644). In total, 38.29% of the total population (11,056 people) live in Tokiwadaira housing complex, most of whom are over 65s (47.5% (3,559) in 2017 and 45.6% (3,512) in 2016) who moved there upon retirement and now live alone. There are also private apartments surrounding Tokiwadaira housing complex, which were built in the 1970s-1980s, while various types of green space support recreational demands. There are two types of green space: hubs and links. Hubs are neighbourhood parks surrounding the housing complex and apartments, pocket parks between the housing complex or apartment buildings, small gardens in front of the housing complex or apartments, and small neighbourhood pine forests. Links, meanwhile, are greenways of keyaki trees that provide shade in spring and summer and cherry blossom tunnels that bloom in spring.

We assume that people in different types of dwelling and neighbourhood might have different perceptions based on their dwelling situation, record of volunteering activity, and personal factors. By investigating landscape perception, the variation in resident types could be understood to describe green space quality. Due to the differences in perception of nature and urban green spaces, it is necessary to clarify the differences in green space perception between the housing complex and apartment residents, to examine what residents' attributes may influence their green space management experience, and to formulate factors inducing residents' awareness and attitude toward green spaces.

4.2 Methodology

The participatory planning and design method play a key role in ensuring user satisfaction (Turan et al. 2016). It helps formulate comfortable, legible, and convenient green spaces with a variety of activities to meet public needs. With participatory planning, residents are actively involved in urban green space planning and the design process; this results in a greater public spirit, social connection, user satisfaction, significant financial saving, and a better maintained environment

4.2.1 Study area

The object of research comprised residents' perceptions of nature and green spaces. To assess their awareness and attitude toward of green space, residents of different types of dwelling, housing complex and apartments in Tokiwadaira Area, one of the residential areas in Matsudo City, Chiba Prefecture with plentiful green space, were selected as respondents (Figure 9 and 10). The survey was conducted from January to February 2018.

4.2.3 Data collection and sampling

Nowadays, the context of landscape perception, particularly for assessing awarenessand attitude toward green spaces, involves not only experts and students (Ueda 2006; Pratiwi et al. 2014), but also general society and local residents (Ross and Wall 1999; Ueda 2009). Stratified random sampling was used in this research. The respondents comprised residents living in apartments and housing complex. The data were obtained through a survey questionnaire administered to 2020 residents; the number of returned questionnaires comprised 93 from housing complex respondents and 127 from apartment respondents. The questionnaire was arranged using their native language and filled out using pen to avoid systematic errors.

The sample size was sufficient as the research sample for each type of dwelling exceeded 30 respondents (Gay and Diehl 1992; Roscoe 1975; Fraenkel & Wallen 1993). The data were obtained from questionnaire surveys using the posting method with a return envelope. The data were obtained from questionnaire surveys using the posting method with a return envelope.

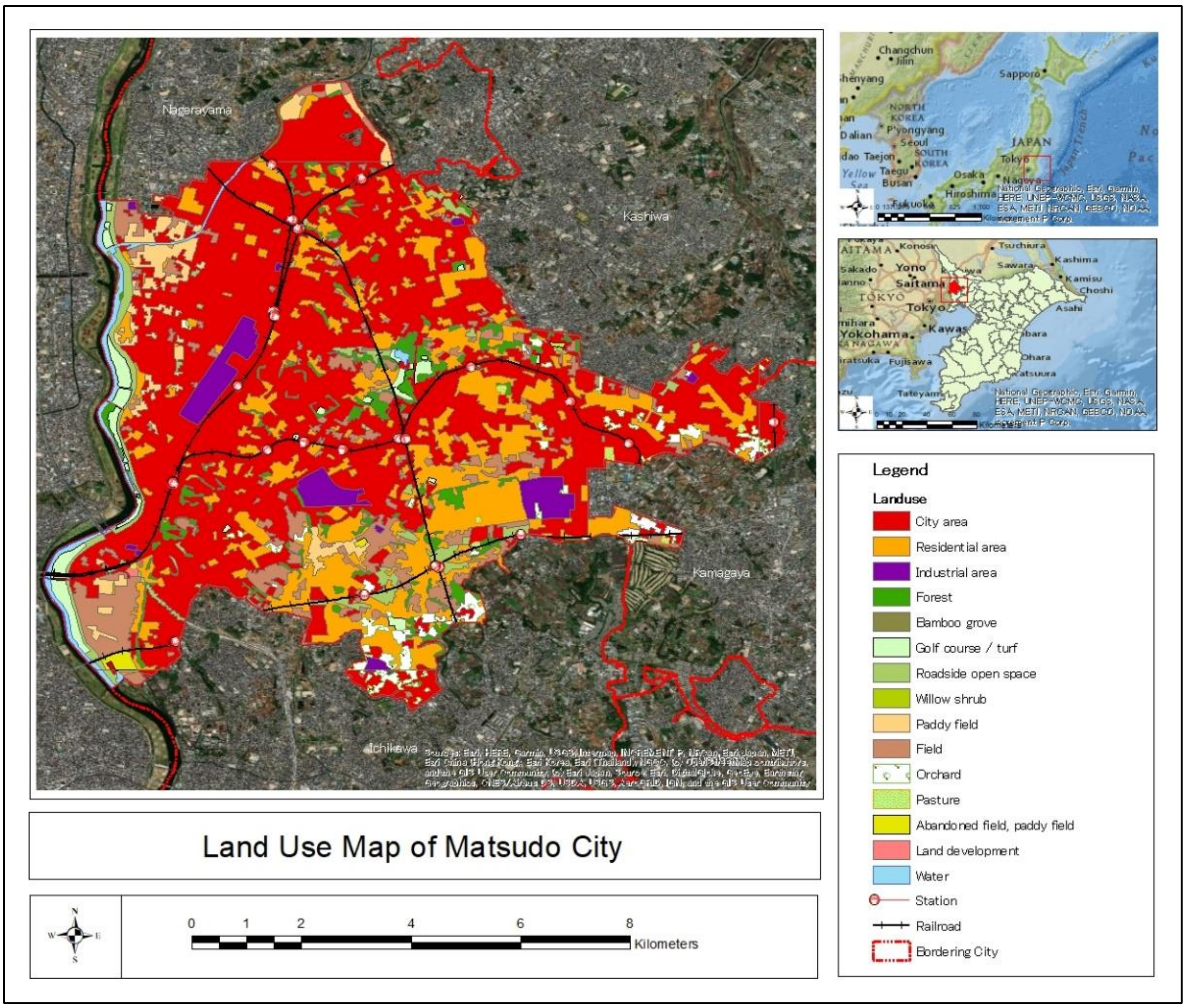


Figure 9. Map of Matsudo city land use.

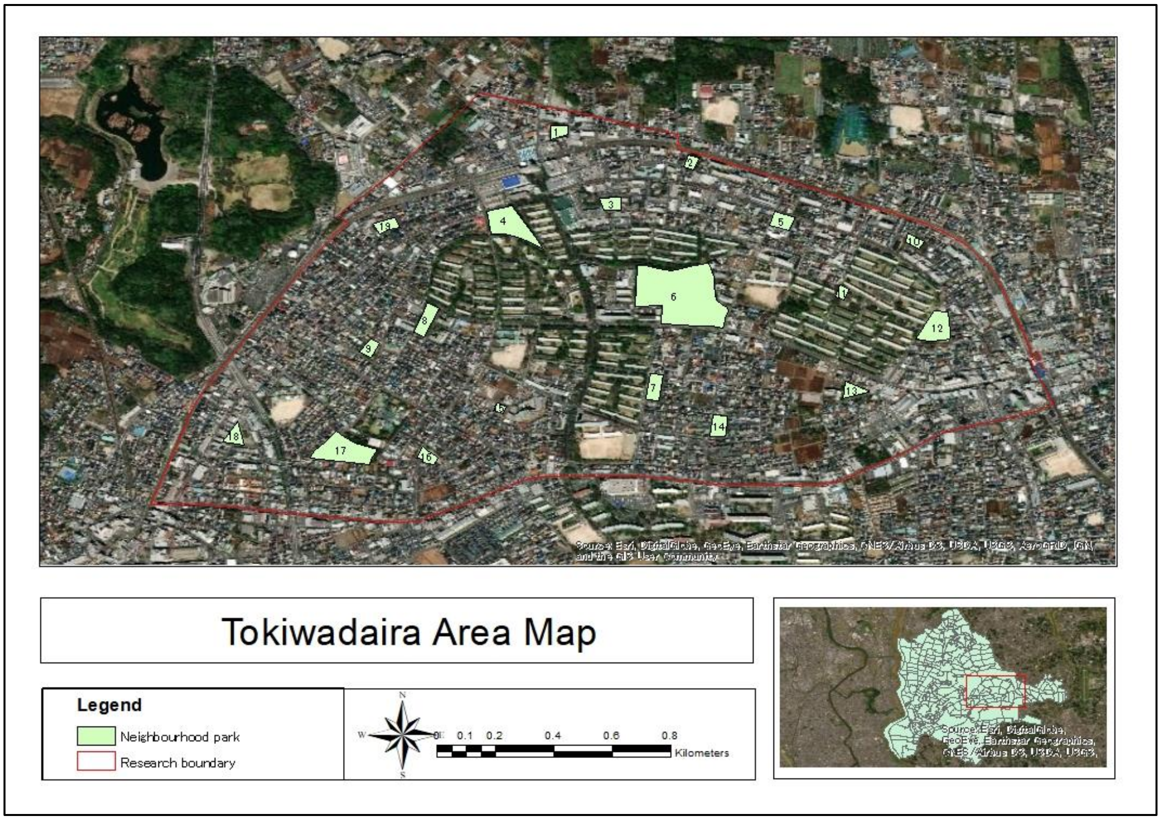


Figure 10. Map of Tokiwadaira area.

4.2.4 Data analysis procedure

Based on previous studies (Lucas 1991; Pratiwi et al. 2014; Gunawan and Pratiwi 2015), the research procedure for developing a design concept consisted of perception and preference survey, analysis, and interpretation.

Awareness and attitude toward UGS survey

1. Living space and volunteering activity

The residents were asked to describe the character of their living space and their activities in the green spaces, including their green space in residence, activity intensity in green spaces, gardening, volunteering activity, expected number of hours participating in volunteering activity. Residents then chose their perceived level of benefit, constraint in relation to, and interest in nature and green spaces using a 5-point Likert Scale from “Extremely,” “Sometimes,” “Neither,” “Not so much,” and “Not at all,” as described in Kim et al. (2018).

2. Residents' attributes

It was necessary to clarify residents' attributes such as gender, age, existence of children, employment status, and length of stay. As Pratiwi et al. (2014) suggested, these factors may lead to differences in perception and preference.

Awareness and attitude toward UGS analysis

1. Analysis of awareness and attitude level between housing complex and apartment residents

The purpose of this analysis was to examine the significant differences in perceived merits of UGS, reasons for reluctance to access UGS, and attitudes toward UGS. The respective question types consisted of 8, 8, and 10 variables, respectively. A Mann-Whitney U test was applied to examine significant differences in perception level.

2. Analysis of attributes influencing green space management experience

The purpose of this analysis was to examine the relationship among residents' attributes and residents' gardening and volunteering activity in green spaces. The questionnaire comprised five variables: gender, age, existence of children, occupation, and length of stay. A Chi-square test was applied to examine these relationships.

3. Factor analysis in perceiving UGS

The data, consisting of 26 variables of green space perception, were analyzed using factor analysis. Factor analysis using the principal component method and Varimax rotation was applied to characterize residents' awareness and attitude toward green space. Factor analysis was conducted as follows (Hidayat and Istiadah 2011): (1) defining variable, (2) counting matrix correlation among variables, (3) extracting factor, and (4) rotating factor.

Interpretation

Interpretation of awareness and attitude toward green space was formulated and derived from analysis of awareness and attitude and factor analysis. The differences in residents' awareness and attitude of their surrounding nature and green spaces were considered, to provide guidance on urban green space planning for specific local governments.

4.3 Result and Discussion

4.3.1 Difference of awareness and attitude toward UGS

Generally, the trends of housing complex and apartment residents were similar, from the highest to lowest awareness level respectively: “extremely,” “sometimes,” “neither,” “not so much,” and “not at all.” The Mann Whitney U test demonstrated a significant difference in perceptions of the merits of green spaces between housing complex and apartment residents, especially in the “it is near” (p = 0.037) and “it can control the dust” variables (p = 0.003), where housing complex residents had a higher median in those variables (5 vs 4, 4.2 vs 3.9, respectively, Figure 11). Forty-six percent of housing complex residents but only 41% of apartment residents perceived that green spaces could control the dust. Fifty-one percent of apartment residents but only 26% of housing complex residents reported “sometimes” thinking about how near the green space is to their house (Figure 12). Tokiwadaira housing complex was surrounded by several types of green space, including neighbourhood parks, playgrounds, small front gardens, backyards, greenways, and pine forests. There are more than 20 species of tree in Tokiwadaira housing complex with tree canopies providing environmental benefits such as removing air pollution. Moreover, as Sulistyantara and Pratiwi (2011) described, the 325.38 hectares (57%) of green space in the tourism area provide economic benefit to the tune of $172.029.

Table 1. Merits of UGS between housing complex and apartment residents

	Beautiful urban landscape	**Feel the nature**	**Near**	**Free activity**	**Children can play**	**Easily inhabit life**	**Control dust**	**Air conditioning**
P-value	0.829	0.738	0.037*	0.363	0.168	0.488	0.003**	0.900

Note. p*<0.05, p**<0.01, ***p<0.001.

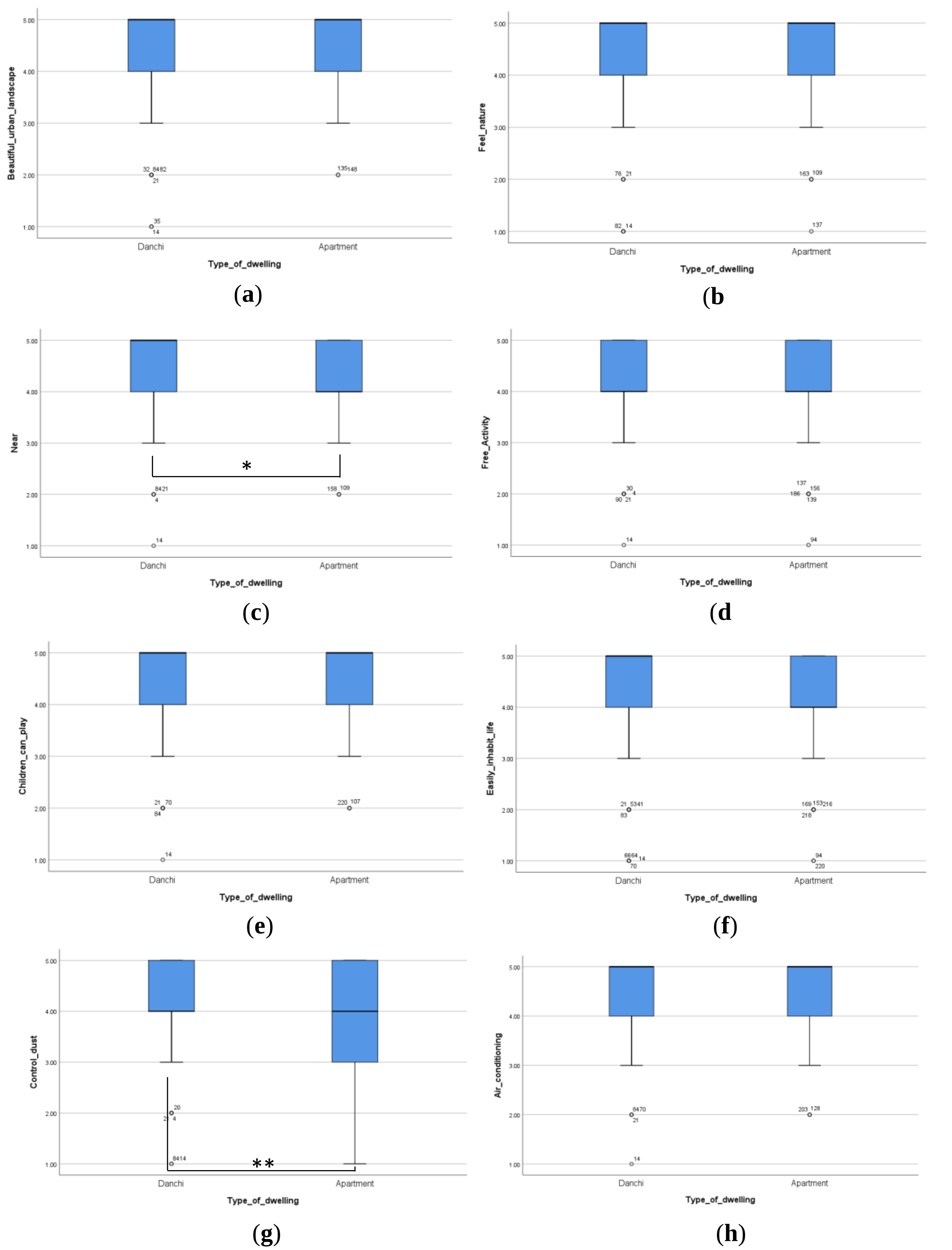
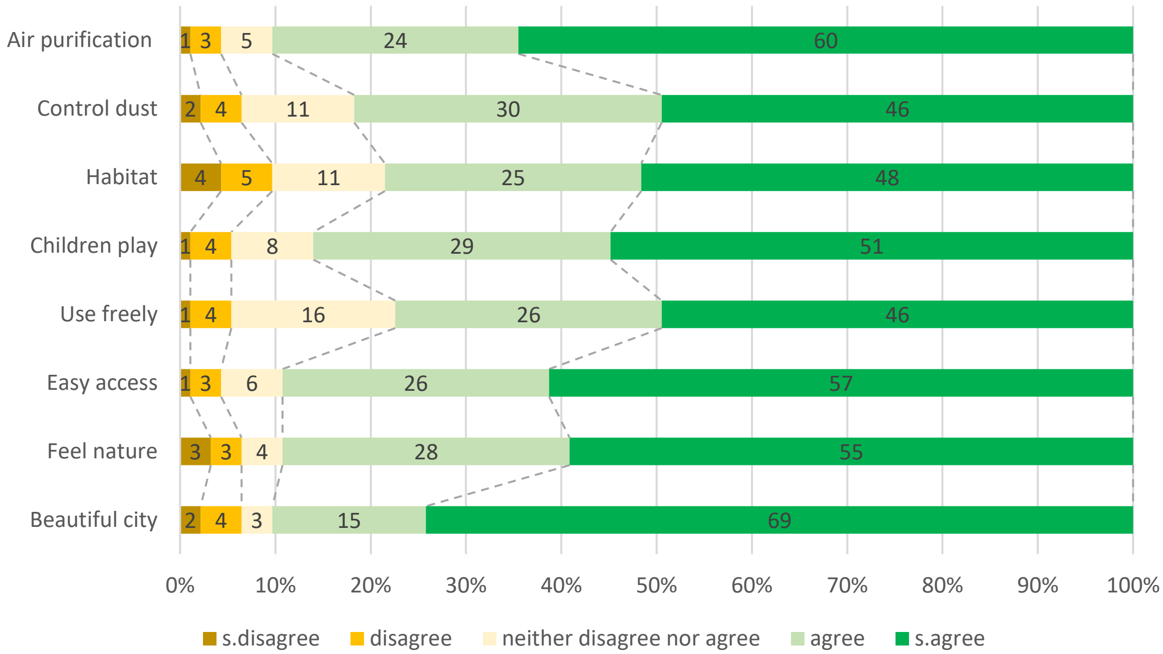
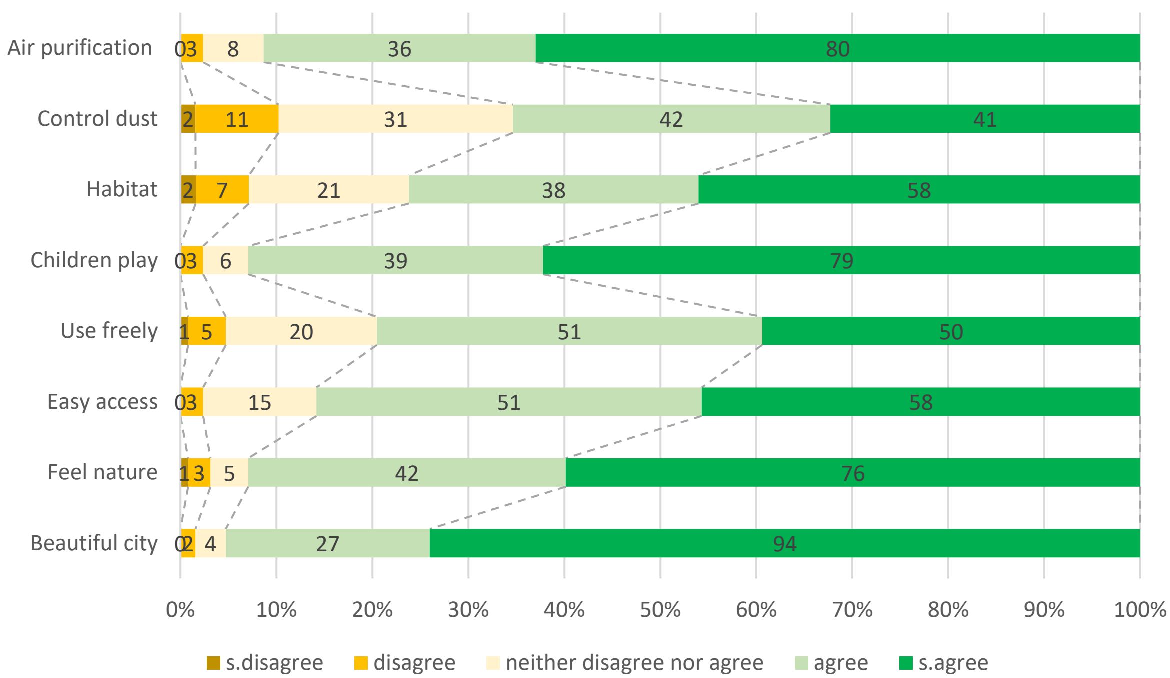


Figure 11. Median merits of UGS: (a) beautiful urban landscape; (b) feel nature; (c) near; (d) free activity; (e) children can play; (f) easily inhabit life; (g) control dust; (h) air conditioning.



(**a**)



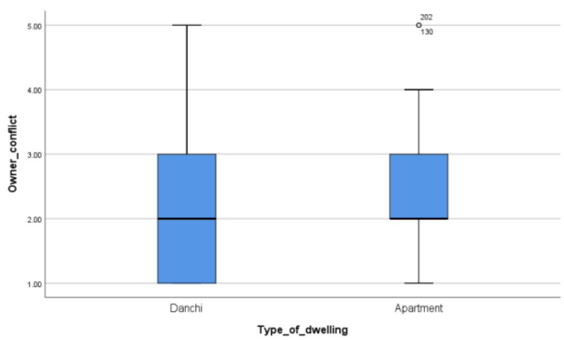
(**b**)

Figure 12. Difference in merits of UGS between: (a) housing complex; and (b) apartment residents.

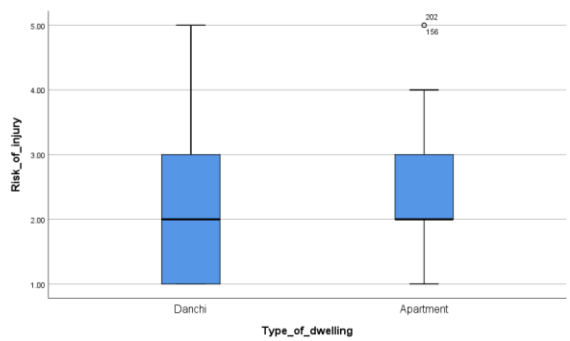
The Mann Whitney U test did not show a significant difference between housing complex and apartment residents in perceived constraints to accessing green spaces (Table 2). Most housing complex and apartment residents thought little about the constraints of green spaces (Figure 13). The highest percentage of housing complex residents reported thinking “not so much” about whether “the plants are well-managed” and “it is hard to enter” (34%), while apartment residents thought “not so much” about “it is hard to enter” (55%, Figure 14).

Table 2. Reasons for reluctance to use UGS between housing complex and apartment residents.

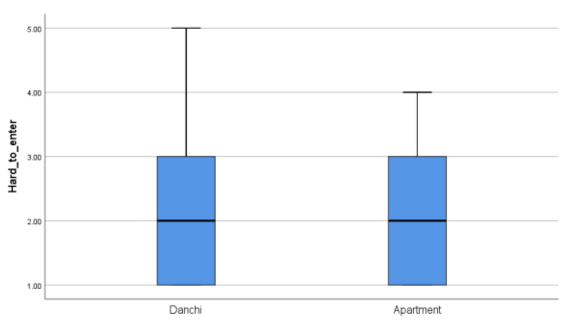
	Owner conflict	**Risk of injury**	**Hard to enter**	**A lot of garbage**	**Contaminated place**	**Not well maintained**	**Narrow**	**Highly likely to be lost**
P-value	0.143	0.281	0.643	0.236	0.584	0.996	0.558	0.653



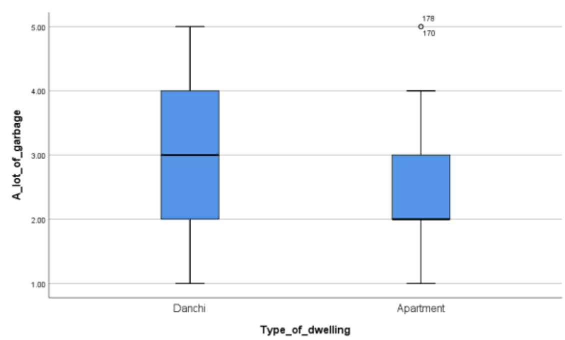
(a)



(b)

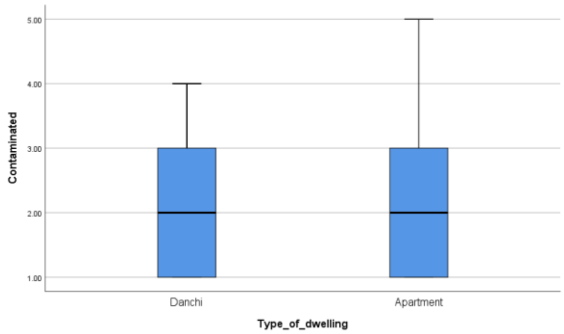


(c)

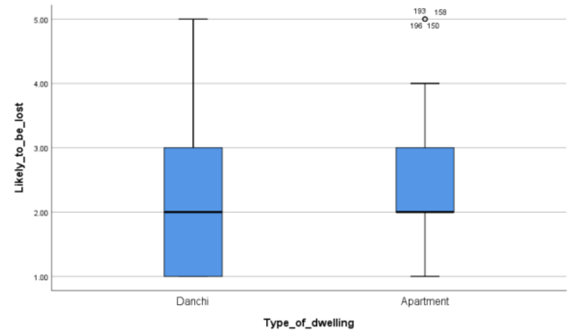


(d)

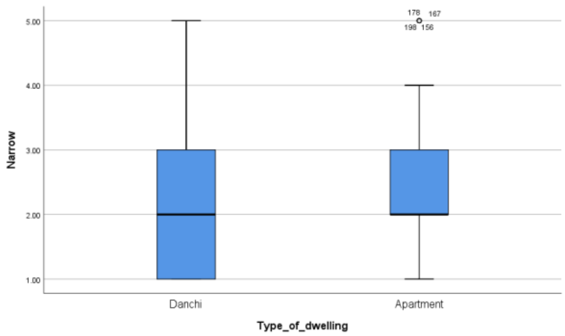
Figure 13. (To be continued)



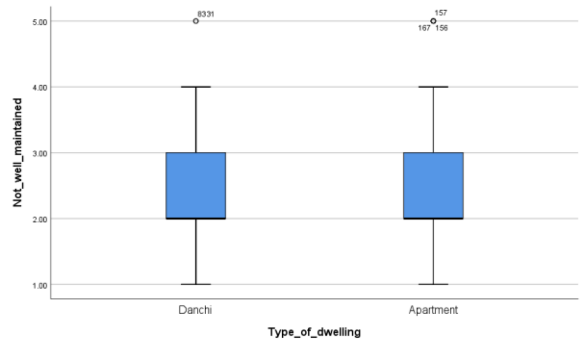
(e)



(f)

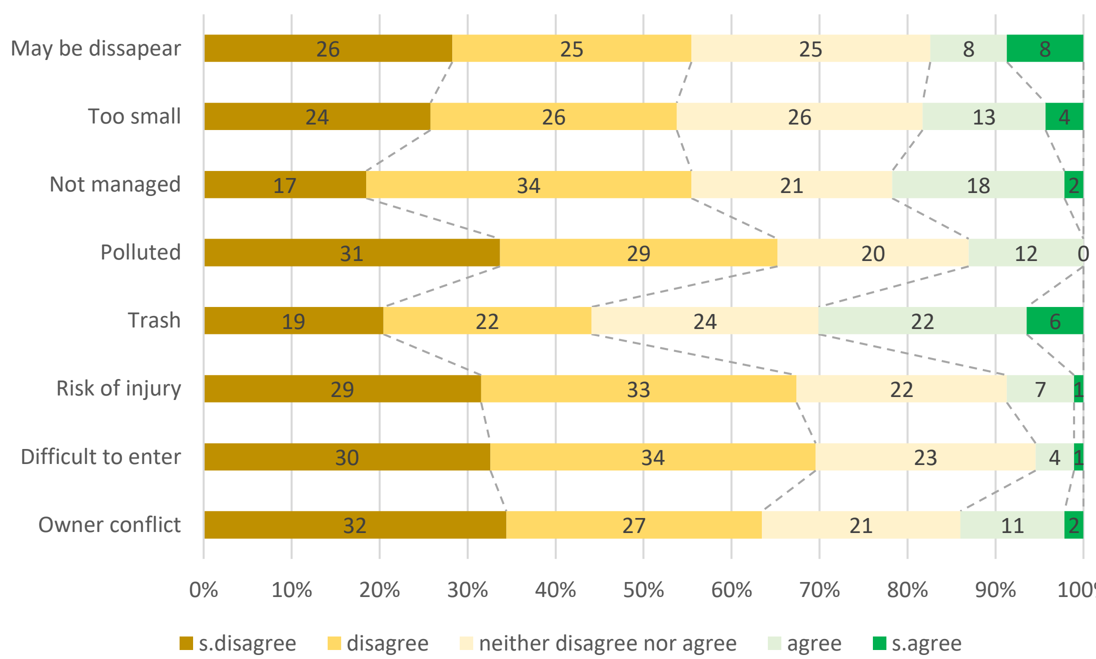


(g)

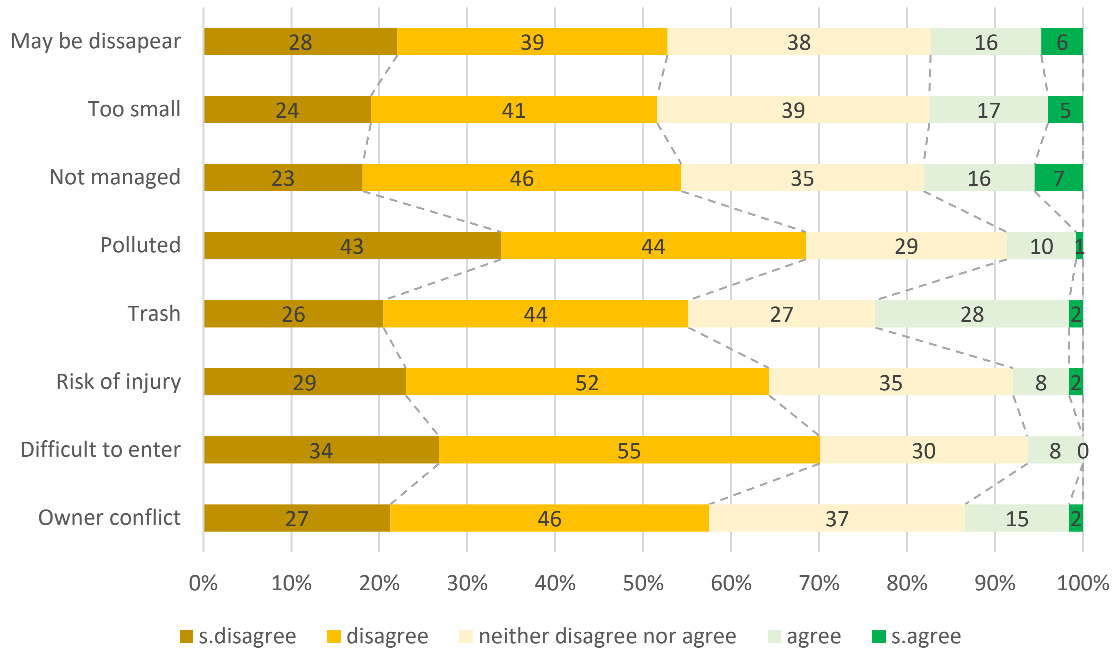


(h)

Figure 14. Median reasons for reluctance to use UGS: (a) owner conflict, (b) risk of injury; (c) hard to enter; (d) a lot of garbage; (e) contaminated; (f) not well maintained; (g) narrow; (h) likely to be lost.



(a)



(b)

Figure 15. Difference in reasons for reluctance to use UGS between: (a) housing complex; and (b) apartment residents

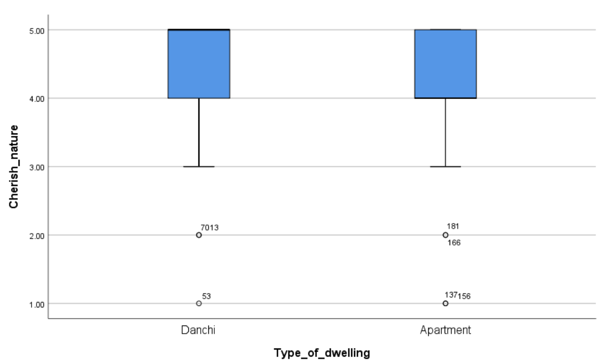
The housing complex and apartment residents differed in terms of their attitude toward green space as shown by result of Mann Whitney U test: "I know common plants, animals, and insects in the area" (p = 0.000); "I feel affection for the region through plants, animals, and insects in the area" (p = 0.001); "it is a well-managed place" (p = 0.001;0.004); and "it is a convenient place to use" (p = 0.003; 0.007, Table 3). Housing complex residents differed from apartment residents in terms of their attitude toward green space, especially in know the creatures, affection of nature, well managed place, and convenient place, as shown in the boxplot below (4 vs 3, 4, 4 vs 3, 4, repectively, Figure 15).

In total, 12% of housing complex residents knew the names of common creatures, 28% felt affection, 29% perceived it is a well-managed place, and 32% perceived it as convenient for use, while the corresponding figures for apartment residents were 5%, 18%, 15%, and 20% respectively (Figure 16). Housing complex residents had more positive awareness and recognition of nature and green spaces than apartment residents. The variation of green space forms near Tokiwadaira housing complex positively affected their knowledge, feelings, and behavior. However, this was not sufficient to create life satisfaction. The growing elderly population is a major concern in Tokiwadaira area, not only financially, but also socially. Contact with nature has many therapeutic benefits, and it is crucial to create community spaces by understanding local residents' characters (Othman and Fadzil 2014).

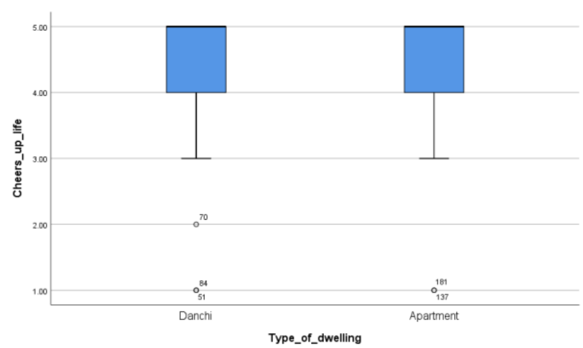
Table 3. Attitudes towards housing complex and apartment residents using Mann Whitney U Test.

	Cherish nature	**Cheers up life**	**Environment coexist**	**Willingness to volunteer**	**Time for nature**	**Money for nature**	**Know the creatures**	**Affection of nature**	**Well managed place**	**Convenient place**
P-value	0.069	0.703	0.724	0.184	0.616	0.587	0.000**	0.001**	0.001**	0.003**

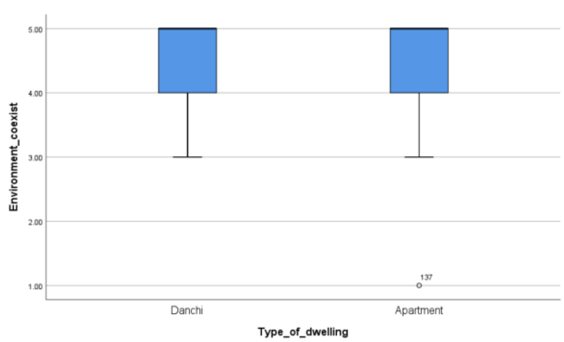
Note. p*<0.05, p**<0.01, ***p<0.001.



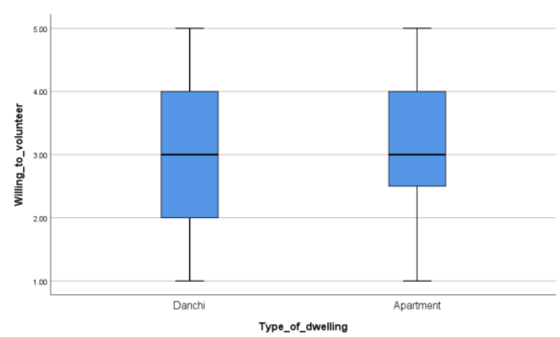
(**a**)



(**b**)



(**c**)



(**d**)

Figure 16. (To be continued)

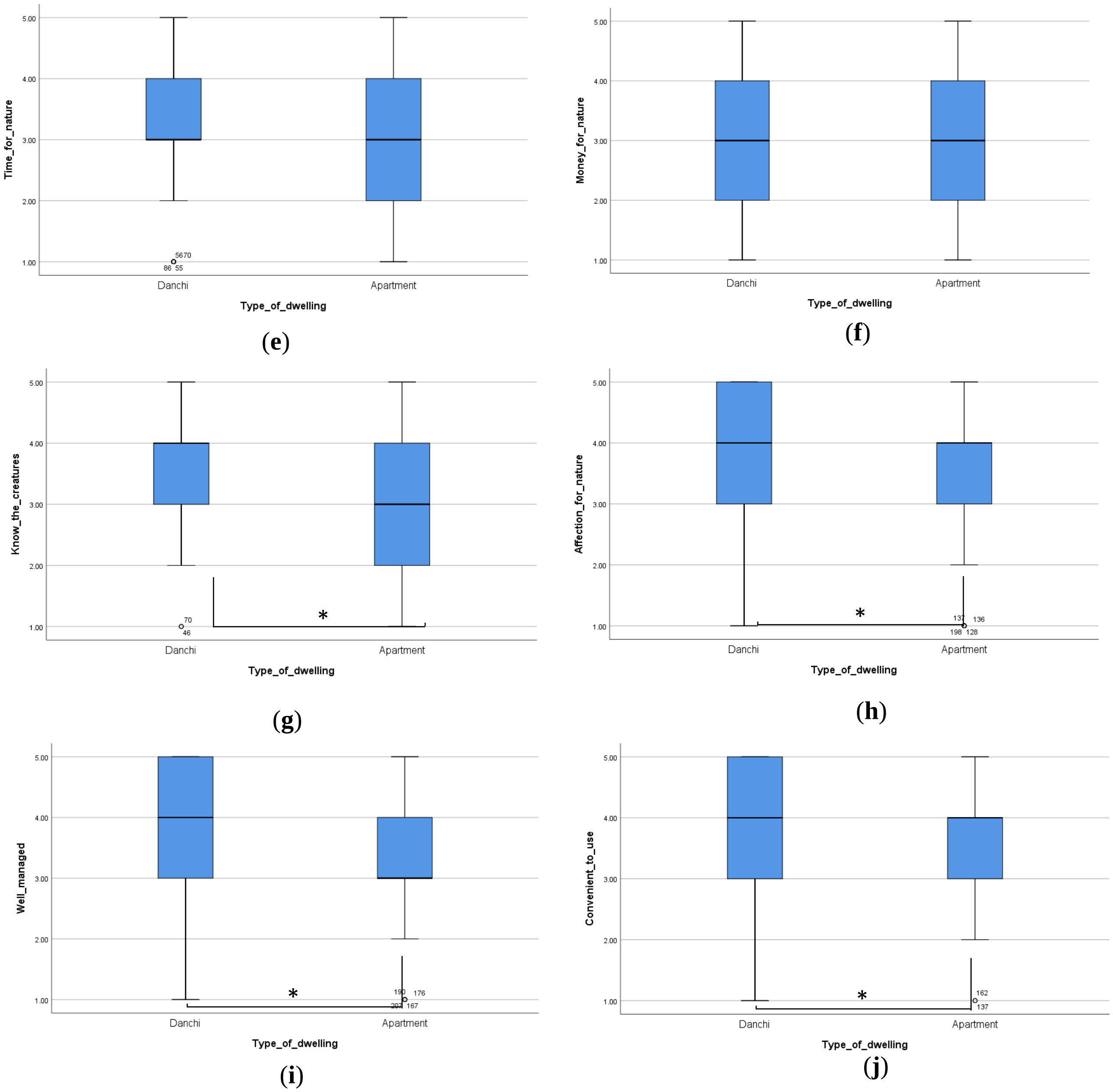
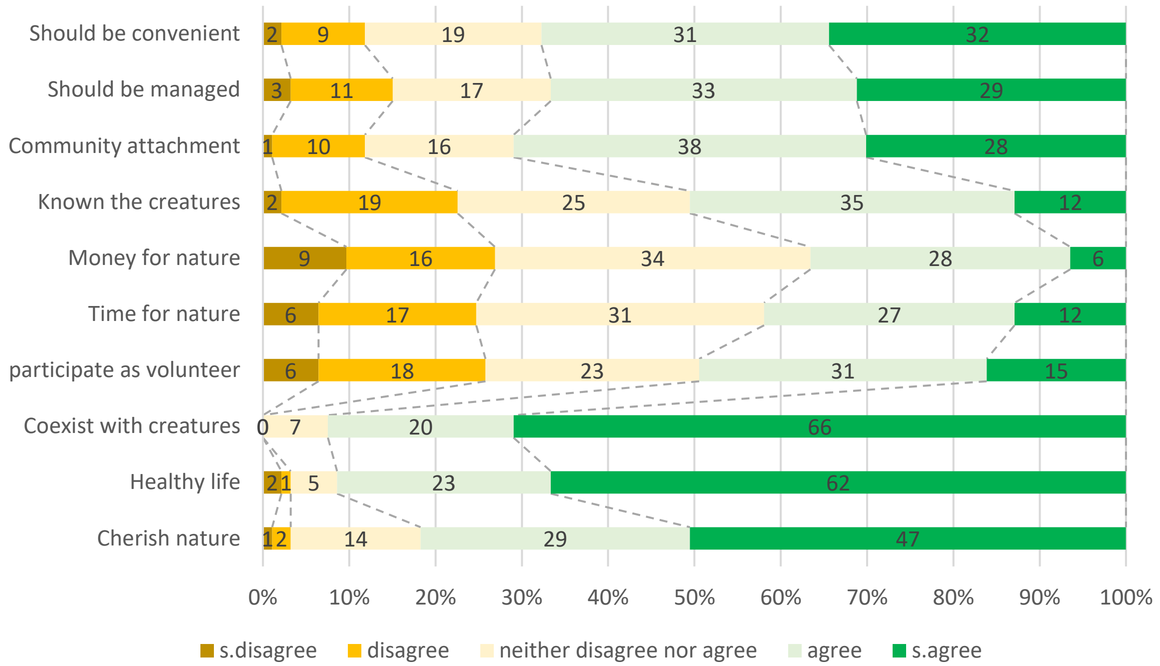
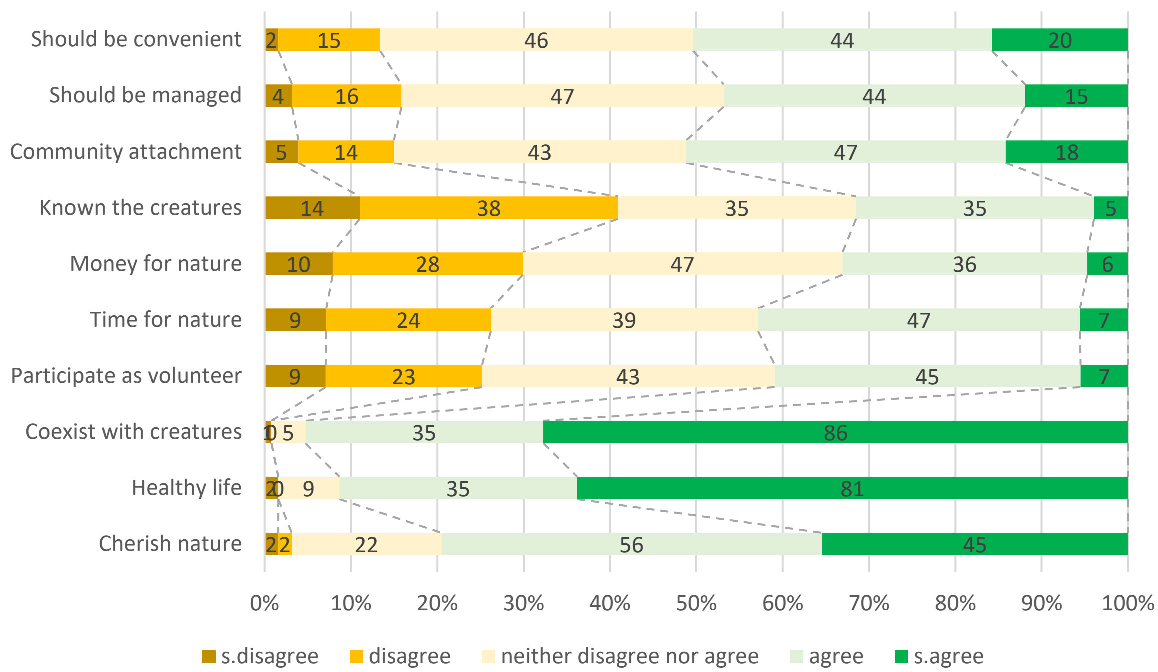


Figure 17. Median attitudes towards UGS: (a) cherish nature; (b) cheers up life; (c) environment coexist; (d) willingness to volunteer; (e) time for nature; (f) money for nature; (g) know the creatures; (h) affection of nature; (i) well managed place; (j) convenient place.



(a)



(b)

Figure 18. Difference in attitudes towards UGS between: (a) housing complex and (b) apartment residents.

4.3.2 Attributes influencing green space management experience

Only two attributes influenced the green space management experience of housing complex residents: gender and green space in residence (Table 4). Gardening activity was mostly conducted by female residents (37.63%, $p = 0.023$), while male residents tended not to use green spaces (16%). The existence of green space in a residence was related to gardening activity. Residents living in housing complex with shared green space conducted gardening (20%) and were still conducting gardening (38%, $p = 0.019$). Meanwhile, apartment residents were influenced by age and length of stay (Table 5). Among apartment residents, residents' age was related to volunteering activity, the number of activity, and gardening activity. The older residents (70-79), the higher absence in volunteering activity (30%, $p = 0.047$) and the number of volunteering activity that was not carried out (31%, $p = 0.000$). The older residents (60-69 and 70-79) were conducting gardening activities (20%, 14%, respectively, $p = 0.013$). Residents living in apartment for 1-10 year had the highest expected volunteering hours per year (1-40 h, $p = 0.003$). Residents' constraints in carrying out volunteering activities were due to aging and decreased mobility.

Table 4. Housing complex residents' attributes and green space management experience.

Activity / Resp. identity	Volunteering activity	Number of activity	Expected volunteering hours per day	Expected volunteering hours per year	Gardening activity	Frequency of activity in green space
Age	0.639	0.937	0.693	0.946	0.587	0.110
Gender	0.419	0.660	0.097	0.171	0.023*	0.335
Children in family	0.993	0.619	0.625	0.751	0.106	0.634
Employment status	0.334	0.916	0.768	0.705	0.781	0.076
Length of stay	0.112	0.534	0.479	0.188	0.251	0.088
Green space in residence	0.359	0.463	0.641	0.962	0.019*	0.330

Note. p*<0.05, p**<0.01, ***p<0.001.

Table 5. Apartment residents' attributes and green space management experience.

Activity / Resp. identity	Volunteering activity	Number of activity	Expected volunteering hours per day	Expected volunteering hours per year	Gardening activity	Frequency of activity in green space
Age	0.047*	0.000***	0.078	0.106	0.013*	0.066
Gender	0.693	0.705	0.432	0.220	0.863	0.550
Children in family	0.314	0.392	0.053	0.166	0.146	0.105
Employment status	0.851	0.307	0.209	0.117	0.343	0.590
Length of stay	0.381	0.820	0.917	0.003**	0.064	0.490
Green space in residence	0.234	0.186	0.704	0.896	0.830	0.357

Note. p*<0.05, p**<0.01, ***p<0.001.

4.3.3 Factors in perceiving green spaces and nature

Only one factor differed in terms of housing complex and apartment residents' perceptions of the benefits of green spaces, namely the multifunctional use of urban green spaces including ecological, aesthetic, and social function (Figure 16). Regarding ecological function, landscape plants instead of air conditioning had an energy-saving function in urban areas, and controlled dust volumes. Regarding aesthetic function, urban green spaces allow citizens to experience beautiful nature in a compact urban landscape. Regarding social function, urban green spaces provide various opportunities for socializing, sharing, and exchanging ideas.

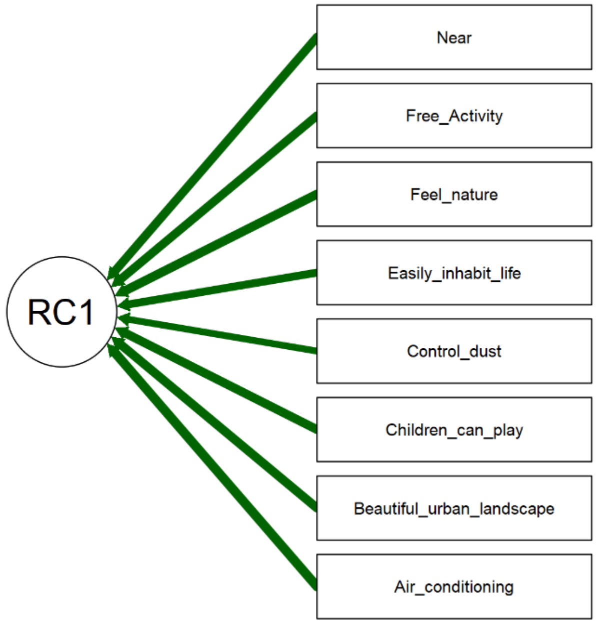


Figure 19. Factors in perceiving merits of UGS.

There were three factors related to perceived constraints of green spaces, namely 1) property and security, as well as 2) sanitation, design, and maintenance (Figure 17). Regarding property and security, residents tend to visit green spaces with clear ownership, for example public parks that can be accessed freely or theme parks with entrance tickets. Security is an important factor in entering green spaces, such as neighbourhood parks with entrance gates, name signs, and an impression of openness. Furthermore, security within green spaces was related to landscape management, overgrown vegetation, or obsolete hard material that could harm the user. Regarding sanitation, residents perceived sites with lots of garbage or that might have been contaminated with smoke or pollution to pose a constraint to accessing green spaces. Regarding design and maintenance, they perceived narrow green spaces and poorly maintained plants as problems that are highly likely to result in the site being lost someday.

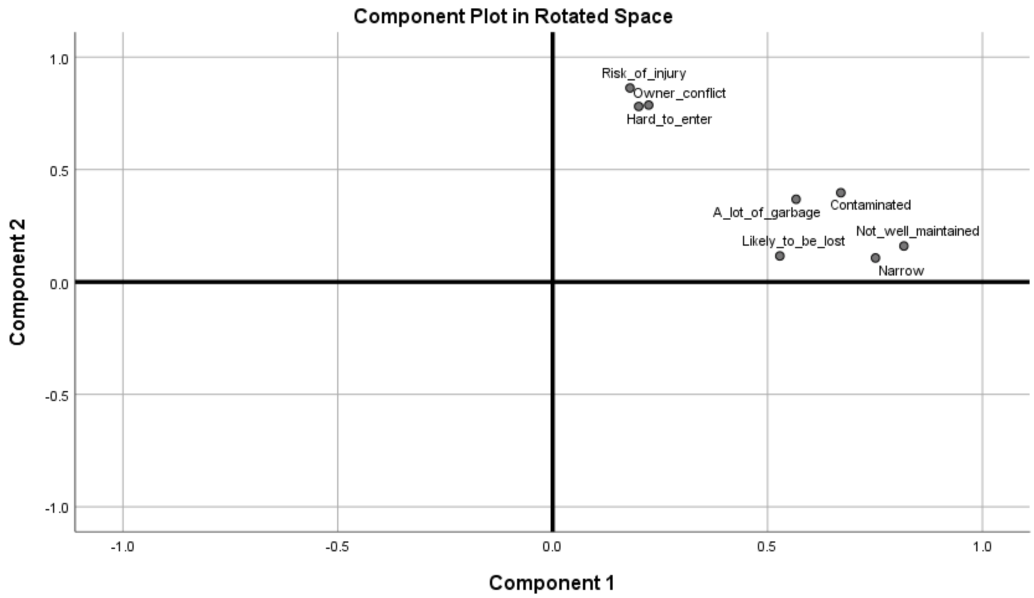


Figure 20. Factors in perceiving reasons for reluctance to use UGS.

In general, there were three factors related to interest in green spaces and nature: 1) high recognition and awareness, 2) moderate recognition and awareness, and 3) low recognition and awareness of nature and green spaces (Figure 19). The differences between housing complex and apartment residents were that the former tend to spend money on nature in all types of recognition and awareness. Regarding low recognition and awareness, they realized that creatures can coexist with the environment and felt affection for nature, considering nature and green spaces to be convenient and well-managed places. These three different types of interest are vital for constructing community buildings in Tokiwadaira area. Meltzer (2000) explained that a modern sense of community is engendered through: 1) extensive shared visioning and participatory planning leading to the early bonding and socialization of group members, 2) well-defined decision-making based on open, representative, and fair processes – usually consensus, 3) diverse populations with a mix of young and old, owners and renters, families and singles – all sharing a common purpose and providing mutual support, 4) the implementation of landscape design in facilitating informal social contact through well-considered public space planning and public/private zoning, 5) organized shared stewardship of the physical environment through work-groups with high participation, flexibility, balance, and mutual advantage, 6) more sharing of common facilities, resources, and spaces such as common spaces, laundry, tools, gardens, childcare, and amenities, 7) a rich social agenda of regular shared meals, celebrations, festivals, workshops, and other activities.

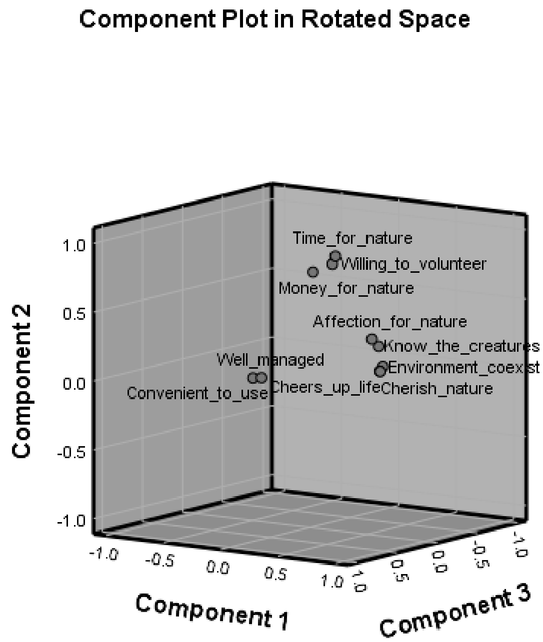


Figure 21. Factors in perceiving attitudes towards UGS.

Based on these typical areas of interest in nature and green spaces, several recommendations can be proposed to develop a better quality of life, particularly in Tokiwadaira area

1. Enhance accessibility to urban green spaces, such as replacing steps with ramps and adding signage from the housing complex to nearby green spaces. Ensure that green spaces are available within walking distance of residential areas for older adults.

2. Provide volunteering programs to manage old trees in Tokiwadaira parks and forests in order to experience nature. People with the same interests could share ideas and experiences and enhance their social bond. Community participation in nature management programs would increase residents’ sense of belonging and ultimately their sense of responsibility and willingness to maintain nature and green spaces. Sinery and Manusawai (2016) also reinforced that from the

perspective of conservation of natural resources, participation is a basic principle determining the success of program achievement.

3. Provide a nature exploring program for children in natural green spaces, especially in Tokiwadaira. As agents of change, informal environmental education for children highly impacts on their perceptions, preferences, and behavior towards the environment. By this means, community, children, and parents could join the seasonal program.

4. Provide opportunities for various structural activities in green spaces for elderly people to support health-promoting activities. Practitioners should be encouraged to provide a variety of structured and unstructured activities in community green spaces to support older adult participation and community engagement. As Pleson et al. (2014) described, activity instructors might be permitted to teach informal classes. Based on the level of community engagement (Bell et al. 2013), regional programs from local governments would be communicative if local bureaucracy provide information sharing and public consultation to increase community participation. Also required at the initial stages are mentoring by experts so that communities can actively engage with their own social and economic improvement, while contributing to their experience and conserving their nearby nature and green spaces (Kusnanto et al. 2016).

5. Provide a small-scale environment clean-up program, like on the home yard and meso scale, for neighbourhood parks, pocket parks, greenways, etc. All citizens could participate in the clean-up, arranging/designing, and finishing phases. The cleanest and most beautiful green space could be proposed as a Tokiwadaira green space model utilizing local material, plants, and knowledge. How people organize spatial living (Wohnweisen) gives us vivid understanding of how they construct social relationships (Elias 1983), while the output of this program in terms of the uniqueness of the social and physical environment would become an attraction in terms of the local knowledge of each dwelling (Mulyati et al. 2016).

4.4 Conclusion

The significant differences in merits of nature and green spaces between Tokiwadaira housing complex and apartment residents were related to distance from green spaces and environmental benefit by controlling dust. Attitudes toward green spaces was categorized by knowing the names of creatures, feeling affection for nature, and perceiving nature and green spaces as well-managed and convenient places. Residents of Tokiwadaira housing complex had a higher level of perception than apartment residents, except for usage for children's play. The attributes influencing green space management experience for housing complex residents were gender and existence of children and green space in residence, while for apartment residents, they were age and length of stay. There were three factors related to residents' attitudes toward green space: 1) high attitude level, 2) moderate attitude level, and 3) low attitude level toward green space. The difference between housing complex and apartment residents was their willingness to spend money on nature.

CHAPTER 5. THE NEIGHBOURHOOD PARK PREFERENCES AND ITS FACTORS AMONG ELDERLY RESIDENTS IN TOKIWADAIRA, JAPAN

5.1 Introduction

Creating an urban green space is a major task in realigning the urban structure of Japan. Japanese cities must prepare for the coming "elderly society". Studies on green space perceptions, preferences, and behaviours were addressed this problem. Neighbourhood environment affected their nature relatedness, referring to the Biophilia hypothesis which stresses the fundamental evolutionary relationship between humans and nature (Wilson 1984). Mutiara and Kinoshita (2011) described that low-level neighbourhood attachments are positively correlated with decreased park activity. Infrequent community involvement in park management is also a primary factor contributing to the decreased sense of community belonging. Dwellers living more than 1 km away from a green space have 1.42 higher odds of experiencing stress than dwellers living less than 300 m from a green space (Grahn and Stigsdotter, 2010). Furthermore, people living within 20 min from the reference site are willing to contribute a significant amount of money to support the greening project (Paul and Nagendra 2017). As the growth of public awareness of the importance of green spaces and the benefits of the planned park, study responding to the needs and preferences of urban communities can help to better plan and design urban green spaces.

In Japan, there is a strong focus on economic growth. However, there has been significant economic stagnation over the past generation. This has damaged both families and communities, resulting in a society problematized by increasing age and a declining birth rate. The Tokiwadaira district is located in the northeast of Tokyo, where the oldest semi-public housing was built during the early 1960s. Demographics there are changing very fast. In 2017, the total population of Tokiwadaira was 28,875 (14,231 males and 14,644 females), including 14,932 households. Of this population, 38.29% (11,056 people) lived in the Tokiwadaira housing complex. In 2016, 45.6% of all residents aged 65 years and older lived in Tokiwadaira housing complex. In 2017, this rose to 47.5%. Most elderly housing complex residents moved into these buildings after retirement and now live alone. While private apartments surround the Tokiwadaira housing complex, most residents seem to ignore both the ageing buildings and elderly residents. The lonely-death phenomenon is also rarely discussed. The emergency of Kodokushi may also be explained as a result of an increase in single-person households such as elderly people (Tamaki 2014) so that it is crucial to investigate their environmental activities and the tendency of preference in Tokiwadaira Neighbourhood Parks (TNP) as potential public space. This study began with the assumption that residents of different dwelling types may prefer different types of neighbourhood parks based on activities, elements, and disturbances in the park. It was therefore considered necessary to investigate the differences in the park preference between housing complex and apartment residents.

The purpose of this study was to investigate the neigbourhood park preference, length of park visit, activities, park elements, and disturbances in the park between housing complex and apartment residents. From the investigation, it is expected to formulate the factors of preferable neighbourhood park for elderly people. In line with the purpose, the objectives of the study were to identify the social characteristics of residents, to determine the significant difference in neighbourhood park preference, length of park visit, activities, park elements, and disturbances in the park between housing complex and apartment residents, and to analyse factors of neighbourhood park preferences.

5.2 Methodology

5.2.1 Study area

One of the areas in Matsudo city, Tokiwadaira was comprised of a commercial area surrounded by residences, urban facilities, and green infrastructure (Figure 10). This study focused on residents' preference for neighbourhood parks. These parks were spread all throughout the Tokiwadaira area, including 1) Himawari Park, 2) Fuyou Park, 3) Aberia Park, 4) Shoubu Park, 5) Hanamizuki Park, 6) Kanegasaku Park, 7) Tsubaki Park, 8) Sakura Park, 9) Sarubia Park, 10) Kunugi Park, 11) Mucho Park, 12) Yamabuki Park, 13) Popura Park, 14) Shirakashi Park, 15) Wakaba Park, 16) Yanagimachi Children Playground, 17) Tokiwadaira Park, 18) Kanna Park, and 19) Kodemari Park.

5.2.2 Data collection

This research obtained personal park preferences among local residents. Data were obtained through postal questionnaire surveys conducted among 2,020 residents. A combined 93 housing complex and 127 apartment residents responded.

5.2.3 Data Analysis Procedure

Based on previous studies (Lucas 1991; Pratiwi et al. 2014; Gunawan and Pratiwi 2015), this study's design concept consisted of a spatial preference survey, preference analysis, and interpretation.

1. Spatial park preference survey (PP)

The spatial preference survey was conducted to ascertain residents' attributes and identify residents' preference. Data were obtained through a postal questionnaire with an attached neighbourhood park map. Respondents were asked to draw a boundary around their most-preferred park. They were then asked about the number of parks visits each month, park activities (PA), preferred park elements (PE), and disturbances in the park (PD). It was also necessary to clarify resident attributes including gender, age, children, employment status, length of stay, and green space management experience and exposure towards green space including the number of volunteering activity, expected hour per day, expected hour per year, gardening activity, recognition of the quantity of the surrounding green space, and frequency of visiting green space. As Pratiwi et al. (2014) and Kim et al. (2018) suggested, these factors may lead to differences in both perception and preference.

2. Preference analysis

Analysis of park preferences examined significant differences in preference based on dwelling type. There were 10 potential neighbourhood park activities and one answer indicating no activity. There were nine preferred park elements. In addition, there were 14 disturbances in the park to choose from. Mann-Whitney U-test was performed to examine the significant differences of preferences between housing complex and apartment residents.

Factor analysis of park preference. Factor analysis using the principal component method and Varimax rotation was applied to characterize park preference. Factor analysis was conducted as follows (Hidayat and Istiadah 2011): (1) defining variable, (2) counting matrix correlation among variables, (3) extracting factor, and (4) rotating factor.

3. Interpretation

Analysis revealed significant differences among resident park preferences and a significant dependency between park preference and resident attributes. This could become a prominent point for discussion and a priority during future design consideration.

5.3 Results

5.3.1 Demographic characteristics of Tokiwadaira residents

Most of housing complex respondents (*N* = 220) were male (55.91%), while apartment residents were female (59.06%). Regarding age, most of the housing complex respondents (60.22%) were older than 70, while most apartment residents (59.06%) were around 40-49. About 83.64% (*N* = 184) did not have children at home. Most of the housing complex respondents were retired (60.22%; N = 56), while the remaining respondents were employed. In opposite, most of the apartment residents were employed (59.84%, *N* = 76), while the remaining respondents were retired. Nearly half of residents (32,73%) respondents had lived in the current area for 1-10 years, followed by 11-20 years (22.73%). Table 6 showed demographic characteristics.

Table 6. Residents' demographic characteristics.

Demographic Characteristics		**Number**		**Percentage (%)**	
		Housing complex residents	**Apartment residents**	**Housing complex residents**	**Apartment residents**
Gender	Male	52	52	55.91	40.94
	Female	41	75	44.09	59.06
Age	<20 years	0	3	0.00	2.36
	20-29 years	0	4	0.00	3.15

Demographic Characteristics		Number		Percentage (%)	
		Housing complex residents	Apartment residents	Housing complex residents	Apartment residents
	30-39 years	1	0	1.08	0.00
	40-49 years	6	75	6.45	59.06
	50-59 years	11	15	11.83	11.81
	60-69 years	19	0	20.43	0.00
	≥70 years	56	0	60.22	0.00
Children in a family	No	82	102	88.17	80.31
	Yes	11	23	11.83	18.11
Employment Status	No	56	51	60.22	40.16
	Yes	37	76	39.78	59.84
Length of stay	<1 year	2	2	2.15	1.57
	1-10 years	36	36	38.71	28.35
	11-20 years	15	35	16.13	27.56

Demographic Characteristics	Number		Percentage (%)	
	Housing complex residents	Apartment residents	Housing complex residents	Apartment residents
21-30 years	18	0	19.35	0.00
31-40 years	8	17	8.60	13.39
41-50 years	9	29	9.68	22.83
51-60 years	5	29	5.38	22.83

5.3.2 Green space management experience and exposure towards the green space

Despite 84% of all respondents (N = 184) not having a volunteering activity, 61% of housing complex residents expected to volunteer for both less than 1 hour per day and per month. Most apartment residents (51%) expected to volunteer for 1-12 hours per day, while they only expected to volunteer for 1-40 hours per month (44%). Housing complex residents tended to have higher expected volunteering activity. When asked about gardening, about 56% of housing complex respondents indicated that they had gardened and continued to do so. A majority (57%) of residential dwellings were surrounded by large quantities of green space. Meanwhile, green space activities significantly varied, ranging from 24% of housing complex respondents and 30% of apartment residents who did not frequently engage to 31% and 13% who used them almost daily, respectively (Table 7).

Table 7. Green space management experience and exposure towards the green space.

Green space management and exposure		Number		Percentage (%)	
		Housing complex Residents	**Apartment Residents**	**Housing complex**	Apartment
Volunteering activity	No	76	108	81.72	85.04
	Yes	17	19	18.28	14.96
Number of activities	No activity	80	109	86.02	85.83
	1-25	13	17	13.98	13.39
	100	0	1	0.00	0.79
Expected hour per day	<1 hour	57	61	61.29	48.03
	1-12 hours	36	65	38.71	51.18
	13-24 hours	0	1	0.00	0.79
Expected hour per year	<1 hour	57	56	61.29	44.09
	1-40 hours	23	56	24.73	44.09
	41-80 hours	6	1	6.45	0.79
	81-120 hours	3	0	3.23	0.00
	121-160 hours	1	0	1.08	0.00
	161-200 hours	1	0	1.08	0.00
	>200 hours	2	0	2.15	0.00
	No	22	35	23.66	27.56

Green space management and exposure		Number		Percentage (%)	
		Housing complex Residents	**Apartment Residents**	**Housing complex**	Apartment
Gardening activity	Yes, but not conducting now	20	35	21.51	27.56
	Yes, conducting now	51	57	54.84	44.88
Recognition of the quantity of GS	Very few	1	0	1.08	0.00
	Few	2	18	2.15	14.17
	Neither	6	19	6.45	14.96
	Large	47	75	50.54	59.06
	Very large	37	15	39.78	11.81
Green space in a residence	Shared green space	78	78	83.87	61.42
	Without shared green space	15	49	16.13	38.58
Frequency of visiting GS	Mostly do not use	22	38	23.66	29.92
	1-3 times a year	8	26	8.60	20.47

Green space management and exposure	Number		Percentage (%)	
	Housing complex Residents	**Apartment Residents**	**Housing complex**	Apartment
1-3 times a month	17	19	18.28	14.96
1-2 times a week	15	20	16.13	15.75
Almost everyday	31	15	33.33	11.81

5.3.3 TNP Preferences and Length of Park Visit

There were significant differences in preference between housing complex and apartment residents regarding neighbourhood parks in the Tokiwadaira district (p = 0.000). The majority (83.9%) of housing complex residents only preferred one of selected six neighbourhood parks (i.e., Kanegasaku Park (83.9%), Shoubu Park (11.8%), Yamabuki Park (1.1%), Sakura Park (1.1%), Aberi Park (1.1%), and Himawari Park (1.1%)), while apartment residents preferred one of selected 12 neighbourhood parks (i.e., Kanegasaku Park (40.2%), Tsubaki Park (28.3%), Shoubu Park (10.2%), Kanna Park (4.7%), Sakura Park (3.9%), Tokiwadaira Park (3.1%), Yamabuki (3.1%), Himawari Park (3.1%), Aberi Park (0.8%), Sarubiya Park (0.8%), Fuyou Park (0.8%), and Popura Park (0.8%) (Figure 2a). There were also significant differences in lengths of visit between housing complex and apartment residents (p = 0.000). Housing complex residents spent more time in neighbourhood parks (an average of 5.34 hours per month) than apartment residents (an average of 3 hours per month).

5.3.4 Activities, Preferred Park Elements, and Disturbances in the Park

There were no significant differences among preferred park activities among housing complex and apartment residents. Housing complex residents visited parks to accompany their children (31.2%), enjoy nature (23.7%), relax (16.1%), exercise (14%), socialise with neighbours

(6.5%), spend time with family (1.1%), and attend sport event (1.1%). Some did not spend time at parks (5.4%). On the other hand, apartment residents visited parks to relax (20.5%), enjoy nature (18.1%), exercise (15.7%), walk the dog (8.7%), accompany children (7.9%), socialise with neighbours (7.9%), spend time with family (7.1%), and attend sport event (1.6%). Some did not spend time at parks (12.6%) (Figure 20).

Meanwhile, a significant difference regarding preferred park elements between housing complex and apartment residents was found ($p = 0.000$). Apartment residents had high preferences for tree canopies (48.8%). This was followed by well-maintained green spaces (19.7%), good quality paths (10.2%), quiet places (10.2%), a well-maintained children playground (3.9%), good quality sports fields (3.9%), and benches (3.1%). Housing complex residents had high preferences for benches (34.4%), well-maintained green spaces (26.9%), trees (17.2%), good quality paths (11.8%), good quality sports fields (4.3%), well-maintained children playground (3.2%), and quiet places (2.2%) (Figure 20).

There was no significant difference among housing complex and apartment residents regarding park disturbances. Housing complex residents reported disturbances such as poor quality sports field (40.9%), not enough benches (20.4%), nothing (16.1%), untidy paths (5.4%), unmaintained green spaces (4.3%), poor maintained children playground (4.3%), not enough trees (1.1%), inadequate safety (1.1%), many insects (1.1%), and impolite behaviour (1.1%). Apartment residents reported nothing (23.6%), not enough benches (22%), difficult car parking (15%), inadequate safety (9.4%), unmaintained green (7.1%), untidy paths (5.5%), poor quality sports fields (3.9%), noise from playgrounds (3.9%), and traffic noise (2.4%) (Figure 20).

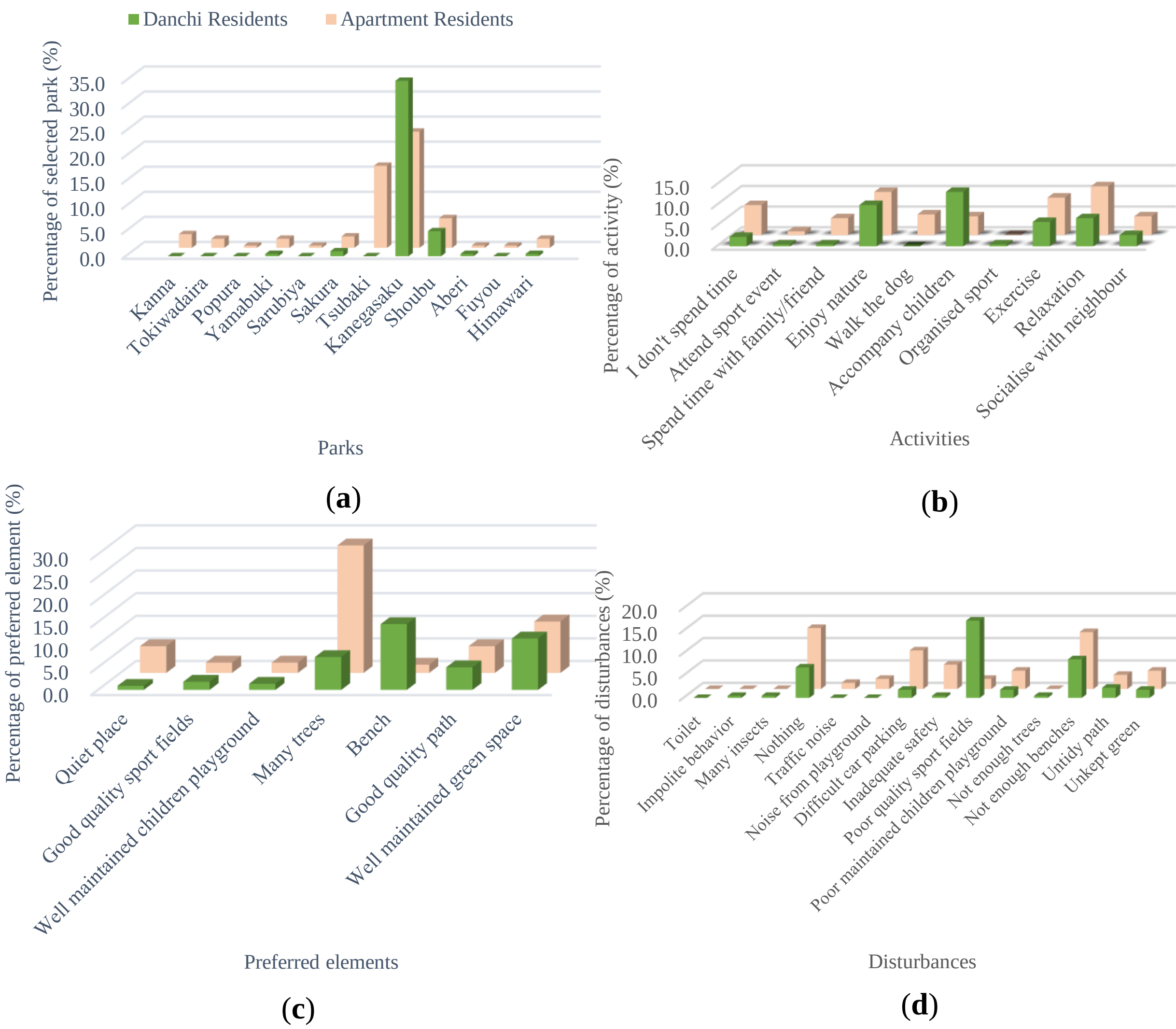


Figure 22. Residents' preferences: (a) neighbourhood park preferences of housing complex and apartment residents; (b) activity in the park; (c) preferred element; (d) disturbances in the park.

5.3.5 Resident Attributes Influencing Preferences

Resident attributes had significant effects on TNP preferences. The attributes influencing housing complex residents' preferences were age, length of stay, the frequency of visiting green space (Table 8). The older residents (70-79) preferred bench (22%) and well-maintained green space (18%, $p = 0.000$). Housing complex residents almost every day visiting green space (30%) preferred to visit Kanegasaku park ($p = 0.019$). Those that had lived in their current location for 1-10 years (21.5%, $p = 0.004$) preferred visit park 4 hours per month and performed accompanying children (14%) and enjoying nature (11%) at park ($p = 0.036$). Furthermore, those that had lived in their current location for 1-10 years also preferred to accompany children (15.1%) and enjoy nature (11.8%) (p = 0.036).

The attributes influencing apartment residents' preferences were age, children in family, recognition of green space, and frequency of visiting green space (Table 9). The middle-aged and elderly apartment residents (40-79 years old) preferred Kanegasaku park (36.22%), Tsubaki park (25.20%), and Shoubu park (7.8%, p = 0.027). Residents without children in a family preferred to perform the various activities in the park such as relaxation (24%) and enjoying nature (20%, p = 0.001). Those who visited green space 1-3 times per month tended to enjoy nature (6.3%), while those who visited green space almost every day (6.3%) tended to have relaxation in the park (p = 0.000). Those who recognized large green space preferred tree canopies (28.3%, p = 0.004).

Table 8. Housing complex residents' attribute and exposure to green space influencing preference.

Respondent	Neighbourhood park preferences				
	Park	**Visit time**	**Activity**	**Element**	**Disturbance**
Attribute					
Gender	0.453	0.397	0.414	0.137	0.491
Age	0.200	0.738	0.948	0.000***	0.857
Children in family	0.052	0.578	0.936	0.831	0.558
Employment status	0.350	0.277	0.488	0.371	0.386
Length of stay	0.682	0.004**	0.036*	0.079	0.886
Exposure to green space					
GS in residence	0.322	0.909	0.172	0.821	0.222
Recognition of UGS	0.453	0.653	0.715	0.881	0.957
Frequency of visiting UGS	0.019*	0.373	0.642	0.319	0.832

Note. *p<0.05, **p<0.01, ***p<0.001.

Table 9. Apartment residents' attribute and exposure to green space influencing preference.

Respondent	Neighbourhood park preferences				
	Park	**Visit time**	**Activity**	**Element**	**Disturbance**
Attribute					
Gender	0.500	0.749	0.086	0.062	0.998
Age	0.027*	0.626	0.127	0.100	0.569
Children in family	0.170	0.322	0.001**	0.171	0.405
Employment status	0.540	0.518	0.188	0.343	0.618
Length of stay	0.984	0.806	0.951	0.956	0.543
Exposure to green space					
GS in residence	0.601	0.831	0.384	0.881	0.761
Recognition of UGS	0.068	0.996	0.355	0.004**	0.099
Frequency of visiting UGS	0.864	0.219	0.000***	0.754	0.911

Note. *p<0.05, **p<0.01, ***p<0.001.

5.3.6 Principal Component Analysis of Park Preference

A Factor Analysis with a Varimax (orthogonal) rotation of 19 questions from park preference survey was conducted on data gathered from 220 participants. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO=0.599). The results of an orthogonal rotation of the solution were shown in Figure 21. When the loadings less than 0.30 were excluded, the analysis yielded a seven-factor solution with a simple structure (factor loadings ≥0.30).

Four items loaded onto Factor 1. It was clear from Table 10 that all of these three items related to the type of dwelling, the existence of shared green space in a residence, and spatial park preference. This factor was labelled as "the existence of shared green space in perceiving park". Two items loaded onto a second factor related to public green space management experience. This factor was labelled as "engagement in green volunteering activity". The only one item loaded onto Factor 3 related to the demography attribute namely employment status. This factor was labelled as "employment status of residents". The two items loaded onto Factor 4 related to the willingness to spend time in volunteering activity both in a day and a year. This was labelled as "a willingness to spend time in volunteering activity". The three items loaded onto Factor 5 related to the exposure towards the green space, namely frequency of visiting green space, park visit time, and private green space management experience such as gardening activity. This was labelled as "frequency of green space visit, management experience, and length of park visit". Item for Factor 6 related to the demography attribute namely gender, so that this factor was labelled as "gender of residents". Item for Factor 7 was labelled as "disturbances in the park".

These seven factors contributed to over 59.6% of the total item variance. The first component, the existence of shared green space in perceiving park was responsible for almost 14.6% of the total item variance followed by engagement in green volunteering activity was responsible for 11.1% of the total item variance, employment status of residents determines activity in the park was responsible for 8.2% of the total variance, willingness to spend time in volunteering activity was 7.5% of the total item variance, frequency of green space visit, management experience, and length of park visit was responsible for 6.6% of the total item variance, gender of residents was responsible for 6.3% of the total item variance, and lastly disturbances in the park that might be found in the park was responsible for 5.3% of the total item variance.

Table 10. Survey item and factor loadings.

Survey Item	Component						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Type of dwelling	**.650**	-.084	.032	.170	-.194	.336	.071
Green volunteer activity	.004	**.943**	-.046	.040	.073	-.015	-.033
The number of activities	.054	**.930**	.008	.112	.045	.024	.011
Expected hour per day	.053	.194	.137	**.805**	.021	.070	.008
Expected hour per year	-.018	-.027	.016	**.851**	-.044	-.169	-.152
Gardening activity	.083	.176	-.066	.131	**.663**	.039	.031

Survey Item	Component						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Green space in residence	**.591**	-.130	-.147	-.067	.240	-.117	.293
Feeling in surrounding greenery	-.672	-.041	-.236	.046	-.046	.113	-.061
Frequency of visiting green space	-.273	.034	-.104	-.177	**.583**	.204	-.032
Gender	.035	-.018	-.053	-.189	.048	**.790**	-.136
Age	-.331	-.122	-.572	-.115	.204	-.376	-.182
Children in family	-.051	.057	.351	.166	.077	.426	.122
Employment status	.229	-.063	**.638**	.133	.086	.084	.149
Length of stay	.102	.039	-.715	-.011	.029	.077	.119
Spatial park preference	**.556**	.108	-.012	-.007	-.144	.114	-.175
Park visit time	-.082	-.122	.193	-.034	**.569**	-.185	-.314
Activity	.181	.001	.384	-.284	-.231	-.142	-.227
Preferred Park Element	.492	.165	.267	-.009	-.265	-.297	-.158
Disturbance in the Park	.012	-.022	.062	-.121	-.134	-.055	**.847**

Note. Bold numbers indicate which components loaded onto each of the seven factors (Source: Study result)

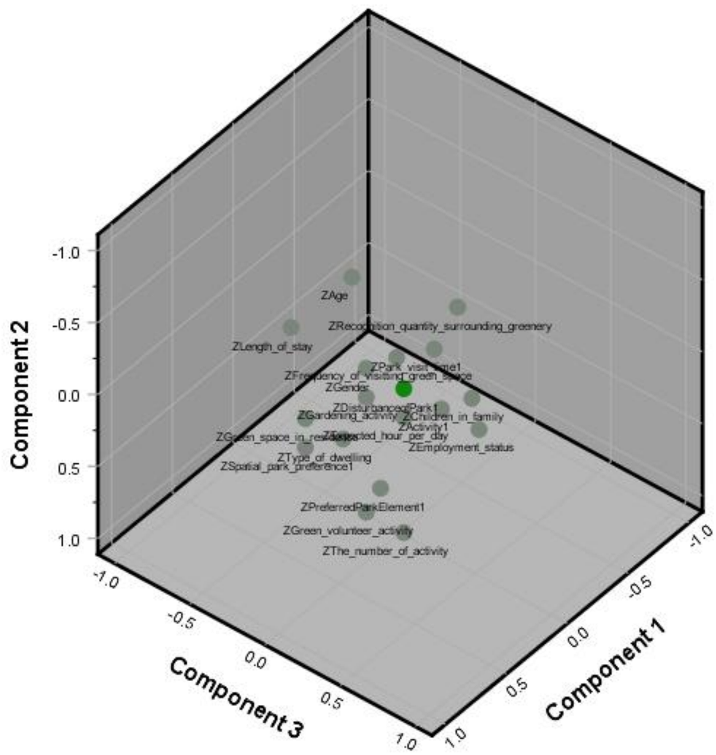


Figure 23. Loading plot of park preferences.

5.4 Discussion

5.4.1 Neighbourhood Characteristics

The Tokiwadaira district contains two types of neighbourhoods (i.e., housing complex and apartment). Housing complex was mostly occupied by residents aged 70 and above; these residents were typically retired. On the other hand, apartments are typically occupied by residents aged 40-49 years; these residents are usually employed. Based on green space management experience and exposure towards the green space, neighbourhood characteristics indicate that housing complex residents tended to do gardening at home due to large green spaces surrounding the housing complex. As explained by Pratiwi et al. (2018), female residents exhibited more environmental behaviour and have more social ties than male residents. They also tended to grow plants and have a high social attachment to the neighbourhood. Although apartment residents had gardening experience and large green spaces, they did not typically work in gardens. Employed residents spent a significant amount of time in offices; this might affect their environmental behaviour (Pratiwi et al. 2018; Laurens 2012).

5.4.2. Significant Differences in Neighbourhood Park Preferences

Housing complex and apartment residents had different park preferences. Housing complex residents over 70 years of age preferred to visit large parks within short walking distances. Neighbourhood parks located close to home will be visited more frequently than those located further than 15 minutes' walking distance (Willemse 2015). Further, apartment residents preferred to visit a range of park sizes at variable distances from their dwellings. Large green spaces and variety of features encouraged residents to visit Kanegasaku Park and stay longer at this park than at the other parks (Veitch et al. 2012). On the other hand, litter, vandalism, and unclean toilets may deter park use. Housing complex and apartment residents also had different park element preferences. Bench availability was crucial for the user who stayed for extended periods; these provided rest before moving onto other activities, while the shading from tree canopies was needed by the user in performing activities in the park. Residents living in housing complex with shared green space conducted gardening in their shared-space garden. As identified by Hake (2017), the shared-space garden was one of the distinct modalities of learning space. It contributed to the social organization, a sense of well-being, generation of social capital, and community engagement. Whereas, apartment residents who recognized large green space preferred tree canopies. Perceived greenery in the local environment had been linked to human mental well-being, although the frequency of visiting green space is more tightly linked to mental well-being than either perceived local environmental conditions (Coldwell and Evans 2018).

5.4.3. Factors of Park Preferences

In the case of TNP usage, residents' connection with nature was mainly characterized by the existence of green space in a residence which encouraged exposure towards green space (Kim, et al., 2018) and shaped park preference (Harris et al. 2017). Engagement in green volunteering activity and willingness to spent time for it were in line with Rattam et al. (2011) findings that volunteering activity increased an individual's awareness and participation in social activity. While employment provided services and sustained people in everyday lives so that unemployed residents were helped by accessible neighbourhood parks. Abdullah and Zulkifli (2015) reinforced that parks as a part of the social environment could reduce the problem of unemployment as the root of stress and problem in families, communities, and individuals. The other variables encouraging exposure towards green space such as frequency of visiting green space and green space management experience such as gardening created a higher rate of perception of urban green space merits (Kim et al. 2018).

5.4.4 Direct and Indirect Pathways to Health Benefits from UGS in Tokiwadaira

Residents differed in types of park preference and park elements. It was found that necessary provisions in neighbourhood parks for elderly people that affect preference were benches and tree canopies. When selecting their preferred green space, many participants showed similarity in the character of large green space surrounding their dwelling. It shows that dwelling landscape affected their nature relatedness, invoking the Biophilia hypothesis that has contributed to the theory and human instinctive aesthetic preference for natural environment and subconscious affiliation (Wilson 1984). Participants' activity was naturally influenced by internal factors, such as age. Elderly people tended to indulge in relaxation activities with others, such as enjoying nature, accompanying grandchildren, socializing with neighbors, and walking their dogs. Further, these activities were also influenced by external factors such as existing park elements; these elements include the provision of large numbers of tree canopy and quiet places. Elderly people with small personal spaces tended to seek spaces of contemplation to get comfortable and be around few people. In the case of elderly people, parks may exhibit some obstacles, although they may provide good quality sports fields and be well-maintained, having a low number of benches and inadequate car parking facilities may negatively impact elderly people's perceptions of and participation in park space (Pratiwi and Furuya 2019).

Residents perceiving the neighbourhood parks highlight their understanding and appreciation of aesthetics. Considering Maslow's hierarchy of needs, these aesthetic benefits should be considered in landscape development, and urban planners should prioritize the input of residents. Further, urban planners can meet the needs of local residents and consider the next generation's input for longer-term city planning. The implementation of tree database management to conserve local features should be considered for the support of outdoor activities and healthy socialization to avoid isolation in old age. This effort might support the second level of Maslow's hierarchy of needs, self-actualization. Finally, the goal of life need in urban society is not only self-actualization but also the possibility of transcendence in the quality of life. Human perception and preference and human psychological and physiological health have been considered factors of life satisfaction (Diener and Diwas-Diener 2009; Abdullah and Zulkifli 2016).

Table 11. Direct and indirect pathways to health benefits from UGS in Tokiwadaira.

No	Ecosystem Properties	Ecosystem Function	Effect on People	Moderating Factors	Potential Health Benefits
Direct pathway to health benefit					
1	Tree Vegetation biomass; leaf area and shape; vegetation structure; type of tree species; spatial distribution	Filtering of air pollutants; foliage density, deciduousness, spatial location	Cleaner air inhale	The scale of effect to cause a change in health outcomes based on levels of pollution	Cleaner air is a protective factor for respiratory illness and cardiovascular disease
Indirect pathway to health benefit					
2	Well maintained Green Space Grass cover; shrub cover; tree canopy cover; tree canopy height; tree leaf area and shape	Controlling temperature; Shade provision, evapotranspiration, high albedo of vegetation, and wind reduction	Larger park encourages physical and non-physical activity (e.g. accompanying children, enjoying nature, relaxation) and time spent (4hour/month, 1-3	-Individual preferences - Local factor: shared GS in residence, recognition of the quantity of surrounding GS -GS management experience: gardening activity	Physical activity (walking) provides a protective factor for heart disease, high blood pressure, obesity, mental illness, increase in positive feelings, reduction in anxiety level

No	Ecosystem Properties	Ecosystem Function	Effect on People	Moderating Factors	Potential Health Benefits
			times/month-almost every day)		
3	Structural complexity of vegetation; number of habitats; presence of water bodies	A setting that includes element of living systems including plants provides a view that requires limited concentration or focus	Autonomic generation of psychophysiological stress reduction response; recovery from fatigue of directed attention; increase in positive affect	Interaction between an individual and the nature element (stimulation of four senses)	Benefits include improved cognitive function and mental health; potential protective factor for stress related illness; possibly reduced blood pressure and improved healing times

5.5 Conclusion

Results indicate three significant differences between housing complex and apartment residents (i.e., neighbourhood park preference, length of park visit, and park element. The only attribute influencing housing complex residents' preferences was the length of stay, while the only attributes influencing apartment residents' preferences were children in family and recognition of quantity of surrounding green space. There are seven factors of park preferences. This information may help urban planners conduct participatory planning with the community and optimise local features through consideration of elderly residents' needs. Further research will engage at the psychological and physiological effect of experiencing nature walking through the tree canopy at a park. Furthermore, there must be a detailed mood and anxiety inventory and proper physiological parameters, whether this type of activity is necessary for increasing quality of life.

CHAPTER 6. PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF EXPERIENCING UGS IN ADULTS

6.1 Physiological and Psychological Effects of Walking in Urban Parks and Its Imagery in Different Seasons in Middle-Aged and Older Adults: Evidence from Matsudo City, Japan

6.1.1 Introduction

With concerns about urbanization diminishing contact between humans, nature, and public health, urban dwellers seek effective and convenient methods to resolve urban stress. Forest therapy is a set of practices that involve exposure to natural stimuli by practicing physical activity or relaxation in and around forest. This practice aims to regenerate immunocompetence through plant-derived physiological effects of relaxation (Li 2010). Most studies investigated physiological and psychological relaxation effect on young adults related to walking and viewing in urban parks and forests. Physiological studies have demonstrated that benefits of park and forest environment on decreased blood pressure (Park et al. 2009; Lee et al. 2009; Tsunetsugu et al. 2013), pulse rate (Park et al. 2009; Lee et al. 2009; Matsuba et al. 2011), heart rate (Tsunetsugu 2013; Song et al. 2013, 2014, 2015, 2019a, 2019b), salivary cortisol concentration (Lee et al. 2009; Miyazaki et al, 2014), and increased parasympathetic nervous activity (Park et al. 2009; Tsunetsugu et al. 2013, Matsuba et al. 2011; Song et al. 2013, 2014, 2015, 2019a, 2019b). In addition, psychological studies have exhibited the benefits on improved subjective measures of comfortable, natural, relaxed, vigorous, calm feeling, restoration (Matsuba et al. 2011, Song et al. 2013, 2014, 2015, 2019a, 2019b) as well as reduced negative mood states (e.g., tension, anger, fatigue, depression, confusion) and anxiety level (Song et al. 2013, 2014, 2015; Miyazaki et al, 2014; Takayama et al. 2014).

In a study of older adults, forest therapy resulted in physiological and psychological relaxation. Chen et al (2018) investigated the effects of the two-day forest therapy program and reported that it decreased systolic blood pressure and negative mood states (e.g., confusion, fatigue, anger-hostility, tension) among the middle-aged female group. Ochiai et al. (2015) examined the effects of conducting various activity of forest therapy for 4 hours decreased systolic and diastolic blood pressure, urinary adrenaline, and serum cortisol. Li et al. (2016) investigated the effects of forest bathing of 80-minute walking each in the morning and afternoon and reported that urinary dopamine after forest bathing was lower than that after urban area walking and serum adiponectin after the forest bathing was greater than that after urban area walking. Yu et al. (2017) reported decreased pulse rate, systolic and diastolic blood pressure and reduced negative mood states (e.g., tension, anger, fatigue, depression, confusion) and anxiety as well as improve positive emotion through 2-hour short walk in the forest. Song et al. (2017) also reported the effects of viewing a forest environment on middle-aged hypertensive men for only 10 minutes women and reported the high-frequency component of heart rate variability (HRV) was higher and heart rate was lower in participants viewing the forest area than in those viewing the urban area. Recently, middle-aged and old adults as subjects engaged park therapy (Igarashi et al. 2015; Ojala et al. 2019; Pratiwi et al. 2019), horticulture therapy (Ng et al. 2018), urban gardening (Hofmann et al 2018), community-based physical activity at parks (Uijtdewilligen et al. 2019), and hospital garden therapy (Matsunaga et al. 2011; Goto et al. 2016) as another valuable natural environment even within a compact city.

Furthermore, spatial cognition of experienced landscape is yet to be examined through park therapy programs. By objectifying landscape image as visual information, the variation of participants' perception could be identified that it might reveal the spatial preference and attractiveness of specific landscape elements. In previous studies, it exhibited distinctive characteristics of forests in Japan, Germany, Russia, Indonesia (Ueda 2009; Ueda et al. 2012; Pratiwi et al. 2014) and factors influencing perception consisted of gender, age, past and present landscape type in the region of stay, past and present urbanization level, and experience of journey (Pratiwi et al. 2014). Kohori et al. (2017) determined the classifications of spatial configurations of historical green open spaces in Indonesia known as alun-alun or park squares through landscape image. Ueda and Takayama (2011) also described the expected spatial conditions in a forest atmosphere that behavior and mood have corresponding landscape composition types and spatial condition. It would be necessary to promote the development of programs that can be effectively applied in the forests and improve the forest environment. We developed an integrative examination of physiological and psychological effects of a walking experiment and park imageries in winter, spring, early summer.

The aim of the present study was to elucidate the physiological and psychological effects of walking in urban parks and park therapy images in winter, spring, and early summer. Detailed objectives were 1) to clarify physiological and psychological effects of walking, 2) to analyze images of park therapy, and 3) to analyze correlations between image of park, and physiological-psychological responses in an urban park in winter, spring, and early summer. The hypothesis in our study were that there would be a significant difference in the psychological and physiological effects of walking in an urban park and in a city area; there would be a correlation between psycho-physiological responses and image of park.

6.1.2 Methodology

6.1.2.1 Experimental sites

The field experiment was performed from January to June 2019 in Forest and Park for the 21st Century (experimental site), and route 6 of Mabashihigashi (control site) in Matsudo, Chiba Prefecture, Japan (Figures 22 and 23). Forest and Park for the 21st Century (FPC) is a general park comprising an area of 50.5 hectares built to protect and raise nature of Sendabori District. The best-known spots of this park consisted of Sendabori pond, Midori no Sato (Village of Green), Gathering Square, Hill for Getting Close to Green, Jomon no Mori, Light and Wind Square, Wild Grass Garden, and Flower Garden. Two walking routes, Midori no Sato (Village of Green)-Gathering Square in winter and early summer, and one walking course, Park Center-Nature Observation in spring, were utilized in this study. Selection criteria for walking course included 1) minimum one-trip length of 400 m, 2) flat slope, 3) significant trees along the course. Changes in walking courses for each season were based on landscape elements which could be appreciated, such as cherry blossoms in spring, and typical Japanese deciduous and broad-leaved forests in winter and summer. The walking distance of winter and summer courses was 1.2 km; the length of the walking course in spring was 800 m; average walking speed was around 1.3 m/s. We selected and set suitable walking times of 15 minutes maximum for winter and early summer. Walking at the same average speed, the spring course could be completed in 11 minutes. The details regarding experimental sites are presented in Table 12.

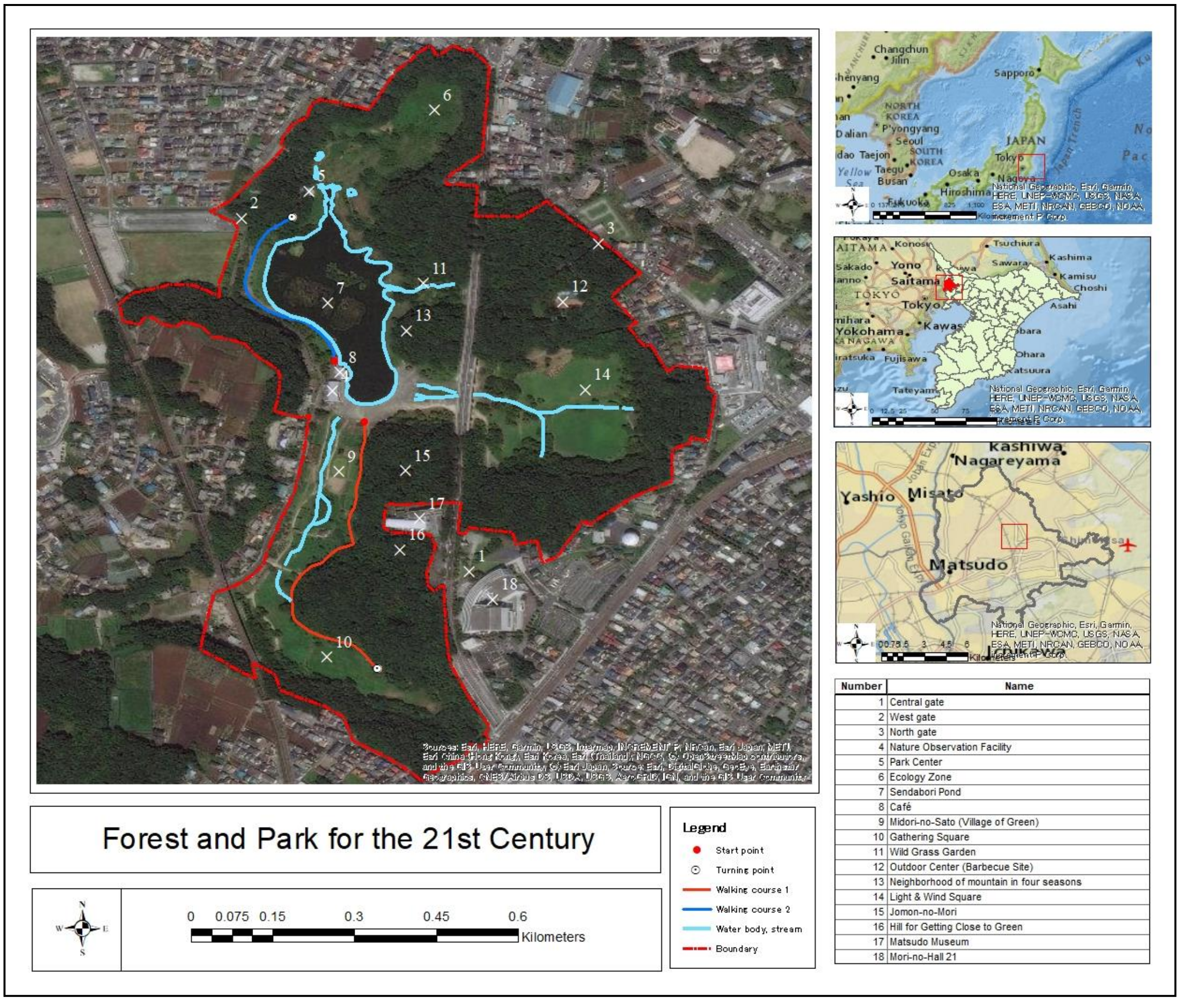


Figure 24. Experimental site of walking experiment

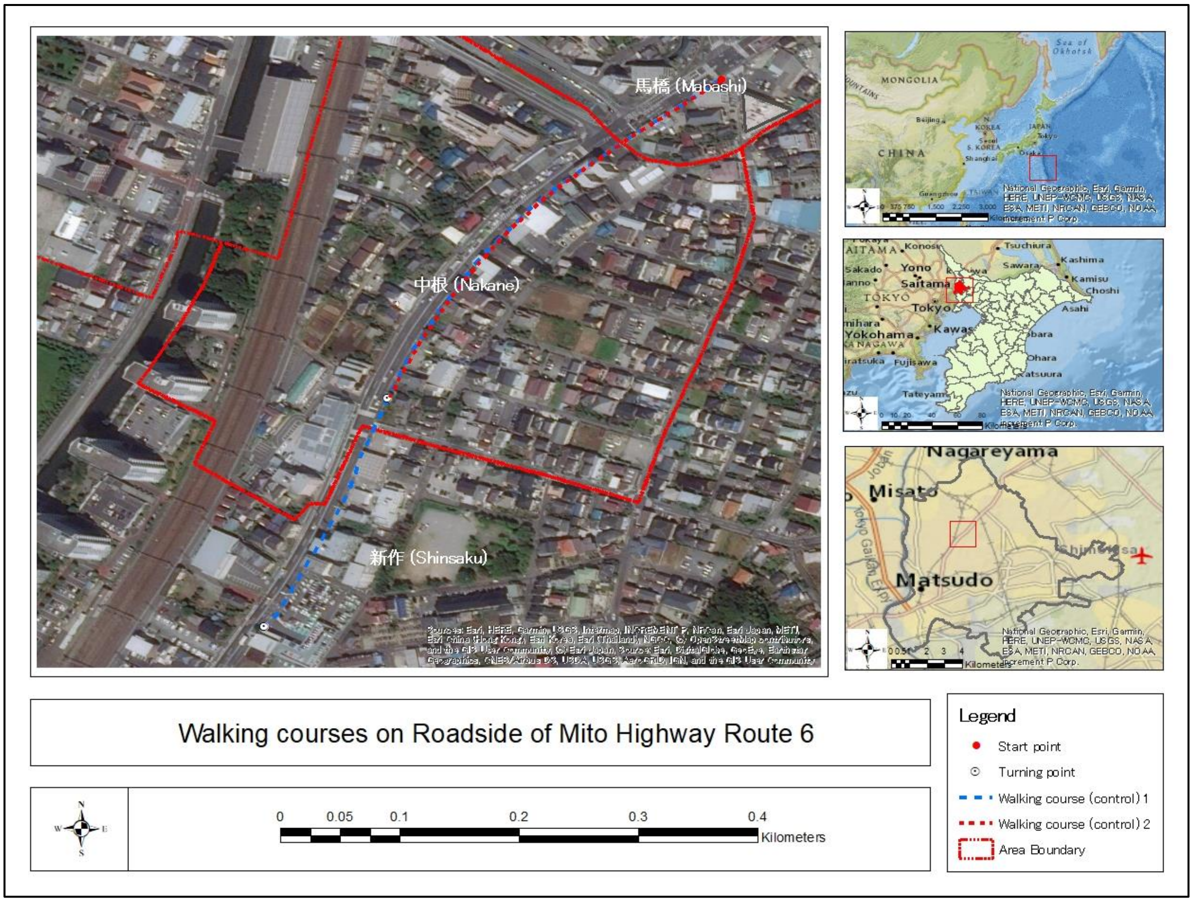


Figure 25. Control site of walking experiment

Table 12. Details regarding park (experimental site) and city (control site) of walking experiment.

Biophysical Aspects	**Winter**	**Spring**	**Summer**
Route of walking course	Experimental site: Round trip of Village of Green-Gathering Square (walking course 1, 1.2 km) City: Roadside of Mito Highway Route 6 (control walking course 1, 1.2 km)	Experimental site: Round trip of Park center-Nature Observation (walking course 2, 800 m) City: Roadside of Mito Highway Route 6 (control walking course 2, 800 m)	Experimental site: Round trip of Village of Green-Gathering Square (walking course 1, 1.2 km) City: Roadside of Mito Highway Route 6 (control walking course 1, 1.2 km)

Biophysical Aspects	**Winter**	**Spring**	**Summer**
Experimental Period	January 17-February 25, 2019	March 28-April 3, 2019	May 30-June 6, 2019
Land use	Park: Secondary forest White Oak (*Quercus myrsinifolia*), Red Oak (*Quercus acuta*), Zelkova (Zelkova serrata), Muku tree (*Aphananthe aspera*), Itajii (*Castanopsis sieboldii*), Jolcham Oak (*Quercus serrata*), Chino bamboo (*Pleioblastus chino*) City: Urban Area	Park: Artificial planting Yoshino Cherry (*Prunus yedoensis*), Japanese cedar (*Cryptomeria japonica*), Hinoki cypress (*Chamaecyparis obtuse*), Read Oak (*Quercus acuta*), Jolcham oak (*Quercus serrata*), Chino bamboo (*Pleioblastus chino*) City: Urban Area	Park: Secondary forest White Oak (*Quercus myrsinifolia*), Red Oak (*Quercus acuta*), Zelkova (Zelkova serrata), Muku tree (*Aphananthe aspera*), Itajii (*Castanopsis sieboldii*), Jolcham Oak (*Quercus serrata*), Chino bamboo (*Pleioblastus chino*) City: Urban Area
Temperature (°C) (mean ± SD)	Park: 12.2 ± 1.4 City: 13.4 ± 1.7	Park: 14.4 ± 2.8 City: 13.4 ± 2.9	Park: 26.7 ± 2.6 City: 26.7 ± 1.5
Relative humidity (%) (mean ± SD)	Park: 35.5 ± 3.1 City: 35.9 ± 3.4	Park: 45.4 ± 18.1 City: 40.6 ± 14.2	Park: 50.2 ± 10 City：52 ± 5.7

6.1.2.2 Participants

Selection of participants was built up through snowball sampling method as one of the best tools of finding potential participants dealing with the eligibility criteria. A total of 35 people became part of participants' recruitment and they provided information about study aims, experimental procedures, and designated experimental days. The participants' eligibility criteria were: 1) middle-aged and old adults with the age ranged between 40 and 80 and 2) they who do not take blood pressure and heart rate medication. In total, 12 participants living in several areas of Matsudo city (e.g. Tokiwadaira, Mabashi, and Koganehara) for each season were decided. As exhibited in previous physiological and psychological studies in park and forest environment, a sample size of 9-19 participants is enough to obtain significant results (Park et al. 2009; Lee et al. 2009; Song et al. 2013, 2014; Ochiai et al. 2015; Song et al. 2017; Pratiwi et al. 2019; Lee et al. 2015; Takayama et al. 2017). Therefore, total subjects of 12 individuals in a set of experiment was sufficient to generated significant and relevant data. Four males and eight females (mean age, 70.2 ± 4.4 years) participated in the winter experiment, six males and six females (mean age, 66.4 ± 10.5 years) participated in the spring experiment, and five males and seven females (mean age, 65.75 ± 10.1 years) participated in the early summer experiment. After arriving in sites, the participants were briefed on the experiment procedures and informed consent in a waiting room. During the experimental period, the participants were prohibited from consuming alcohol, tobacco, caffeine, and food. The experimental procedures were in conformation with the regulations of the Ethics Committee of the Center for Environment, Health, and Field Sciences, Chiba University, Japan (Receipt code number: 18-06).

6.1.2.3 Experimental Design

Twelve participants were randomly classified into two groups (experimental and control group) in a day. Each group consisted of 2–4 participants. After arriving at each site, all participants were provided informed consent and guided walk orientations by staffs, filled out questionnaires, measured blood pressure, and their heart rates began to be monitored. The participants then walked in the designated walking course in the park or city area for 15 minutes in winter and early summer, and 11 minutes in spring (Figure 24). Participants returned to the waiting room, filled out a set of questionnaires, got blood pressure checked, and stopped measuring heart rates (Figure 25). They had a lunch break and for 30 minutes. In the afternoon, the participants visited the reverse sites in order to terminate the effect of order (Table 13). Participants walked the designated course moved of the urban park—with views of Village of Green and Gathering Square in winter and summer, and Yoshino-cherry and Sendabori Pond in spring.

Table 13. Time schedules during the walking experiment in winter, spring, and early summer. POMS: Profile of Mood States; STAI: State-Trait Anxiety Inventory; LIST: Landscape Image Sketching Technique.

Time	**Activity**	**Place**
08:30	Assembling at pickup point	Tokiwadaira station building, South gate
08:30-09:00	Moving to park park/city area by car	-
09:00-09:20	Guided orientation by staff	Designated walking course at park/city
09:20-09:40	Initial measurement of blood pressure and heart rate, evaluation of POMS, STAI	Waiting room
09:40-10:00	Walking experiment with continuous heart rate measurement	Designated walking course at park/city
10.00-10:20	Afterward measurement of blood pressure, evaluation of POMS, STAI, LIST (only park group), termination of heart rate measurement	Waiting room
11:20-12:00	Moving to the reverse sites by car	-
12:00-12:30	Having a lunch break	Waiting room
12:30-12:50	Initial measurement of blood pressure and heart rate, evaluation of POMS, STAI	Waiting room
12:50-13:10	Walking experiment with continuous heart rate measurement	Designated walking course at park/city
13:10-13:30	Afterward measurement of blood pressure, evaluation of POMS, STAI, LIST (only park group), termination of heart rate measurement	Waiting room

(**a**)

(**b**)

(**c**)

(**d**)

Figure 26. Walking course scenes in: (a) urban park in winter; (b) urban park in spring; (c) urban park in early summer, (d) city area.

6.1.2.4 Physiological and Psychological Measures

Heart rate and blood pressure were measured as physiological parameters during the walking experiment. Heart rate was measured continuously using a heart rate sensor (MyBeat WHS-3, Union Tool, Tokyo, Japan). The average of heart rate values during the walking period was used in the analysis. Systolic and diastolic blood pressure was measured by an oscillometric method using a digital automatic sphygmomanometer pre-and post-experiment (Omron HEM-1021, Omron Corp., Kyoto, Japan). The mean of two measurements was used in the analysis.

Two psychological parameters, namely the Profile of Mood States 2 (POMS) Japanese version and the New State-Trait Anxiety Inventory (STAI) Japanese version, were delivered pre- and post-experiment. A POMS 2, which is a reliable and valid measure of psychological response contained of 35 questions complying six mood states: “anger–hostility” (A–H), “confusion–bewilderment” (C–B), “depression–dejection” (D–D), “fatigue–inertia” (F–I), tension–anxiety” (T–A), and “vigor–activity” (V–A) [37–38]. A five-point Likert scale, ranging from 0 (not at all) to 4 (extremely), was used for each item to evaluate subjects’ mood states. The Total Mood Disturbance (TMD) score was calculated as [(A–H) + (C–B) + (D–D) + (F–I) + (T–A) – (V–A)] (Heuchert and McNair 2012; Hashim 2018; Konuma et al. 2018). A new STAI Japanese version was jointly researched in consideration of cultural factors and presented its consistency reliability (Spielberger and Sarason 1985; Iwata et al. 1998). The State-Anxiety part of STAI was used to measure the current state of anxiety which contains 20 questions. A four-point Likert scale, ranging from 1 (not at all) to 4 (very much so), was used to evaluate participants’ anxiety levels. All research tools and materials are shown in Figure 24.

Figure 27. Research tools and functions.

6.1.2.5 Landscape Image Sketching Technique (LIST)

Landscape Image Sketching Technique (LIST), an approach to holistically analyze the meaning of the environment, consists of a combination of brief sketches of various landscapes, keywords referring to the landscape, and short verbal descriptions of landscapes by respondents (Ueda 2009; Ueda et al. 2012). The most distinct aspect of LIST is the analysis of visual data of scenic sketches. Sketches are unique representations of individual’s landscape imageries (Ueda

2009; Ueda et al. 2012; Pratiwi et al. 2014; Kohori and Furuya 2017). In this study, this method could represent participants' view after walking towards spatial experienced the urban park environment and linguistic value orientation. Ueda also emphasized that the three phases have four Fuukei (a Japanese word meaning landscape perception) conditions: (1) identification of landscape elements through spatial view and linguistic knowledge), (2) structure of person-environment relationship (as self-orientation), and (3) the meaning (intersubjective values) of place according to how one's intentions are interpreted. Thus, image of park therapy is central in the square model and comprises all the elements (Figure 26). Landscape Image survey (keywords, text, brief sketch of park therapy) was conducted after the walking experiment in the urban park to investigate the spatial conditions of park therapy (Ueda et al. 2012; Pratiwi et al. 2014; Kohori and Furuya 2017; Ueda and Takayama 2011).

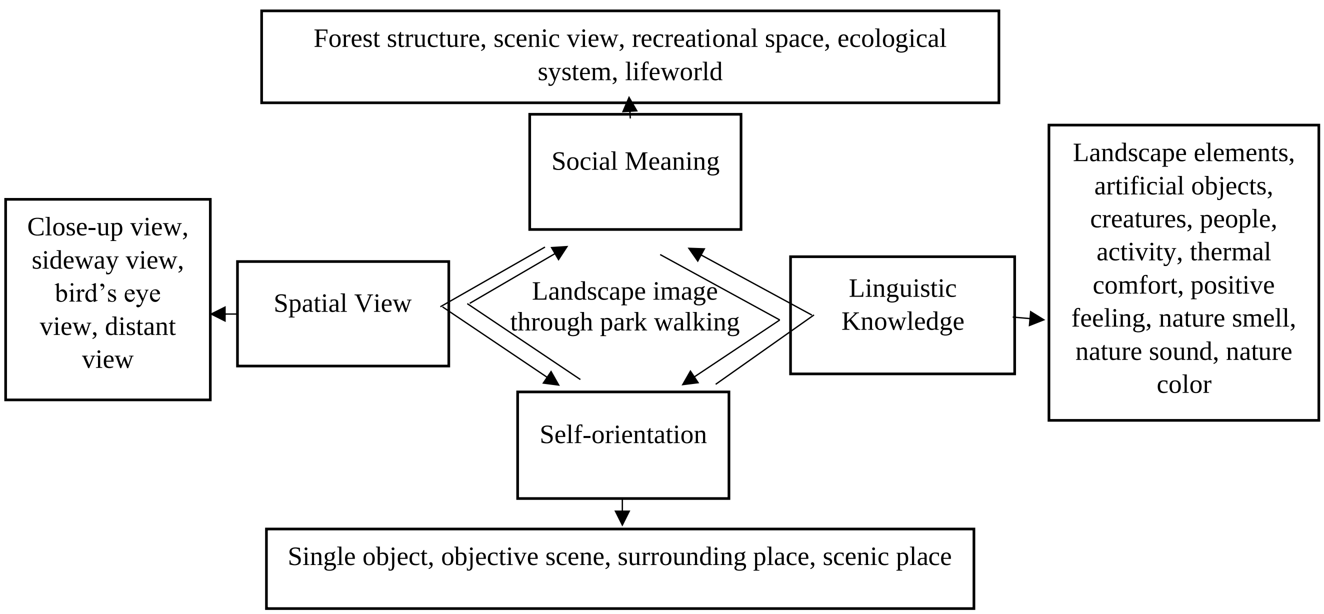


Figure 28. Diagram of landscape image through park walking among old adults

Note. Adaptated from "Landscape image sketches of forests in Japan and Russia", by H. Ueda, T. Nakajima, N. Takayama, E. Petrova, H. Matsushima, K. Furuya, and Y. Aoki, 2012, *Forest Policy and Economics*, *19*, 20-30. Copyright 2012 by H. Ueda.

1. Keywords and text of forest

In the landscape image survey, participants were asked to imagine the image of park therapy that they had experienced and then used words related to park therapy and explained the situation within park therapy. The first step of LIST method showed how the retrieve process of landscape cognition.

2. Brief sketch of park

The same participants were asked to draw a brief sketch of their landscape image on A4 size paper. The second step of LIST aimed to complement incomplete verbal data from keywords and explanation regarding walking in the park. These following questions were asked to the middle-aged and older adults:

- What imagery comes to mind when you hear the words "park therapy"? Regarding your own imagined "park therapy", please answer the following three questions.
- Please fill in the blanks with a few keywords about your free association "park therapy."
- Please explain the situation of your park therapy image using a few sentences (not more than 100 words).
- Please draw a brief sketch of your park therapy image (with keywords if necessary).

6.1.2.6 Data Analysis procedure

1 Physiological-psychological measures analyses

Heart rate data were analyzed by averaging the number of times the heartbeats in the space of a minute at each site. Blood pressure data were divided into pre- and post- walking data in each site. A paired t-test was employed to compare mean differences of physiological measures between the two environments and pre- and post-walking in the urban park. The Wilcoxon signed-rank test was employed to assess whether their psychological measures mean ranks differ between the two environments and pre- and post-walking in the urban park. The Kruskal-Wallis test was employed to determine the difference of participants' characteristics during park therapy in all seasons.

In a comparative analysis, the heart rate, blood pressure, total mood disturbance, and state anxiety outcomes of current study were compared with those of our prior study that investigated physiological and psychological effects of viewing the urban park for 11-15 min (Pratiwi et al. 2019). The numbers of participants who exhibited positive and negative responses in the current and prior results were counted for comparative analysis (Song et al. 2019). A positive response was implied by an alleviation in heart rate, blood pressure, total mood disturbance, and state anxiety and a negative response as the reverse. The Chi-Squared test was employed to compare the difference in the proportion of positive and negative responses between the current and prior studies.

2 Landscape image analysis

An analysis of visual and verbal data was implemented onto 4 Fuukei conditions (landscape image aspects, Figure 27), namely 1) identification of landscape elements (through linguistic knowledge and spatial view), 2) structure of person-environment relationship (through self-orientation), and 3) meaning of place (through social meaning) (Ueda et al. 2012). Each landscape image sketch was classified into landscape image aspects using checklist method. The presence of the variables in the landscape image sketches was defined as '1', while '0' indicated the absence of the variables in the landscape image sketches (Pratiwi et al. 2014). The chi-square test was applied to examine the significant differences between verbal data and visual data keywords of landscape image. Spearman's rho correlation was applied to analyze the correlation between park therapy image and physiological-psychological measures. All statistical analyses were applied using SPSS 26.0 (IBM Corp., Armonk, NY, USA). Quantitative content analysis was conducted using KH Coder 3 to quantify the highest degree of centrality. The explanatory verbal data of landscape images was examined by automatically extracting frequent words from data, statistically analyzing them to obtain entire landscape images, and exploring features of data while avoiding researcher prejudice (Higuchi 2014).

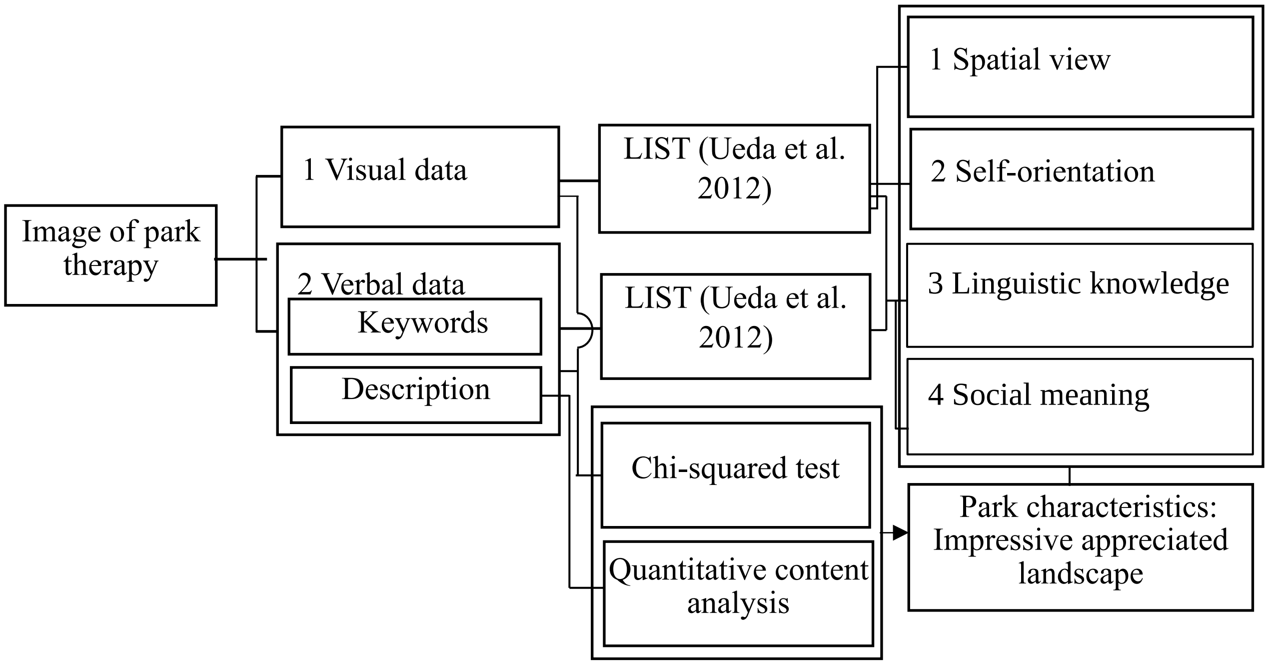


Figure 29. Diagram of LIST framework.

6.1.3 Results

6.1.3.1 Participant Socioeconomic, Sociodemographic, and Shinrin-yoku Information

The information regarding participant socio-demography, socio-economy, and shinrin-yoku is shown in Table 14. Based on the Kruskal–Wallis test, the participants' characteristics during park therapy were not significantly different in all seasons. In this study, the mean age of the middle-aged and older adults was 70.2 ± 4.4 in winter, 66.4 ± 10.5 in spring, and 66.8 ± 10.1 in summer. The proportion of male and female participants was similar in all seasons (33.3% of males and 66.7% of females; 50% of males and 50% females; 41.7% males, and 58.3% females, respectively). In terms of employment status, 75% of participants were unemployed while 25% were employed. Regarding their educational background, 44.4% of participants held vocational education, 30.6% graduated from senior high school, 22.2% held a university degree, and 2.7% only completed from junior high school. Regarding monthly income, 47.2% of participants had less than JPY 150,000, 30.6% had between JPY 150,000-200,000, 11.1% had more than JPY 250,000, and 8.3% had JPY 200,000-250,000. With regard to health, 94.4% participants did not smoke, 63.9% slept less than 7 h, and 52.8% did not consume alcohol. Participants performed sports or exercise activity seven times and shinrin-yoku five times in a month. About 55.5% of the participants felt sufficient in social attachment to their environment, marked by bi-monthly community involvement.

Table 14. Participant information of walking experiment.

Parameter	**Winter (*N* = 12)**	**Spring (*N* = 12)**	**Summer (*N* = 12)**	***P*-Value**
Age (years)	70.2 ± 4.4	66.4 ± 10.5	66.8 ± 10.1	0.791
Gender				0.635
Male	33.3%	50%	41.7%	
Female	66.7%	50%	58.3%	
Employment status				0.535
No	83.3%	66.7%	75%	
Yes	16.67%	33.3%	25%	
Educational background				0.534
Junior high school	8.3%	-	-	
Senior high school	33.3%	25%	33.3%	
University	16.7%	16.7%	33.3%	
Other (vocational education)	41.7%	58.3%	33.3%	
Income (JPY/month)				0.882
Less than JPY 150,000	41.7%	41.7%	58.3%	
JPY 150,000–200,000	41.7%	25%	25%	
JPY 200,000–250,000	8.3%	16.7%	-	
More than JPY 250,000	8.3%	16.7%	16.7%	
Smoking behavior				0.368
No	100%	91.7%	91.7%	
Yes	-	8.3%	8.3%	
Alcohol use				0.897
No	50%	58.3%	50%	
Yes	50%	41.7%	50%	
Sleeping time (hours)				0.893

Parameter	Winter (*N* = 12)	Spring (*N* = 12)	Summer (*N* = 12)	*P*-Value
Less than 7 h	58.3%	66.7%	66.7%	
7–9 h	41.7%	33.3%	33.3%	
Sport activity (times/month)	7.2 ± 6.6	5 ± 5.5	7.6 ± 9.3	0.658
Shinrin-yoku (times)	2.6 ± 3.8	6.6 ± 5	5.6 ± 8.5	0.741
Social attachment				0.504
Sometimes	50%	66.7%	50%	
Quite often	41.7%	25%	16.7%	
Often	8.3%	8.3%	33.3%	
Participation in community (times/month)	2.3 ± 4.4	1.6 ± 1.9	1.6 ± 2.8	0.994

6.1.3.2 Reliability Analysis of Physiological and Psychological Parameters

The internal consistency (Cronbach's alphas) of physiological and psychological parameters among twelve participants in winter, spring, and summer is given in Table 15. The overall parameters obtained very good internal consistency (0.817-0.989). The results convey that heart rate and blood pressure as physiological parameters had excellent internal consistency (more than 0.9), while POMS and STAI score as psychological parameters had good internal consistency (more than 0.8). The alpha reliability of heart rate in winter, spring and summer was 0.980, 0.982, and 0.989, respectively; for blood pressure, it was 0.936, 0.908, and 0.849, respectively. While the alpha reliability of the POMS score in winter, spring and summer was 0.901, 0.817, and 0.887, respectively; for STAI score it was 0.882, 0.858, and 0.930, respectively.

Table 15. Verification of internal consistency of physiological and psychological parameters of walking experiment

Parameter	Cronbach's α		
	Winter	**Spring**	**Summer**
Heart rate	0.980	0.982	0.989
Blood pressure	0.936	0.908	0.849

Parameter	Cronbach's α		
	Winter	Spring	Summer
POMS	0.901	0.817	0.887
STAI	0.882	0.858	0.930

6.1.3.3 Physiological Effects

Walking in the urban park was found to result in lower heart rate and blood pressure than walking in the city. The significance of health effect of walking in the urban park on middle-aged and older adults was varied by season. Mean heart rates while walking in the urban park were lower than in the city in all seasons (winter: $p = 0.000$; spring: $p = 0.023$; early summer: $p = 0.000$; Table 16). Figure 28 depicts overall mean heart rates during walk in urban park and city area in winter, spring and early summer. Mean systolic and diastolic blood pressure in spring were significantly lower after walking in the urban park as compared to the city ($p = 0.000$; $p = 0.002$; Figure 29). There were no significant differences in blood pressures in two environments in winter and early summer.

Table 16. Mean heart rate during and blood pressure post-walking in the urban park and city area in winter, spring, and early summer.

Physiological Parameters	Park	City	*P*-Value
	Mean ± SD	Mean ± SD	
Heart rate (bpm)			
Winter	100.4 ± 1.6	104.4 ± 2.0	0.000***
Spring	97.6 ± 2.1	99.6 ± 2.1	0.023*
Early summer	89.7 ± 1.5	92.7 ± 1.4	0.000***
Systolic Blood pressure (mmHg)			
Winter	127.6 ± 20.5	130.5 ± 21.0	0.319
Spring	126.3 ± 17.0	147.3 ± 13.3	0.000***
Early summer	124.7 ± 21.4	129.3 ± 20.4	0.25

Diastolic Blood pressure (mmHg)			
Winter	72.2 ± 15.9	74.2 ± 15.2	0.277
Spring	76.0 ± 11.9	87.5 ± 8.4	0.002**
Early summer	70.3 ± 10.0	73.0 ± 9.8	0.242

Note. ***p*< 0.01, ****p*< 0.001.

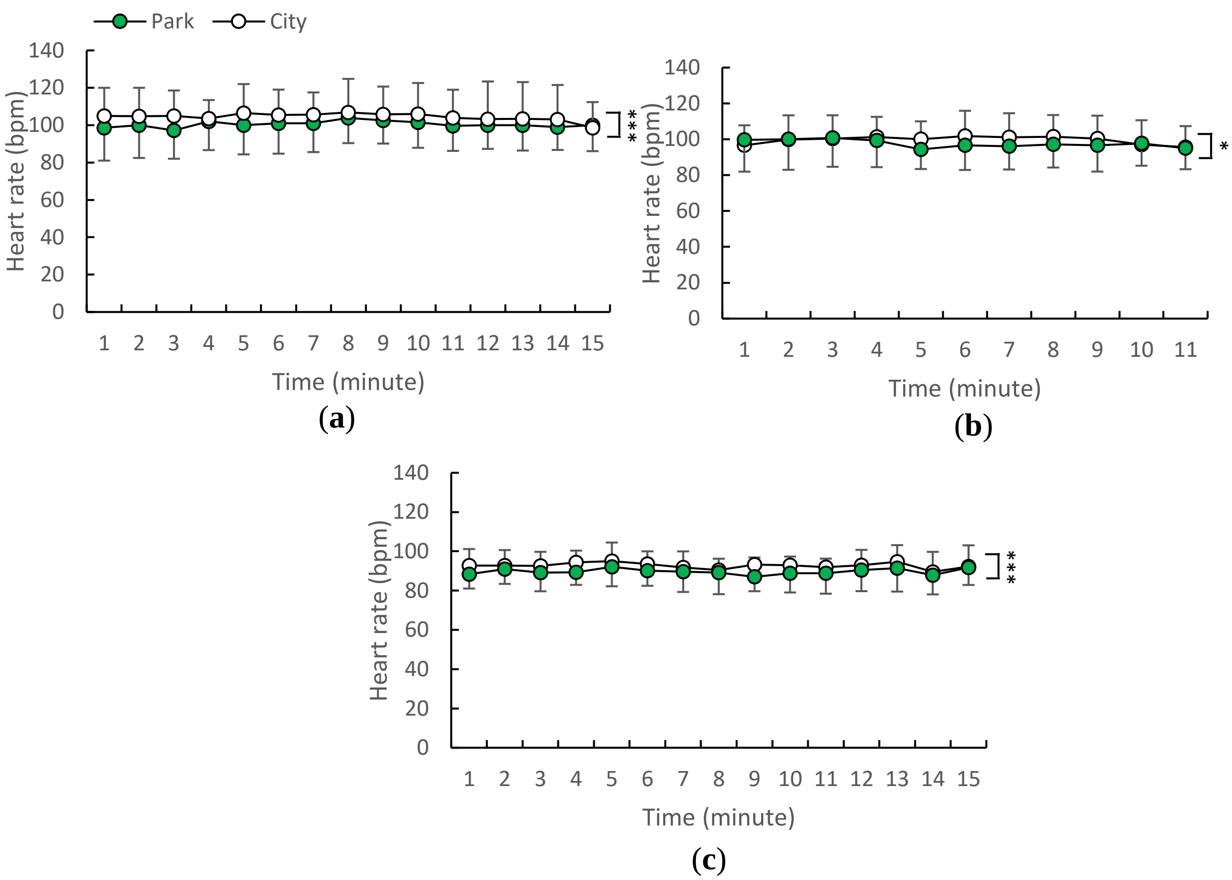
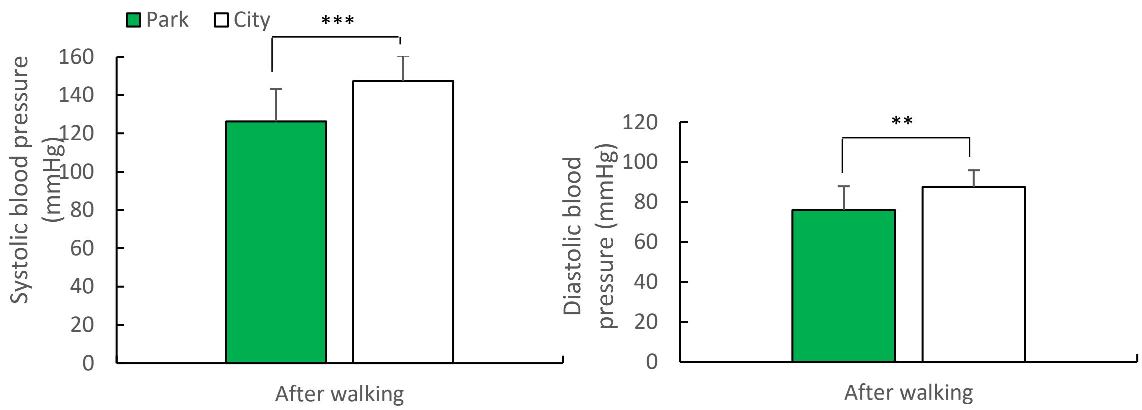


Figure 30 One-minute average heart rate during walking in the urban park in: (a) winter, (b) spring, and (c) early summer. $N = 12$, mean ± standard deviation. *p< 0.05, ***p< 0.001, analyzed by the paired t-test (one-sided).



(a) **(b)**

Figure 31. Average blood pressure after walking in the urban park and the city in spring: (a) systolic blood pressure; (b) diastolic blood pressure. $N = 12$, mean ± standard deviation. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, determined by the paired t-test (one-sided).

The physiological outcomes of current study were compared with those of our prior study in which participants view urban parks (Pratiwi et al. 2019). The proportions of participants exhibiting positive and negative responses in urban parks are shown in Table 17. In prior results (Pratiwi et al. 2019), 83.3% of the participants exhibited the highest proportion of positive responses in systolic and diastolic blood pressure post-spring viewing in urban parks than the other parameters' and was significantly lower than those post-walking (91,7%) in the current study (p = 0.020). The proportion of participants exhibiting positive response in systolic (50%, 75%) and diastolic blood pressure (66.7%, 75%) was almost equal between post-early summer walking and viewing in urban parks; there was no significant difference. In current results, 66.7% of the participants exhibited higher positive responses in heart rate during spring and early summer walking in urban parks than those during viewing (16,7%) in the prior study. Both proportions of participants in heart rates between two studies in spring and early summer found no significant difference.

Table 17. Proportions of participants who exhibited positive and negative responses in heart rate during and blood pressure post-walking and viewing in urban parks.

Season	Activity	Heart rate		Systolic blood pressure		Diastolic blood pressure	
		Positive response	**Negative response**	**Positive response**	**Negative response**	**Positive response**	**Negative response**
Winter	Walking	8 (66.7%)	4 (33.3%)	7 (58.3%)	5 (41.7%)	8 (66.7%)	4 (33.3%)

Season	Activity	Heart rate		Systolic blood pressure		Diastolic blood pressure	
		Positive response	Negative response	Positive response	Negative response	Positive response	Negative response
(*N* = 12)	Viewing	-	-	-	-	-	-
Spring (*N* = 12)	Walking	8 (66.7%)	4 (33.3%)	11 (91.7%)	1 (8.3%)	11 (91.7%)	1 (8.3%)
	Viewing	2 (16.7%)	10 (83.3%)	10 (83.3%)	2 (16.7%)	10 (83.3%)	2 (16.7%)
Chi-Squared Test		1.200 (*p* = 0.273)		5.455 (*p* = 0.020)		5.455 (*p* = 0.020)	
Early summer (*N* = 12)	Walking	8 (66.7%)	4 (33.3%)	6 (50%)	6 (50%)	8 (66.7%)	4 (33.3%)
	Viewing	2 (16.7%)	10 (83.3%)	9 (75%)	3 (25%)	9 (75%)	3 (25%)
Chi-Squared Test		1.200 (*p* = 0.273)		0.444 (*p* = 0.505)		2.000 (*p* = 0.157)	

6.1.3.4 Psychological Effects

Brief walking in the urban park led to lower negative moods and state anxiety, and higher positive mood than walking in the city. In winter, significant reduction of negative moods was discovered in the POMS analysis, with negative subscale scores “confusion–bewilderment” (p = 0.029), “depression–dejection” (p = 0.042), and total mood disturbance (TMD) significantly lower after park therapy (p = 0.023; Figure 30). The mean values of negative moods “fatigue–inertia“ and TMD decreased, whereas “vigor–activity” increased in post-walking compared with pre-walking in the urban park (F–I: p = 0.012; TMD: p = 0.003; V–A: p = 0.042; Figure 31). In spring, “depression–dejection” (p = 0.036), “vigor–activity” (p = 0.037), and TMD (p = 0.008) were significantly lower after park therapy. In early summer, “anger–hostility” (p = 0.039), “confusion–bewilderment” (p = 0.021), “fatigue-inertia” (p = 0.007), and “tension–anxiety” (p = 0.035) were also significantly lower following park therapy (Table 18). The significant difference in mood change between post- and pre-walking in the urban park was not detected in spring and early summer. STAI analysis also demonstrated significant decreases in state anxiety after seasonally walking in the urban park compared with the city area (p = 0.0125; p = 0.028; p = 0.027, respectively; Figure 32). The mean values of state anxiety declined in post-walking compared with pre-walking in the urban park in winter (p = 0.008; Figure 33).

Table 18. Mean POMS and STAI scores post-walking in the urban park and city area in winter, spring, and early summer.

Psychological Parameters	**Park**	**City**	***P*-Value**
	Mean ± SD	**Mean ± SD**	
Mood State (POMS)			
Winter			
Anger–hostility (A–H)	0.7 ± 1.5	0.8 ± 1.6	0.297
Confusion–bewilderment (C–B)	1.7 ± 2.5	2.7 ± 3.7	0.029*
Depression–dejection (D–D)	2.3 ± 3.1	3.0 ± 2.8	0.042*
Fatigue–inertia (F–I)	0.9 ± 2.1	2.0 ± 4.0	0.051
Tension–anxiety (T–A)	1.9 ± 2.4	2.8 ± 4.2	0.147
Vigor–activity (V-A)	13.9 ± 5.2	12.3 ± 6.2	0.054
Total Mood Disturbance (TMD)	-6.5 ± 11.1	-0.9 ± 18.2	0.023*
Spring			
Anger–hostility (A–H)	0.0 ± 0.0	0.8 ± 1.7	0.055
Confusion–bewilderment (C-B)	0.6 ± 1.0	1.6 ± 2.2	0.053
Depression–dejection (D–D)	0.7 ± 0.9	1.3 ± 1.8	0.036*
Fatigue–inertia (F–I)	0.4 ± 1.4	1.1 ± 2.2	0.09
Tension–anxiety (T–A)	0.6 ± 1.2	2.1 ± 3.0	0.084
Vigor–activity (V–A)	12.9 ± 4.8	11.7 ± 5.2	0.037*
Total Mood Disturbance (TMD)	-10.7 ± 4.8	-4.8 ± 11.3	0.008**
Early summer			
Anger–hostility (A–H)	1.1 ± 1.7	2.4 ± 2.9	0.039*
Confusion–bewilderment (C–B)	1.9 ± 2.4	3.2 ± 2.8	0.021*
Depression–dejection (D–D)	2.3 ± 3.3	2.8 ± 3.5	0.274
Fatigue–inertia (F–I)	1.9 ± 2.3	3.3 ± 2.5	0.007**
Tension–anxiety (T–A)	2.2 ± 2.3	3.8 ± 3.0	0.035*
Vigor–activity (V–A)	9.8 ± 4.4	10.5 ± 5.4	0.311
Total Mood Disturbance (TMD)	-0.5 ± 10.8	5.0 ± 14.6	0.054
State Anxiety (STAI)			
Winter	29.8 ± 6.9	35.8 ± 12.0	0.013*
Spring	29.6 ± 6.6	33.9 ± 8.6	0.028*
Early summer	34.8 ± 8.7	38.2 ± 8.2	0.027*

Note. * $p < 0.05$, ** $p < 0.01$.

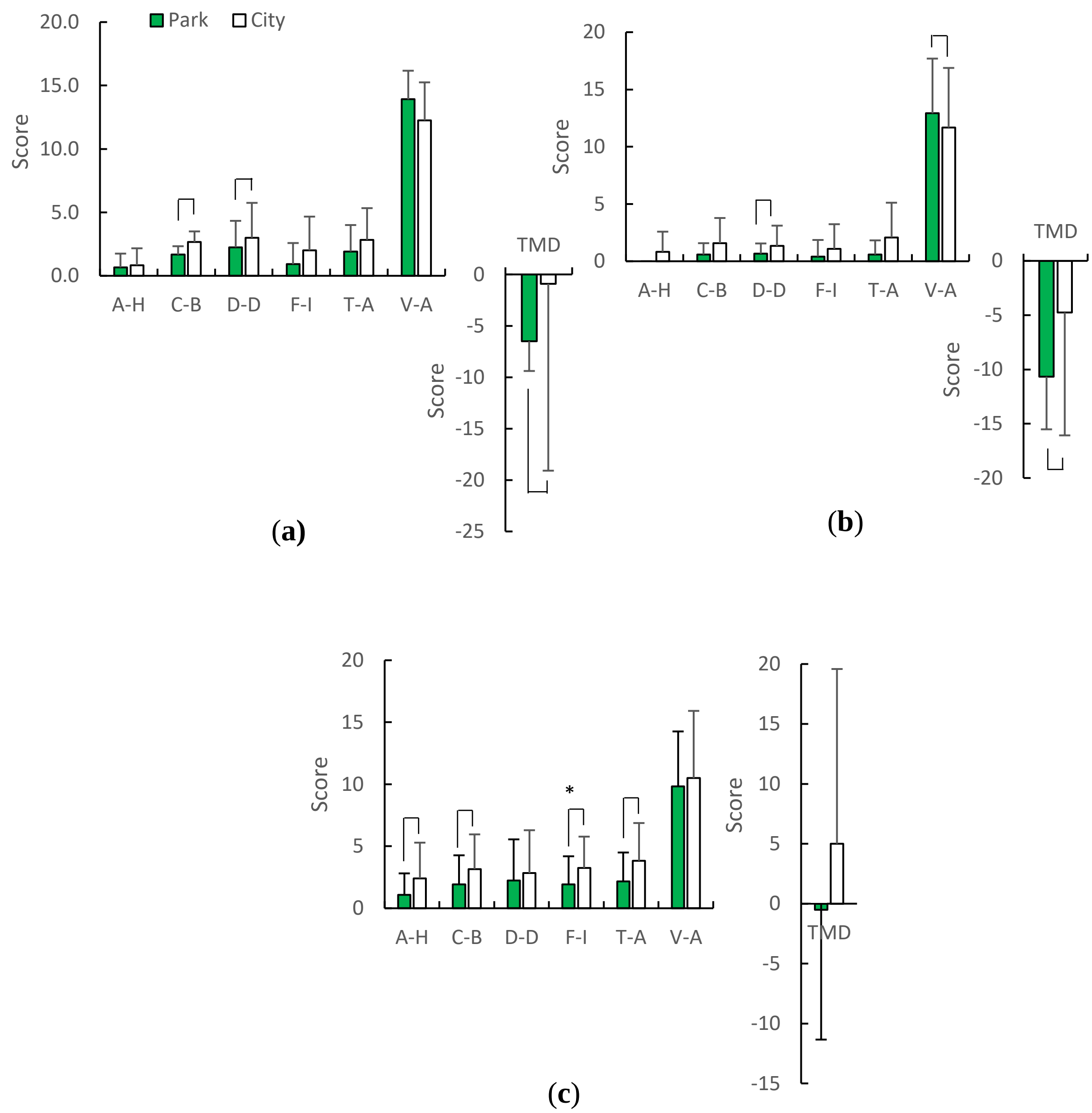


Figure 32. The POMS score after walking in the urban park and the city: (a) winter walking period; (b) spring walking period; (c) early summer walking period. T–A, tension–anxiety; D–D, depression–dejection; A–H, anger–hostility; F–I, fatigue–inertia; C–B, confusion–bewilderment; V–A, vigor–activity; TMD: Total Mood Disturbance. $N = 12$, mean ± standard deviation. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, determined by the Wilcoxon signed-rank test (one-sided).

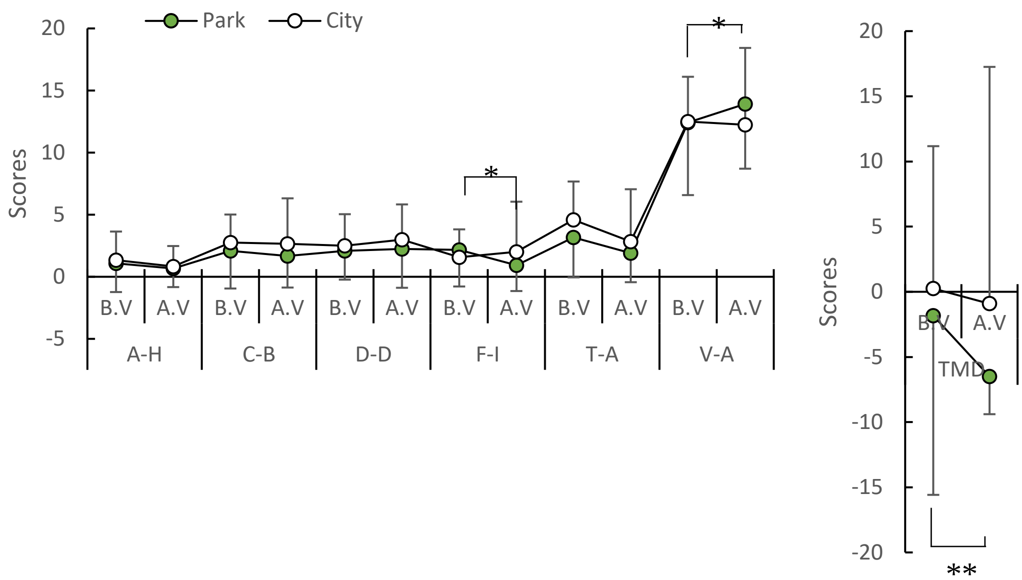


Figure 33. Comparison of POMS score pre and post-walking in the urban park in the winter. A–H: anger–hostility; C–B: confusion–bewilderment; D–D: depression–dejection; F–I: fatigue–inertia; T–A: tension–anxiety; V–A: vigor–activity; TMD: Total Mood Disturbance. $N = 12$, mean ± standard deviation. *$p < 0.05$, **$p < 0.01$, determined by the Wilcoxon signed-rank test (one-sided).

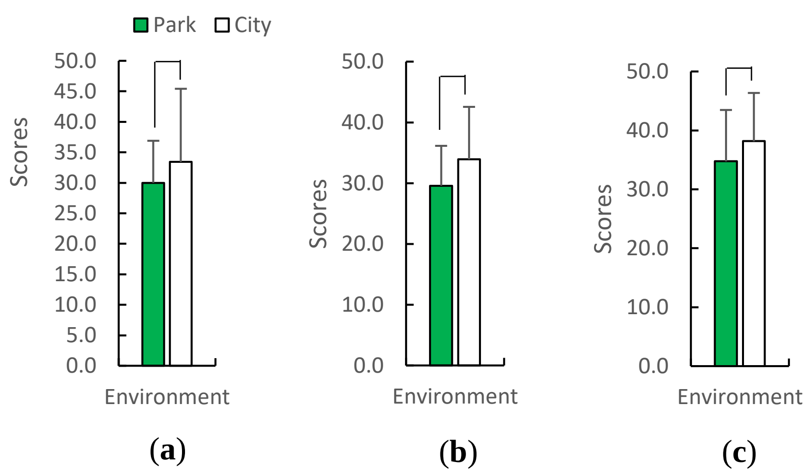


Figure 34. STAI score after walking in the urban park and city area in: (a) winter; (b) spring; and (c) early summer. N = 12, mean ± standard deviation. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, determined by the Wilcoxon signed-rank test (one-sided).

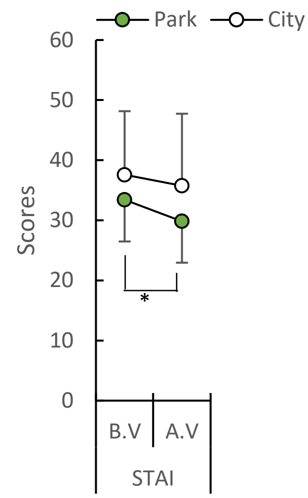


Figure 35. Comparison of STAI score pre and post-walking in the urban park in winter. *N* = 12, mean ± standard deviation. *$p < 0.05$, **$p < 0.01$, determined by the Wilcoxon signed-rank test (one-sided).

The psychological outcomes of the current study were compared with those of our prior study in which participants merely view urban parks (Pratiwi et al. 2019). The proportions of participants who exhibited positive and negative responses in urban parks are shown in Table 19. In our prior results (Pratiwi et al. 2019), 91.7% of the participants exhibited the highest positive responses in state anxiety in post-early summer viewing of urban parks. State anxiety was lower than that post- viewing (75%) and a significant difference was not found. In the current results, 91.7% of the participants exhibited the highest positive responses in total mood disturbance during post-spring walking in urban parks. Total mood disturbance was higher than that post-viewing (66.7%) in the prior study; a significant difference was not found. The proportion of participants exhibiting positive response in state anxiety was almost equal between post-spring walking and viewing in urban parks (66.7%, 75%). Total mood disturbance was similar between post-early summer walking and viewing in urban parks (66.7%), and no significant difference was found.

Table 19. Proportions of participants who exhibited positive and negative responses in total mood disturbance and state anxiety post-walking and viewing in urban parks.

Season	Activity	Total Mood Disturbance		State Anxiety	
		Positive response	**Negative response**	**Positive response**	**Negative response**
Winter (N = 12)	Walking	10 (83.3%)	2 (16.7%)	10 (83.3%)	2 (16.7%)
	Viewing	-	-	-	-
Spring (N = 12)	Walking	11 (91.7%)	1 (8.3%)	8 (66.7%)	4 (33.3%)
	Viewing	8 (66.7%)	4 (33.3%)	9 (75%)	3 (25%)
Chi-Squared Tests		2.182 (p = 0.140)		2.000 (p = 0.157)	
Early summer (N = 12)	Walking	8 (66.7%)	4 (33.3%)	9 (75%)	3 (25%)
	Viewing	8 (66.7%)	4 (33.3%)	11 (91.7%)	1 (8.3%)
Chi-Squared Tests		1.188 (p = 0.665)		0.364 (p = 0.546)	

6.1.3.5 Image of park therapy

Park therapy-related landscape images showed prominent landscape elements such as "trees" (p = 0.004) in winter, "water" (p = 0.031) in spring, "activity" (p = 0.038), and "people" (p = 0.034) in spring, and "greenery" (p = 0.008) and "lawn" (p = 0.038) in early summer. A therapeutic feeling was associated with "comfortable" (p = 0.038) and "relaxed" (p = 0.015) in winter, as well as "broad" in early summer (p = 0.038). Self-orientation and social meaning were explored in spring walk, such as "surrounding place" (p = 0.045) and "recreational space" (p = 0.014, Table 20). In the winter, park therapy images were characterized by deciduous trees which shed their leaves representing comfortable and relaxed feeling by walking through the park. In spring, park therapy images were characterized by surrounding places which expressed subjects' perspectives on the park, with trails or cherry blossom-viewing spots at the center and water as a background to describe subject's activities. In the summer, park therapy images were characterized by wide lawns and fresh greenery in the park. Figures 34–36 show park therapy images in winter, spring, and early summer.

This study also exhibited a correlation between park therapy images and physiological-psychological responses. One linguistic knowledge component correlated with physiological-psychological responses in winter, four linguistic knowledge components, each one spatial view and self-orientation components correlated with physiological-psychological responses in spring, and three linguistic knowledge and two spatial view components were correlated in early summer (Table 10). Green leaves and plants had correlations with increased vigor-activity in spring (r = 0.619). Creatures like "birds" as landscape elements during park therapy had correlations with decreased heart rates in winter. In spring, such landscape elements had correlations with decreased systolic blood pressure, increased vigor, decreased TMD, and state anxiety (r = -0.607; r = -0.652; r = 0.652, r = 0.652; r = -0.585). Other landscape elements like flowers and activities had correlations with decreased diastolic blood pressure in early summer and spring, respectively (r = -0.532; r = -0.562). In spring, people and activity had correlations with decreased heart rates (r = -0.693; r = -0.671). In early summer, water had a correlation with decreased heart rates (r = -0.585). Moreover, a sense of tranquility had correlations with increased vigor–activity and decreased state anxiety in early summer (r = -0.732; r = -0.759). Spatial view during park therapy such as "bird's eye view" had correlations with decreased confusion–bewilderment in early summer, increased vigor–activity, and decreased TMD in spring (r = -0.547; r = 0.518; r = -0.541). Further, sideway view had correlations with decreased state anxiety in early summer (r = -0.723). Only "surrounding place" correlated with decreased tension–anxiety in spring (r = -0.573).

Table 20. Seasonal images of park therapy components

Season	**Linguistic Knowledge**									**Self-orientation**	**Social meaning**
	Landscape Element (%)						**Therapeutic Feeling (%)**				
	Gr	**Tr**	**Wa**	**La**	**Ac**	**Pe**	**Co**	**Re**	**Br**	**Sp**	**Rs**
Winter	0	50	33.3	0	0	16.7	25	41.7	0	8.3	8.3
Spring	33.3	8.3	75	0	25	41.7	0	0	0	50	58.3
Summer	58.3	0	25	25	0	0	0	8.3	25	16.7	16.7

p-value	0.008**	0.004**	0.031*	0.038*	0.038*	0.034*	0.038*	0.015*	0.038*	0.045*	0.014*

*p< 0.05, **p < 0.01, ***p < 0.01, Gr: greenery, Tr: trees, Wa: water, La: lawn, Ac: activity, Pe: people, Co: comfortable, Re: relaxed, Br: Broad, Sp: surrounding place, Rp: recreational space

Table 21. Matrix of correlation of park therapy images and physiological-psychological responses.

Park Therapy Images / Physiological/ psychological responses		Linguistic Knowledge									
		Landscape element						Therapeutic Feeling	Spatial View		Self-orientation
		Gr	**Fl**	**Ac**	**Wa**	**Bi**	**Pe**	**Qu**	**Bv**	**Sv**	**Sp**
Heart rate		-	-	o*	Δ*	□*	o**	-	-	-	-
Blood pressure	Systolic blood pressure	-	-	-	-	o*	-	-	-	-	-
	Diastolic blood pressure	-	Δ*	o*	-	-	-	-	-	-	-
Mood state	Confusion–bewilderment	-	-	-	-	-	-	-	Δ*	-	-
	Tension–anxiety	-	-	-	-	-	-	-	-	-	o*
	Vigor–activity	o*	-	-	-	o*	-	Δ**	o*	-	-
	Total Mood Disturbance	-	-	-	-	o*	-	-	o*	-	-
	State anxiety	-	-	-	-	o*	-	Δ**	-	Δ**	-

*p< 0.05, **p < 0.01, ***p < 0.01, Gr: greenery, Fl: flower, Ac: activity, Wa: water, Bi: bird, Pe: people, Qu: quiet, Bv: bird's eye view, Si: sideway view, Sp: surrounding place, □: winter, o: spring, Δ: summer

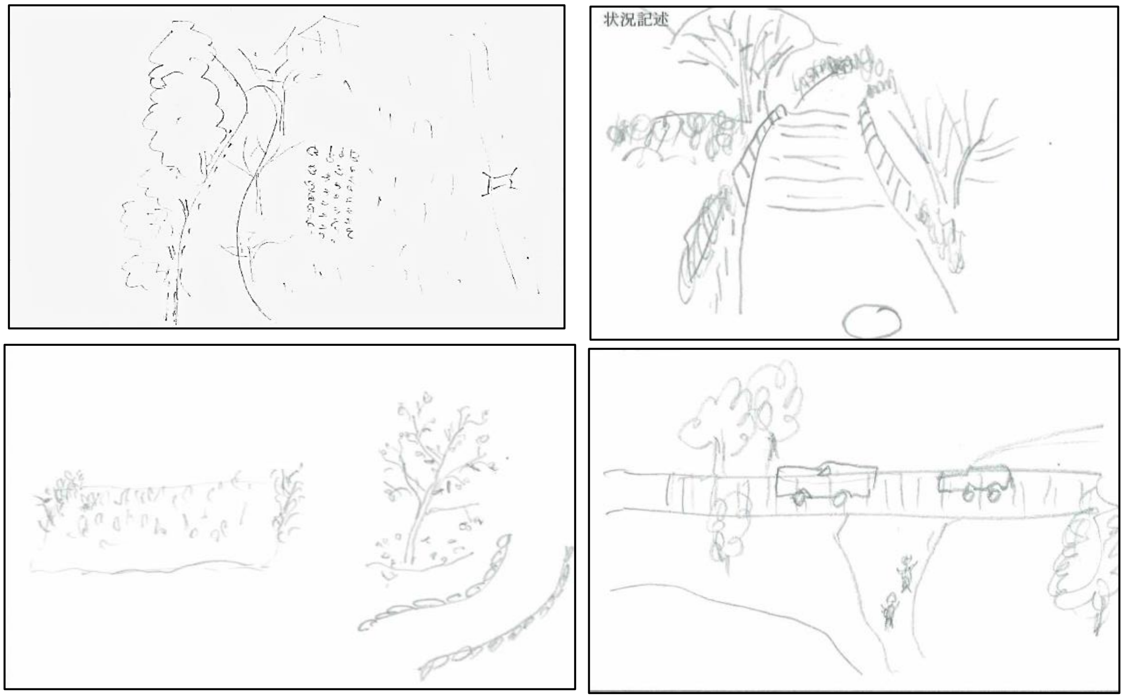


Figure 36. Park therapy image sketches in winter.

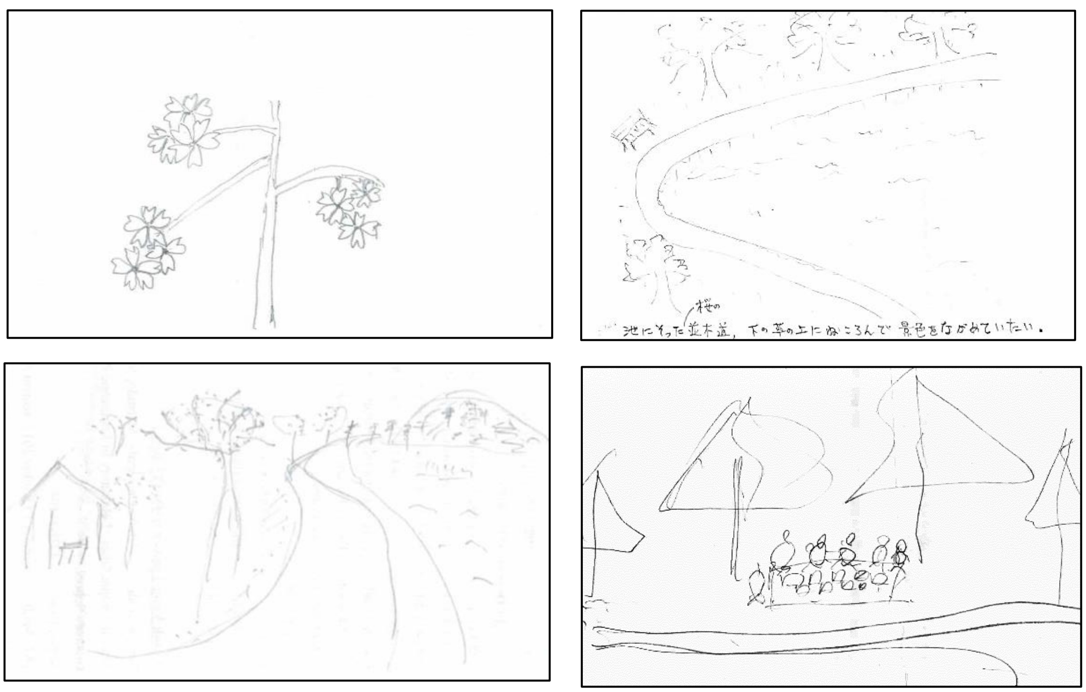


Figure 37. Park therapy image sketches in spring.

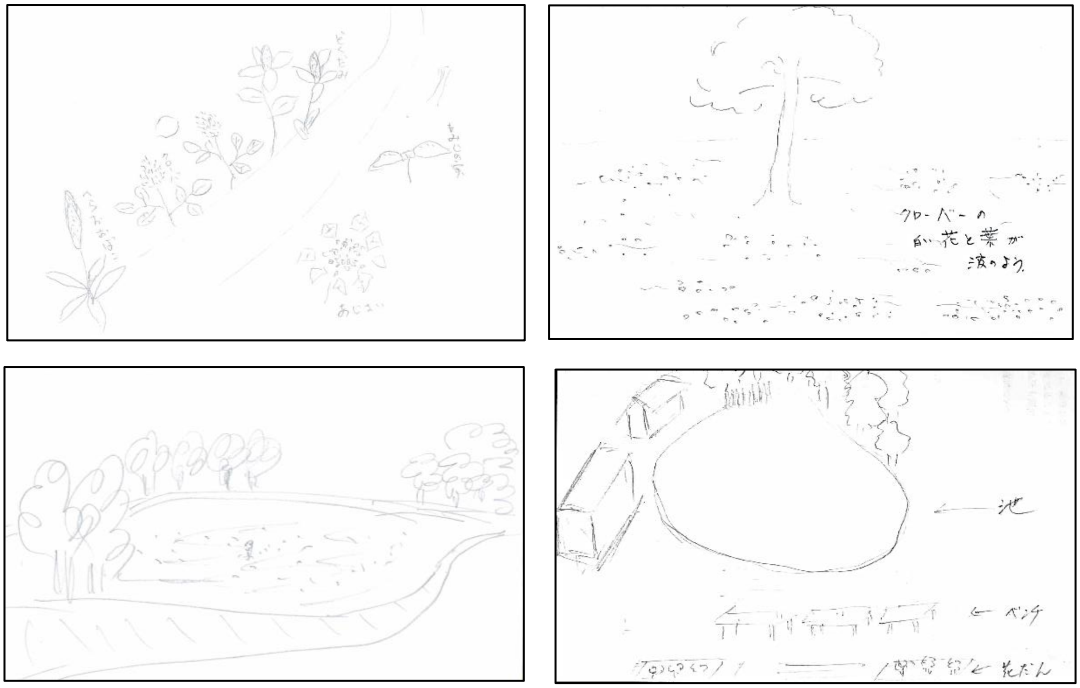


Figure 38. Park therapy image sketches in summer.

In order to obtain complete landscape images and investigate seasonal verbal data, quantitative content analysis was applied. Co-occurrence network analysis showed the centrality of the particular node. The terms of the highest degree centrality found during seasonal park therapy were “to see” and “to bloom” (Figure 37). In the winter, the term “good feeling” was strongly associated with “forest bath,” “nature,” “large,” “flower bed,” “bench,” “pleasant,” “one,” “every month,” “time,” and “all.” In spring, the term “cherry blossom” was associated with “cherry blossom viewing,” “photography,” “exercise,” “today,” “to enter,” “few steps,” “to take,” and “grandchild.” In the summer, the term “grass” was associated with “new edge,” “impressive,” “landscape,” “to play,” “under the tree, “to grow” (Figure 38).

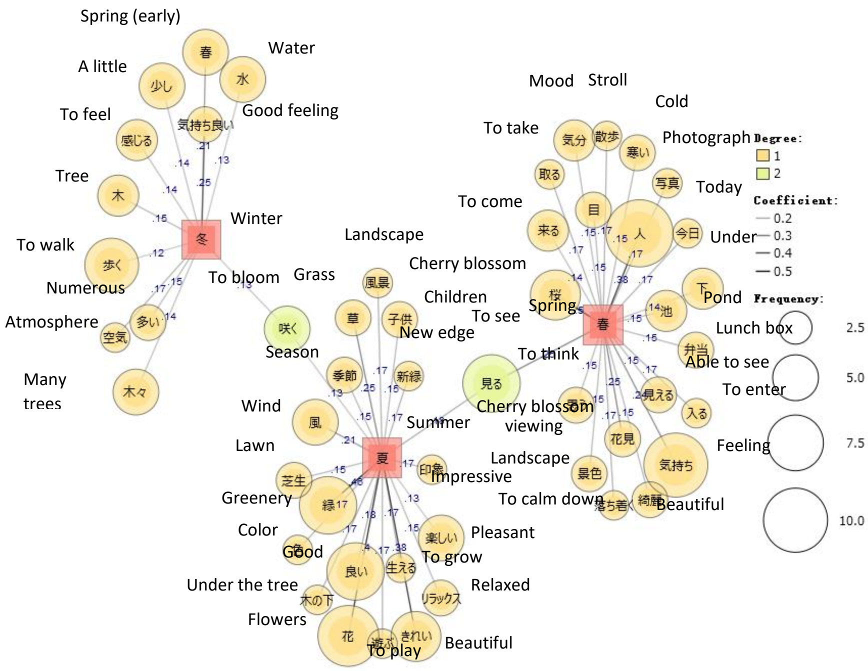


Figure 39. Seasonal Co-occurrence Network of park therapy images.

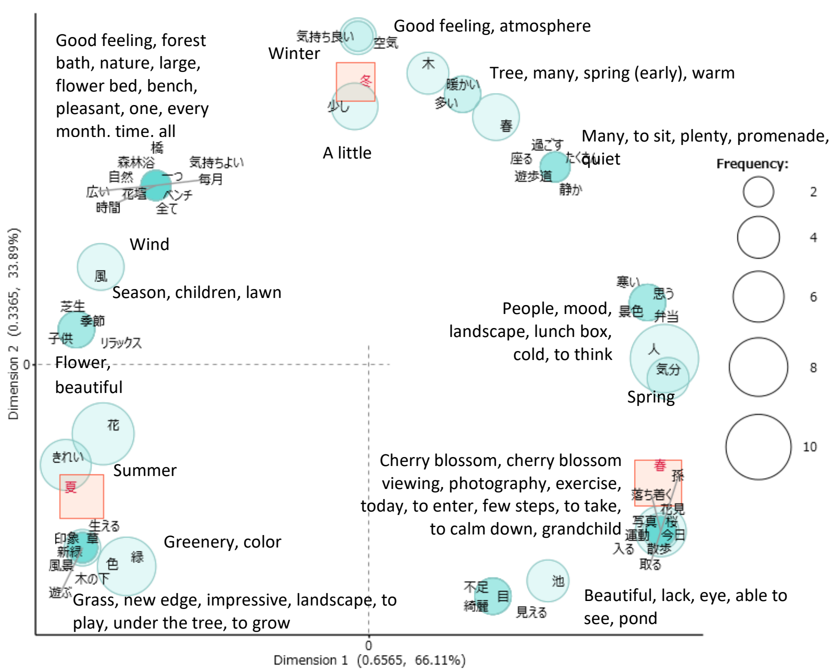


Figure 40. Seasonal Correspondence Analysis of park therapy images.

6.1.4 Discussion

This study elucidated the physiological and psychological effects among middle-aged and older adults after taking brief walks through an urban park, sketching park therapy images, and deducing correlations between park therapy images and physiological-psychological responses during winter, spring, and early summer. The main findings indicated that, compared to city walking, participants experienced a lower heart rate after 11-min of walking in an urban park in spring and 15-min of walking in winter and early summer. Further, participants experienced lower blood pressure after 11-min of walking in spring. In spring, a higher elevation in positive mood of vigor–activity was detected. Lower negative mood of confusion–bewilderment was detected in winter and early summer. Lower depression–dejection and total mood disturbance were found in winter and spring. Lower anger–hostility, fatigue–inertia, and tension–anxiety were found in early summer. Lower state anxiety was found in all seasons. In winter, a notable elevation in positive mood (vigor–activity), decline in negative mood (fatigue–inertia), total mood disturbance, and state anxiety was only noted with post-walking compared with pre-walking.

The results were compared with those of a prior study in which the participants view urban parks. The proportion of participants exhibiting positive physiological response in heart rate was higher during walking in urban parks (66.7%) than during viewing urban parks (16.47%) in both spring and summer, yet the significant difference was not found. The proportion of participants exhibiting positive physiological responses in systolic and diastolic blood pressures was significantly higher post-spring walking in urban parks (91.7%) than post-viewing (83.3%), and higher post-early summer viewing urban parks (75%) than post-walking (50%, 66.7%); there was no significant difference. In previous forest therapy studies on middle-aged hypertensive males, heart rate was significantly lower while walking (Song et al. 2015) and viewing a forest landscape than those in a city area (Song et al. 2017). Heart rate was lower while viewing a forest landscape than while walking. This indicated that viewing a forest landscape could serve higher immense comfort than walking in a forest landscape. It was partly consistent with the current study results on middle-aged and older adults. Moreover, the proportion of participants exhibiting positive psychological responses in total mood disturbance was higher post-spring walking in urban parks (91.7%) than post-viewing (66.7%) and equal between post-early summer walking and viewing in urban parks. Whereas, the proportion of participants exhibiting positive psychological responses in state anxiety was higher post-viewing urban parks (75%, 91.7%) than post-walking (66.7%, 75%) in spring and early summer respectively. Nevertheless, a significant difference was not found in psychological response comparison. Previous forest therapy studies also reinforced that the scores of the negative moods were lower, while the scores positive mood was higher post-viewing a forest landscape than post-walking in city area on middle-aged hypertensive males (Song et al. 2015), as well as lower total mood disturbance on young males (Park et al. 2011) and state anxiety on young women (Song et al. 2019)

Brief walking in the urban park was more beneficial in cardiovascular health than walking in the city in winter, spring, and early summer. Forest and park therapy studies have reported significantly decreased blood pressure (Park et al. 2009; Lee et al. 2009; Tsunetugu et al. 2013; Pratiwi et al. 2019) and heart rates (Matsuba et al. 2011; Song et al. 2013, 2014, 2015; Igarashi et al. 2015). Moreover, the activity of viewing blooming flowers as the stimulus called flower therapy, reduced heart rate, and pulse rate (Ikei et al. 2013). As in winter, results of blood pressure measurements in early summer were not significant while walking in the two environments, although lower blood pressure after walking in the urban park compared with those in city area was observed. This could be due to environmental stimuli (typical landscape characteristics, lower temperature in winter, intensity of sunlight in summer, visitor walking through, park staff's maintenance activity, as well as immediate activity and noise) might affect blood pressure measurement (Lee et al. 2019; Lyu et al. 2019).

According to two psychological evaluations, walking in the urban park led to psychological health which was observed in all seasons. We found that only positive mood of vigor–activity escalated in the urban park in spring, while the negative moods of confusion–bewilderment decreased in the urban park in winter and early summer, depression–dejection and total mood disturbance in winter and spring, anger–hostility, fatigue–inertia, tension–anxiety in early summer, and state anxiety in all seasons. The significant mood changes in fatigue–inertia, vigor–activity, and total mood disturbance were discovered post-walking compared with pre-walking in the urban park in winter. As previous forest and park therapy studies described that a significant difference in moods (e.g., decreased negative moods, increased positive mood) and state anxiety after walking in the urban parks (Song et al. 2013, 2014, 2015, 2019a, 2019b). Park stimulations which were experienced in spring such as walking, viewing cherry blossoms, pond, and forest, as well as watching people's activities under cherry trees led to higher positive moods than those in winter and early summer (Song et al. 2014; Yu et al. 2017; Pratiwi et al. 2019; Lyu et al. 2019). These results indicate that a 15-minute walk in winter and early summer and an 11-minute walk in spring have physiological and psychological merits for middle-aged and older adults, which were congruent with previous studies implemented in other sites in Japan, China and Taiwan (Li et al. 2016; Yu et al. 2017; Matsunaga et al. 2011; Igarashi et al. 2015; Goto et al. 2016; Mao et al. 2017).

By analyzing verbal and visual LIST data, prominent landscape elements were detected through the brief winter, spring, and early summer walks. Park therapy images related to "trees," "comfortable" and "relaxed" feelings during winter, "water", "activity", "people", "surrounding place," and "recreation place," during spring, "greenery", "lawn", and "broad" during early summer. The most dynamic landscape components were plants with their colors and quantities of leaves in seasonal dynamics—trees (50%) were the most sketched landscape element in winter and greenery (58.3%) in early summer. This seasonal dynamic determines characteristics of park coloring in which optical and climatic factors act as specific filters that influence the perception of park landscape coloring (Oleksiichenko et al. 2018). Park therapy without human activity inside the urban park encouraged more comfortable and relaxed feelings (Song et al. 2013, 2014, 2015; Ochiai et al.2015). Through park therapy image analysis, relationships between perceived landscapes and participants' physiological-psychological responses became clear. Bird's existence in the urban park was one of the factors which had correlations with most of the physiological and psychological benefits. According to Ratcliffe et al. (2013), bird songs and calls were found as one of natural sounds most commonly associated with stress recovery and attention restoration. In further quantitative text analysis, "good feeling" was the centrality of landscape images in winter, "cherry blossom" in spring, and "greenery" in early summer. These texts had the highest centrality degree, with the words associated being interconnected and playing an essential role in the people-nature relationship (Min et al. 2019). In spring, various stimuli influenced the number of the text mining results; subjects used their senses to describe activities, landscape elements, and impressions found through the park therapy program. Descriptive verbal data stressed that results of text mining were consistent with results of verbal data and visual data keywords and were capable of detecting centrality of a landscape images. These findings provide scientific evidence that urban green spaces do not only have a social and environmental benefits, but also play a vital role in both mental and physical health—considered factors for life satisfaction (Diener and Biswas-Diener 2008; Abdullah and Zulkifli 2016).

This study exhibit that evidence-based brief walking through deciduous trees, cherry blossoms, and fresh greenery in a nearby urban park and its park images led physiological and psychological relaxation as well as landscape appreciation. As many urban park studies indicate, this finding reinforces the fact that simple physical activities such as walking in a nearby urban park can decrease anger–hostility, confusion–bewilderment, depression–dejection, fatigue–inertia, tension–anxiety, total mood disturbance, and anxiety level, and increase vigor–activity. The various effect of physiological and psychological benefits of the park walking might be stimulated by physical variables (e.g., temperature, relative humidity) and seasonal landscape characteristics such as greenery, flower, bird, physical activity, tranquility, middle distance in viewing scenery, and dense surrounding vegetation. This study's findings suggest that walking in the urban park during different seasons with seasonal landscape elements could be considered in the park program to enhance senior citizen's quality of life. The findings might be useful for special reference of design considerations of park therapy road, especially in feature of park landscape, namely 1) accessible walking course among tree stands or thinned forest, 2) medium distance as suitable views of distance zone, 3) diversity of seasonal landscape changes (e.g., greenery, flower, bird, water, lawn, physical activity) so that park user could feel tranquil in the park.

Our study has several limitations. First, the main limitation is substantial risk of "memory effects" with the tests (walking and seated viewing) carried out over the same period. Second, we had a limited number of participants of a walking experiment in each season. Therefore, further study using larger samples of middle-aged and older adults and a randomized controlled trial of city citizens is involved to promote these findings. Third, this study was conducted to clarify the physiological and psychological effects of walking in urban parks with seasonal landscape characters. Because experiments were conducted on the same walking course and duration of walking sessions in winter and early summer and different walking course and duration of the walking session in spring, differences might have influenced the results. Forth, parameters applied only physiological parameters of blood pressure and heart rate, psychological parameters of POMS and STAI, and landscape perception of LIST. Another parameter, such as landscape preference using geo-tagged photographs or virtual reality (VR) method could be integrated into physiological and psychological study for advanced findings. All limitations must be addressed in future research.

6.1.5 Conclusion

This study provided significant scientific evidence of the physiological and psychological relaxation effects of walking in an urban park and correlate park therapy images accordingly. Walking in urban parks resulted in 1) significant decreases in heart rates in winter, spring, and early summer, 2) significant decreases in blood pressure in spring, 3) significant decreases in confusion–bewilderment in winter and early summer, depression–dejection in winter and spring, anger–hostility, fatigue–inertia, and tension–anxiety only in early summer, 4) significant decreases in total mood disturbance in winter and spring, 5) significant increases in vigor–activity in spring, and 5) significant decreases state anxiety in winter, spring, and early summer. In winter, park therapy image exhibited the people-nature relationship with “trees,” “relaxation” and “comfort,” describing good feelings as psychological benefits of park therapy. In spring, park therapy image exhibits landscape elements, self-orientation, and social meaning of place, namely “water”, “activity”, “people”, “surrounding place”, and “recreational space”, wherein cherry blossom-viewing became significant as a traditional Japanese way of appreciating nature. In early summer, park therapy image exhibits landscape openness such as “greenery”, “lawns,” and “broad,” in which beautiful fresh greenery, thick grass, and green lawn display intense color. The correlation among park therapy images and physiological-psychological responses were high in “birds” as indicator creatures in landscapes, “bird’s eye view” as middle distance to view the landscapes, greenery as an important park feature in order to experience relaxation, and other components such as flowers, activity, water, people existence, tranquility, sideway view, and surrounding place. Evidence-based special features of park landscape, namely 1) accessible walking course among tree stands or thinned forest, (2) medium distance as suitable views of distance zone, (3) diversity of seasonal landscape changes (e.g., greenery, flower, bird, water, lawn, physical activity) are suggested onto design considerations of park therapy road. Park images during the experiment period provide impressive and preferable park elements, suitable views, orientation and sense of place in the park. Furthermore, our findings also propose participatory planning and design through middle-aged and older adults’ perception and experience of park therapy for sustainable landscape development, especially senior citizen-friendly urban parks.

6.2 Physiological and Psychological Effects of Viewing Urban Parks in Different Seasons in Adults

6.2.1 Introduction

Aging and population growth have led to increasing cases of atherosclerotic vascular disease worldwide. As of 2015, almost 26.6% of Japan's population was over the age of 65, exceeding Sweden (19.9%) and Italy (22.4%). This indicates that Japan's aging population is progressing rapidly when compared to European countries (UN 2018). In 2050, 37.7% of the Japanese population will be over the age of 65. Since the 20th century, strokes have been found to be highest cause of death in Japan. The main trigger for strokes is raised blood pressure or hypertension (WHO 2010). Turning one's attention to forest bathing as a natural and low-cost activity is believed to alleviate stress-related diseases through plant-derived physiological relaxation (Tsunetsugu et al. 2010). This approach aims at "preventive medical effects" that induce physiological relaxation and improve immune functions to prevent diseases (Park et al. 2009; Lee et al. 2009; Park et al. 2010; Matsuba et al. 2011; Lee et al. 2012; Song et al, 2013, 2014, 2015; Igarashi et al. 2015; Miyazaki et al. 2015; Ochiai et al. 2015; Song et al. 2017).

Studies demonstrated how brief walks in parks and forest environments reduced stress states and stimulated physiological and psychological relaxation. Studies on healthy young adults exhibited that brief walks in park and forest environments could reduce blood pressure (Park et al. 2009) pulse rate (Matsuba et al. 2011), heart rate (Song et al. 2013, 2014, 2015), and increase the natural logarithm of the high-frequency component of heart rate variability (Park et al. 2010; Lee et al. 2012; Miyazaki et al. 2015). Forest and park therapy generated a significant increase in parasympathetic nervous activity and a significant decrease in sympathetic nervous activity [6,9]. Walking in urban parks leads to vigor (Song et al. 2013, 2014, 2015), comfort, calmness, and accordance with nature (Matsuba et al. 2011), and significant decreases in tension, anger, fatigue, depression, confusion, and anxiety (Song et al. 2013, 2014, 2015).

Several studies have investigated the effects of forest views in inducing physiological relaxation and reducing stress states in healthy young populations. The effect of viewing an urban forest landscape resulted in salivary cortisol concentration, pulse rate, and diastolic blood pressure in young males when compared with viewing urban landscapes (Lee et al. 2009). Moreover, viewing a forest for 10–15 minutes significantly increased parasympathetic nervous activity and significantly decreased the heart rate of middle-aged hypertensive men (Song et al. 2017). This forest therapy method improved mood, heightened the positive impact, induced a feeling of subjective restoration and vitality for young male university students (Park et al. 2011), and led to lower anxiety levels for young women (Song et al. 2019). The increasing scientific evidence on physiological relaxation improves human immune function recovery, prevents illnesses, and maintains and promotes health through exposure to nature (Lee et al. 2012; Miyazaki et al. 2015).

Not all urban inhabitants have access to a natural forest. However, most cities and urban areas have a pocket of nature, such as a block park, neighborhood park, urban park, or urban forest, where there are plants that offer a relaxation benefit to people. Parks are valuable natural environments within a city. Most citizens across all ages have access to their preferred nearby parks (Pratiwi et al. 2019). In a study of park and garden landscape, Hofmann et al. described that gardening as model activity was an effective means of mitigating the harmful effects of chronic stress among Swiss citizens (Hofmann et al. 2017). Ng et al. (2018) suggested that horticultural therapy could potentially be useful for reducing inflammation and protecting neuronal functions for healthy Asian elderly adults. Xie et al. (2018) enforced the role of parks in supporting healthy aging, finding that older adults with best access to parks experienced lower odds of cardio-cerebral vascular diseases, joint diseases, and endocrine diseases than other citizens with the least access to the parks. Additionally, the identified essential barriers to physical activity and park use (e.g., busy activity, lack of social support, weather-related concerns, and the fear of injuring oneself) will inform the design of a Park Prescription intervention in promoting physical activity, park use, as well as physical and mental well-being (Uijtdewilligen et al. 2019).

In a study of real-time park therapy, Igarashi et al. described that viewing a kiwifruit orchard landscape for 10 minutes resulted in induced physiological and psychological relaxation, such as a significant increase in the parasympathetic nerve activity; a significant decrease in heart rate; a significant increase in comfortable, relaxed, and natural feelings; and significant improvements in mood states for adult females (Igarashi et al. 2015). Viewing a hospital rooftop forest for 12 minutes led to autonomic sensitivity to the forest's natural elements and sufficiently relaxed older female patients (Matsunaga et al. 2011) Viewing a Japanese garden for 15 minutes reduced heart rate and improved the behavioral system in Japanese patients with dementia (Goto et al. 2016). In another cross-cultural study, viewing different garden styles (e.g., Japanese garden, architectural garden, and landscape garden) induced psychological, emotional, and healing values among young Canadian and Japanese university students. Parasympathetic nervous activity increased in viewing the landscape garden, as the most natural-looking (Elsadek et al. 2019). Most of the evidence-based studies have shown that the physiological and psychological benefits of walking or viewing in a forest and park landscape with varied environmental factors, including the type of natural environment, landscape design, as well as cultural differences, play a role in human interaction with the landscape. However, it might be difficult for middle-aged and elderly residents to visit natural forests due to lack of mobility, opportunity, and time. The effect of different seasons of park therapy in viewing urban parks—in this case, viewing cherry blossoms as the significant flower in Japan and fresh greenery in nearby urban parks—on middle-aged and elderly residents has been rarely investigated.

In Japan, a large part of the country is populated by forest, in which trees are particularly revered. Therefore, Japan's forest area represents the relationship of "man in harmony with nature" (Miyazaki et al. 2018). We developed an evaluation of the physiological and psychological effects of a viewing experiment in spring and summer; the city's prevailing climate is a major factor in the intensive use of the park. There is a seasonal visitor pattern in peak season, which is higher than the beginning and the end of the season (Ter 2011). Participants viewed Yoshino cherry (*Prunus yedoensis*) in spring and Katsura tree (*Cercidiphyllum japonicum*) in early summer in a large urban park in Matsudo, Chiba Prefecture, Japan. Yoshino cherry has been the most widely planted cherry species since the late 19th century (Aono and Kazui 2008), whereas Katsura tree is an indigenous shade deciduous tree which is now only sporadically found in China and Japan (Dosmann et al. 2000). Matsudo city is a beautiful city suburb of Tokyo. A natural environment such as the Forest and Park for the 21st Century (FPC) within the urbanized city still exists and is well managed every season.

This study aimed to clarify (1) the physiological relaxation effects and (2) the psychological relaxation effects of remaining sedentary while viewing cherry blossoms in spring and fresh greenery in early summer. The former was examined by measuring blood pressure and heart rate, whereas the latter were evaluated by assessing the Profile of Mood States (POMS) and State-Trait Anxiety Inventory (STAI). The general hypothesis was that there would be a significant difference in the psychological and physiological effects of seated viewing in an urban park and in a city area, as well as before and after the seated viewing.

6.2.2 Methodology

6.2.2.1 Experimental Sites

A field experiment was conducted from March to June 2019 in the FPC, Matsudo, Chiba Prefecture, Japan (Figure 39). Route 6 of Mabashihigashi, Matsudo, Chiba Prefecture was the urban area selected as the control site (Figure 40). The distance between the forest park and urban area was 2.8 km by car. The selection criteria for the urban park and city area were 1) safety, 2) well-maintained park or forest area, and 3) city areas located near downtown (Song et al. 2019a, 2019b). The FPC is large, spanning an area of 50.5 hectares with six types of sightseeing routes of natural landscape elements like ponds, farms and paddy fields, lawns, forests, wild grass gardens, and flower gardens. There were two viewing spots with the view of cherry blossoms in the viewing point, pond in the short distance, and forest in the medium distance in spring, as well as fresh greenery (Katsura tree) in the viewing point, pond in the short distance, and forest in the medium distance in early summer (Figure 41). The selection criteria for viewing spots included 1) shady refuge and 2) significant trees in the surroundings. The average temperature and relative humidity of the urban park and city area in spring and early summer are presented in Table 22.

Table 22. Average temperature and relative humidity of seated viewing experiment.

	Spring	**Summer**
Experimental Period	March 28–April 3 2019	May 30–June 6 2019
Temperature (°C) (mean ± SD)	Park: 14.4 ± 2.8 City: 13.4 ± 2.9	Park: 26.73 ± 2.64 City: 26.73 ± 1.53
Relative humidity (%) (mean ± SD)	Park: 45.4 ± 18.1 City: 40.6 ± 14.2	Park: 50.2 ± 10 City：52 ± 5.71

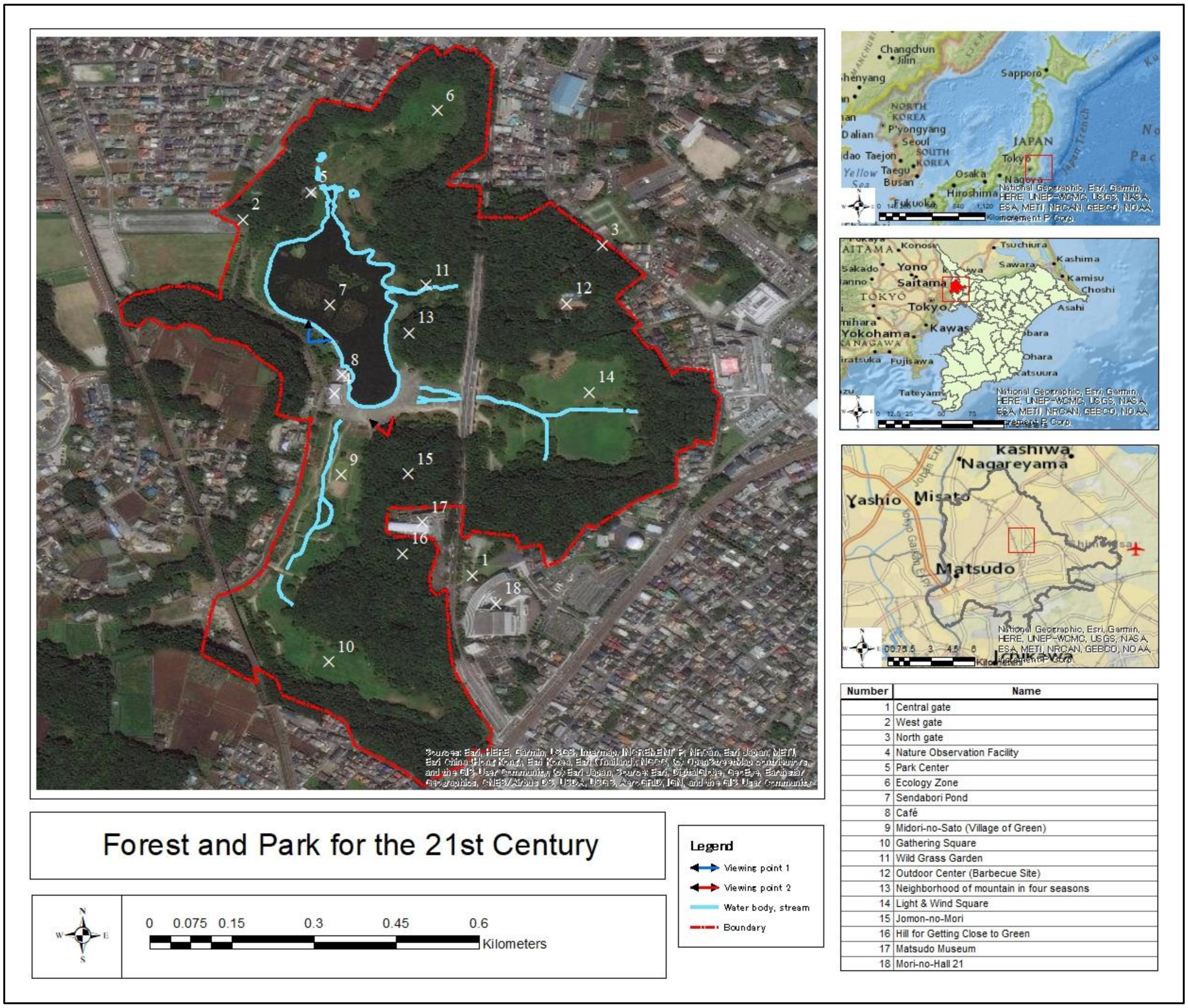


Figure 41. Experimental site for viewing points.

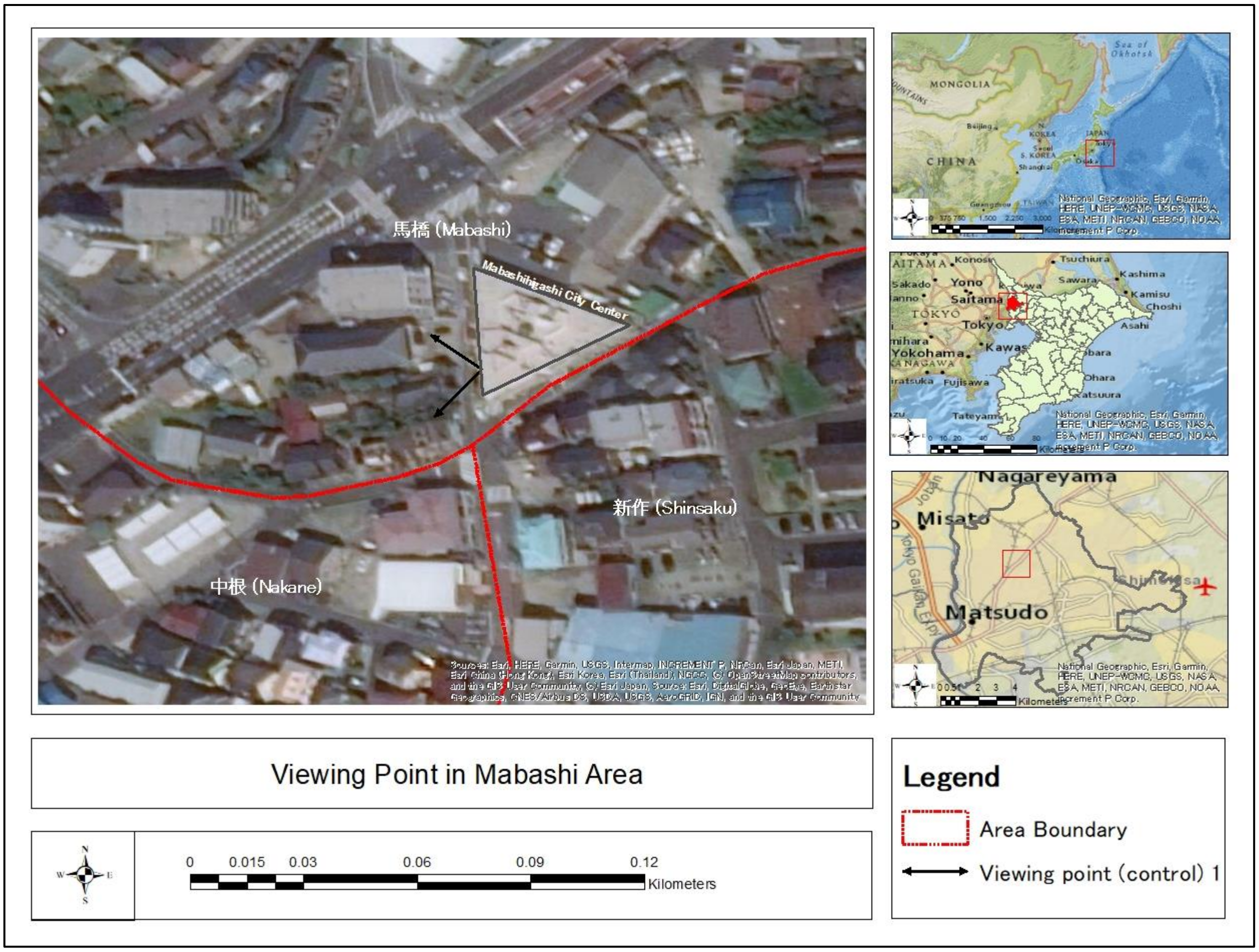


Figure 42. Control site for viewing point

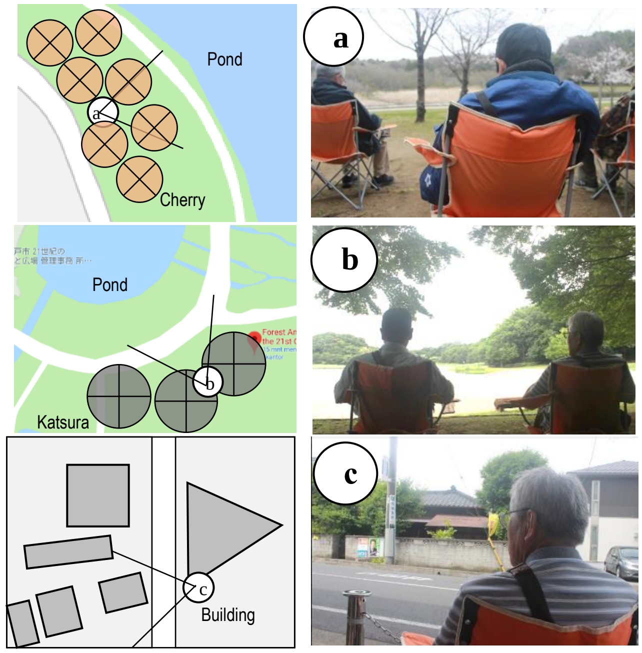


Figure 43. Schematic and photographs displaying the seated viewing scenes: (a) urban park site in spring, (b) urban park site in early summer, and (c) city area site.

6.2.2.2 Participants

Six middle-aged females and six males (mean age, 66.4 ± 10.5 years) participated in the spring experiment, and seven females and five males participated in the early summer experiment (mean age, 65.8 ± 10.1 years, Table 23). A snowball sampling method was used to select key informants who were in close vicinity to the FPC. We asked two key informants, both male and female. Interviews were conducted to ensure the experiment day and participation. The key informants collected the participants living in Tokiwadaira, Mabashi, and Koganehara Areas. Study aims and procedures and eligibility criteria for participants in the form of flyers and guidance handouts were delivered to the key informants. The participants' eligibility criteria were: 1) middle-aged and elderly over the age of 40, and 2) they were not taking blood pressure or heart rate medication. A total of 12 subjects per set of the experiment were sufficient to obtain significant information (Song et al. 2019a, 2019b). Additionally, the results of previous physiological studies have indicated that a sample size of 9–19 participants in the forest therapy experiment is sufficient to draw significant results (Ochiai et al. 2015; Lee et al. 2015; Song et al. 2017). Finally, 12 participants living in Tokiwadaira, Mabashi, and Koganehara Areas for each season were selected.

Respondents were briefed on the study's aims and procedures, and informed consent was obtained before the experiment. Alcohol, tobacco, caffeine, and food consumption were prohibited during the experiment, as was talking to other participants. The study was approved by the Ethics Committee of the Center for Environment, Health, and Field Sciences, Chiba University, Japan (Receipt code number: 18-06).

Table 23. Participant characteristics in seated viewing experiment.

Parameter	**Spring (*N* = 12)**	**Summer (*N* = 12)**
Age (years)	66.4 ± 10.5	66.8 ± 10.1
Gender		
Male	50%	41.7%
Female	50%	58.3%
Employment status		
No	66.7%	75%
Yes	33.3%	25%
Education		
Senior high school	25%	33.3%
University	16.7%	33.3%
Other	58.3%	33.3%
Income (JPY/month)		
Less than JPY 150,000	41.7%	58.3%
JPY 150,000–200,000	25%	25%
JPY 200,000–250,000	16.7%	-
More than JPY 250,000	16.7%	16.7%
Smoking behavior		
No	91.7%	91.7%
Yes	8.3%	8.3%
Alcohol use		
No	58.3%	50%
Yes	41.7%	50%
Sleeping time (hours)		

Parameter	Spring (N = 12)	Summer (N = 12)
Less than 7 h	66.7%	66.7%
7–9 h	33.3%	33.3%
Sport activity (times/month)	5 ± 5.5	7.6 ± 9.3
Shinrin-yoku (times)	6.6 ± 5	5.6 ± 8.5
Social attachment		
Sometimes	66.7%	50%
Often	25%	16.7%
Always	8.3%	33.3%
Participation in community (times/month)	1.6 ± 1.9	1.6 ± 2.8

6.2.2.3 Experimental Design

To eliminate the order effects, 12 participants were randomly divided into two groups in a day. One group consisted of 2–4 participants in a day. Each group went to the experimental viewing spot in the park or city area in the morning. If the number of participants in a day was less than four people, there would be only one group that participated in a day. At the beginning of the seated-viewing experiment, participants received guided orientations and completed questionnaires; their blood pressure was measured, and the monitoring of their heart rates began. On the day of the experiment, each participant viewed the park or city area in the morning for 11 minutes in spring and 15 minutes in early summer (Table 24). Participants returned to the waiting room and completed questionnaires; their blood pressure was measured, and the monitoring of their heart rates stopped. They ate lunch containing the same number of calories and rested for 30 minutes. The experiment was repeated in opposite sites. Participants viewed the shading of Yoshino-cherry (*Prunus yedoensis*) in spring and of Katsura tree (*Cercidiphyllum japonicum*) in early summer (Figure 42). They viewed the landscape of Sendabori pond in the short distance and forest in the medium distance on the designated viewpoint.

Table 24. Time schedules during the viewing experiment of park therapy in spring and early summer.

Time	Activities (Location)
08:30	Gathering at meeting point (in front of station building)
08:30-09:00	Dropping off to park park/city area by car
09:00-09:20	Orientation and signing of consent forms (resting room)
10:20–10:40	Pre-measurement of blood pressure and heart rate, POMS, STAI (resting room)
10:40–11:00	Seated-viewing experiment (park/city)
11:00–11:20	Post-measurement of blood pressure and heart rate, POMS, STAI (resting room)
11:20-12:00	Moving to the urban park/city by car
12:00-12:30	Having lunch (resting room)
13:30–13:50	Pre-measurement of blood pressure and heart rate, POMS, STAI, (resting room)
13:50–14:10	Seated-viewing experiment (park/city)
14:10–14:30	Post-measurement of blood pressure and heart rate, POMS, STAI (resting room)

Figure 44. Seated-viewing experiment site in Forest and Park for the 21st Century: (a) cherry-blossom-viewing in spring; (b) leisure activities in summer

6.2.2.4 Physiological and Psychological Indices

Heart rate was measured as a physiological response using a heart rate sensor (MyBeat WHS-3, Union Tool, Tokyo, Japan), whereas blood pressure was measured using a digital sphygmomanometer (Omron HEM-1021, Omron Corp., Kyoto, Japan). Two psychological scales, namely, the shortened Japanese version of the Profile of Mood States (POMS) and the State-Trait Anxiety Inventory (STAI), were delivered before and after the experiment. POMS, which was used to evaluate psychological responses to park viewing, comprised 35 adjectives, following six subscales: "anger–hostility" (A–H), "confusion–bewilderment" (C–B), "depression–dejection" (D–D), "fatigue–inertia" (F–I), tension–anxiety" (T–A), and "vigor–activity" (V–A). The total mood disturbance (TMD) score was calculated by combining A-H + C–B + D–D + F–I + T–A – V–A. A high TMD score indicated unfavorable psychological state (Konuma et al. 2015; Hashim 2018). As this study aimed to examine participants' levels of anxiety influenced by park and forest environments, a Japanese version of the State-Anxiety part of STAI was used to measure state anxiety. State anxiety comprises 20 adjectives (Spielberg and Sarason 1985; Iwata et al. 1998).

6.2.2.5. Data Analysis Procedures

Physiological and psychological data from 12 participants were analyzed. A paired t-test was used to compare mean physiological indices between the urban park and the city area, as well as before and after viewing in the urban park in each season. The Wilcoxon signed-rank test was applied to examine differences in reported psychological indices. All statistical analyses were performed using SPSS 26 (IBM Corporation, Armonk, NY, USA).

6.2.3 Results

6.2.3.1 Participant Characteristics

The mean age of the participants was 66.4 ± 10.5 in spring and 66.8 ± 10.1 in summer (Table 25). The composition of gender was almost the same: 50% of males and 50% females in spring, 41.7% males, and 58.3% females in summer. Most of the participants (N = 24) were retired (70.83%), while the remaining participants were employed. Participants' education background varied from senior high school, to university, and others. Half of the participants (N = 24) had an income of less than JPY 150,000/month (50%). Most of the participants did not smoke (91.7%) and had sleeping time less than 7 h (66.67%); nearly half of them did not drink alcohol (54.1%).

They engaged in sports activity six times and shinrin-yoku six times in a month. About 58.3% (*N* = 24) had a medium level of social attachment to their neighborhood, with two times of participation in the community in a month.

6.2.3.2 Assessment of the Reliability of Physiological and Psychological Indices

Table 25 shows the internal consistencies (Cronbach's alphas) of physiological and psychological indices among twelve subjects in spring and summer. The alpha reliability of physiological indices of heart rate in spring and summer was 0.815 and 0.824; for blood pressure it was 0.931 and 0.781, respectively. While the alpha reliability of the psychological response of the POMS score in spring and summer was 0.71 and 0.896, it was 0.896 and 0.933 for the STAI score, respectively. The results show that POMS and STAI had high internal consistency, while heart rate and blood pressure measures had reasonably good internal consistency. Therefore, all physiological and psychological indices had acceptable validity and reliability for this study.

Table 25. Verification of internal consistency of seated viewing experiment.

Indices	**Cronbach's α**	
	Spring	**Summer**
Heart rate	0.815	0.824
Blood pressure	0.931	0.781
POMS	0.71	0.896
STAI	0.896	0.933

6.2.3.3. Physiological Effects

Compared with seated viewing in the city, seated viewing in the urban park was found to result in lower blood pressure but a higher heart rate. The magnitude of health benefits of viewing in the urban park on adults differed by season. The mean blood pressure was lower in the urban park (129.1/76 mmHg; systolic blood pressure: $p = 0.003$; diastolic blood pressure: $p = 0.009$) than in the city (142.1/83.6 mmHg). A paired *t*-test showed that the mean values of systolic blood pressure in spring increased post-viewing compared with pre-viewing ($p = 0.001$). In early summer, blood pressure was lower after viewing in the urban park compared with the city (post-urban park viewing: 116.7/63.1 mmHg; post city area viewing: 125.8/72.9 mmHg). The only significant difference in diastolic blood pressure was noted in the two environments in early summer (p = 0.025). Figure 43 shows average systolic and diastolic blood pressure after the urban park and city area viewing in spring. Figure 44 shows average systolic and diastolic blood pressure after the urban park and city area viewing in early summer. In spring and early summer, the mean heart rates were higher when viewing in the urban park than those when viewing in the city (heart rate in spring urban park viewing was 76.52 bpm, city area viewing was 72.25 bpm; heart rate in summer urban park viewing was 71.97 bpm, city area viewing was 66.89 bpm;p= 0.023,p= 0.000). Figure 42 depicts the one-minute average heart rate during the urban park viewing in spring and early summer.

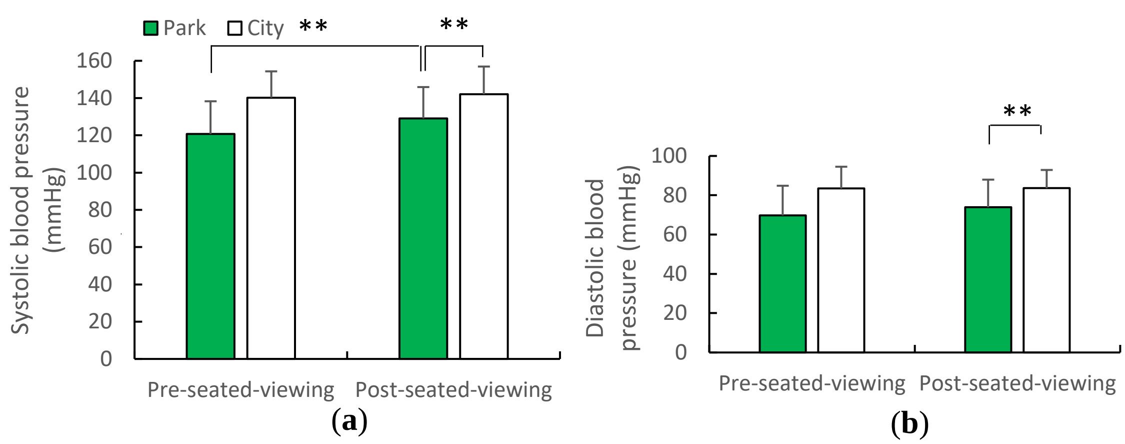


Figure 45. The average of blood pressure after urban park and city views in spring: a) systolic blood pressure and b) diastolic blood pressure. N = 12, mean ± standard deviation. **p< 0.01, determined by the paired t-test (two-sided).

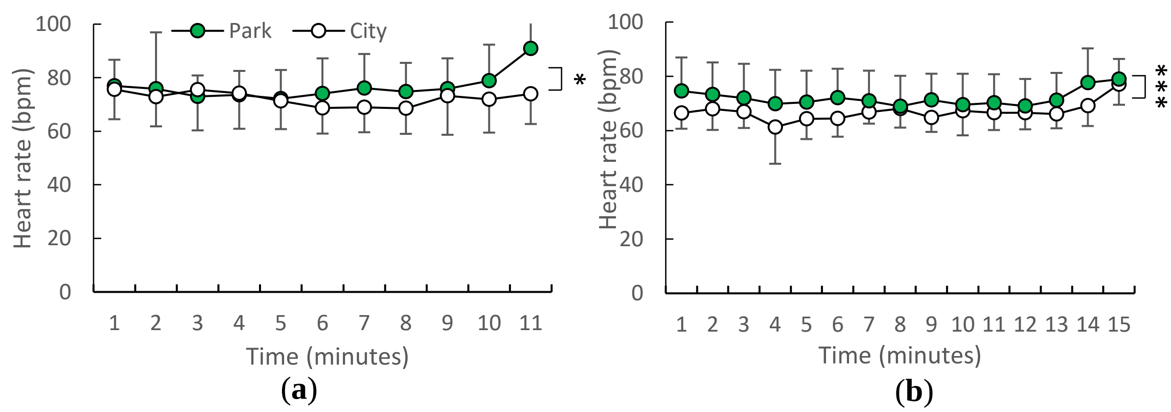


Figure 46. Average one-minute heart rate during urban park viewing in the: a) spring and b) early

summer. $N = 12$, mean ± standard deviation. *$p < 0.05$, ***$p < 0.001$, determined by paired t-test (two-sided).

6.2.3.4. Psychological Effects

In spring, a significant elevation of mood was only detected in the POMS test in the score for positive mood state "vigor–activity" ($p = 0.002$; Figure 45). The mean values of positive mood state "vigor–activity" increased in post-viewing compared with pre-viewing in an urban park (V–A:$p = 0.046$), whereas those of total mood disturbance decreased (TMD: $p = 0.009$; Figure 46). There was no significant difference in the change in mood state in early summer in the two environments between post- and pre-viewing. According to the STAI, middle-aged residents exhibited a greater reduction in anxiety levels after viewing in the urban park compared with the city area in summer ($p = 0.027$; Figure 47). The mean values of anxiety level decreased in post-viewing compared with pre-viewing in an urban park ($p = 0.017$). There was no significant difference in anxiety level in the two environments between post- and pre-viewing in spring.

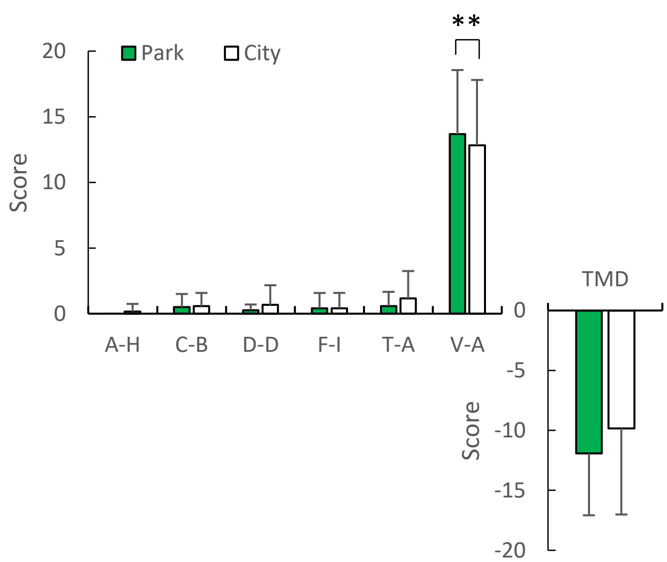


Figure 47. POMS scores after viewing in the urban park and city area in spring. A–H: anger–hostility; C–B: confusion–bewilderment; D–D: depression–dejection; F–I: fatigue–inertia; T–A: tension–anxiety; V–A: vigor–activity. $N = 12$, mean ± standard deviation. **$p < 0.01$, determined by the Wilcoxon signed-rank test (two-sided).

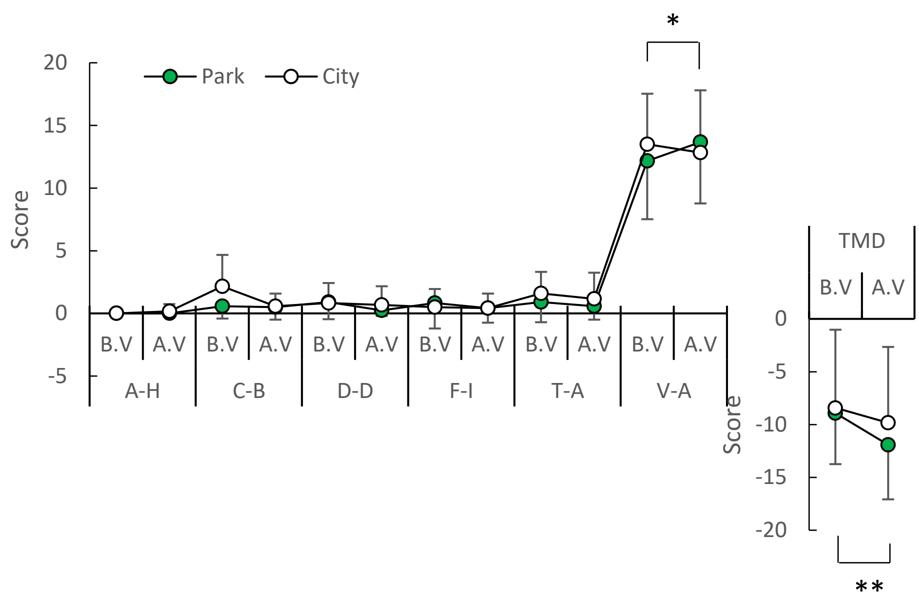


Figure 48. Comparison of POMS score pre and post-view in the urban park in the spring. A–H: anger–hostility; C–B: confusion–bewilderment; D–D: depression–dejection; F–I: fatigue–inertia; T–A: tension–anxiety; V–A: vigor–activity. *N* = 12, mean ± standard deviation. *$p < 0.05$, **$p < 0.01$, determined by the Wilcoxon signed-rank test (two-sided).

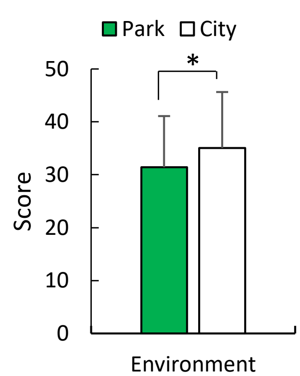


Figure 49. STAI score after seated-viewing in an urban park and the city in early summer. *N* = 12, mean ± standard deviation. *$p < 0.05$, determined by the Wilcoxon signed-rank test (two-sided).

6.2.4 Discussion

This study clarified the physiological and psychological effects of viewing in urban parks during different seasons among middle-aged and older adult residents. Findings exhibited lower blood pressure and higher heart rate in 11-minute seated viewing in an urban park in spring and

15-minute seated viewing in early summer. Positive mood state (e.g., vigor–activity) was significantly higher in spring, and anxiety level was significantly lower in the urban park when compared with the city in early summer. Compared with pre-viewing in the urban park, a significant increase in positive mood state (e.g., vigor–activity) and significant decreases in total mood disturbance in spring and anxiety level were observed post-viewing in early summer.

Both systolic and diastolic blood pressure were lower during a brief viewing session in the urban park compared with those in the city area in spring and early summer. Various studies have reported a significant decrease in blood pressure and heart rate in park and forest environments (Lee et al. 2009; Park et al. 2010; Lee et al. 2012; Miyazaki et al. 2015; Ochiai et al. 2015; Song et al. 2016, 2017). The results of blood pressure responses were in line with those from previous studies, which investigated the physiological responses to urban park seated viewing. However, the heart rate response was contrary to previous studies, and indicated a higher rate after urban park viewing. Ikei et al. (2014) found that looking at blooming flowers—which is also called flower therapy—decreased heart rate and pulse rate. By contrast, the higher heart rate after urban park viewing and lower blood pressure post-viewing in the urban park as compared to pre-viewing in spring might have been caused by the low temperature and the presence of cherry blossoms. Although the higher heart rate after urban park viewing in summer might be caused by water landscape, viewing cherry blossoms in spring significantly increases activity in the prefrontal area. The blooming Yoshino-cherry and human activity could have affected the activity of the prefrontal cortex, which was marked by the increased oxy-Hb concentrations in the prefrontal cortex. This study revealed that people felt excited when viewing cherry blossoms (Suda et al. 2001). In early summer, water bodies have a relative cooling impact on the evaporative procedure. Hence, evaporative cooling might be among the causes of passive cooling for the surroundings (Manteghi et al. 2015). The existence of a water feature can serve as an attractor and confounding variable (Ewert et al. 2018) and provide restorative benefits and stress reduction to garden users (Pouya et al. 2016). Both spring and early summer scenes containing water were associated with a significant positive effect and high perceived restorativeness (White et al. 2010). Viewing in the urban park was more effective in blood pressure reduction than viewing in the city (Matsuba et al. 2011, Ochiai et al. 2015; Song et al. 2017). Decreased blood pressure post-viewing in the urban park compared with pre-viewing was observed in early summer, but no significant differences were detected. The environmental stimuli in summer, such as exposure to the sun and mosquitos in summer, other people passing by, and sudden activity and noise, might have influenced the blood pressure measurement (Lyu et al. 2019).

We discovered that positive mood state such as “vigor–activity” increased in the urban park in spring, although the anxiety level declined in the urban park in early summer. Significant differences in “vigor–activity” and total mood disturbance were found post-viewing compared with pre-viewing in the urban park in spring. Various park therapy studies have reported a significantly decreased negative mood and anxiety level, as well as significantly enhanced mood after viewing urban parks (Song et al. 2013, 2014, 2015; Igarashi et al. 2015). Participants experienced more than one stimulation in spring compared with early summer, such as viewing cherry blossoms, the pond, and people’s activities under cherry blossoms in close-up view, and the forest in the distance. Increased stimulation led to higher positive moods through park therapy programs. These results are partly consistent with previous findings (Yu et al. 2017; Lyu et al. 2019; Saito et al. 2019). The magnitude of physiological and psychological benefits of the park through park therapy programs such as seated viewing were affected by temperature, exposure to the sun, and significant natural elements such as flowers, water bodies, and the coverage of greenery in the urban park. The present study demonstrated that among middle-aged and elderly residents, brief seated viewing of cherry blossoms and fresh greenery in a nearby urban park induced physiological and psychological relaxation. This could be developed into an effective park therapy program for middle-aged subjects in the early stages of age-related diseases such as hypertension and for elderly subjects to connect with nature and have social interaction, which contributes to stress relief and mental health improvement. This study’s findings suggest that the Japanese tradition of viewing Cherry blossoms in parks during spring with significant landscape features (e.g., flowers, water, and greenery) can be integrated into park therapy programs to improve moods and feelings. On the other hand, maintained woodlands with those landscape features as a view in the early summer can be proposed as a viewing point in which people can relax and feel tranquil from the shade. More studies should elevate local values and consider the accessibility and familiarity for the senior citizens. However, this study has limitations, first among which is the small number of subjects participating in park therapy in each season. It was not easy to find middle-aged participants who did not use blood pressure and heart disease medication and could participate in park therapy experiments for 4.5 h. To supplement these findings, more studies should be conducted using larger samples of middle-aged and elderly residents (more than 12 subjects) in order to draw more reliable and significant results. Second, physiological indices used only measured blood pressure and heart rate. Other physiological indices, such as eye movement and brain blood flow, are necessary for comprehensive findings. Third, this study was conducted in only one seated-viewing scene per season in an urban park. For future studies, more seated-viewing scenes per set of the experiment are required. These limitations must be considered in future research.

6.2.5 Conclusion

This study investigated the physiological and psychological relaxation effects associated with viewing park landscape. Viewing urban parks in spring and early summer resulted in (1) significantly lower blood pressures, 2) significantly increased vigor–activity in spring, 3) significantly decreased total mood disturbance in spring, and 4) significantly decreased anxiety levels in early summer. These findings could be used for park therapy programs for middle-aged and older adults in urban parks during spring and early summer. The composition of park therapy scenes might be arranged by considering the significant natural elements (e.g., flowers, water bodies, and maintained greenery) as input for therapeutic park design to provide higher value of relaxation benefits. In this way, nearby urban park usage is promoted, and lifestyle diseases are prevented.

6.3 Psychophysiological Effects of Park Therapy Program in Young Japanese and Indonesian Adults

6.3.1 Introduction

Noncommunicable diseases (NCDs) are the leading causes of human mortality globally. The four main NCDs are defined by the World Health Organization (WHO) as cardiovascular diseases (CVDs), cancers, diabetes, and chronic respiratory diseases (WHO 2014). Asia, a region that is home to nearly half of the world's population, accounts for 54% of global deaths from NCDs (WHO 2014). In 2016, 78% of all NCD deaths, and 85% of premature adult NCD deaths, occurred in low- and middle-income countries. The probability of premature adult NCD mortality also varies by WHO region, with a greater probability observed in the African (22%), Eastern Mediterranean (24%), and South-East Asian (23%) regions than in the Americas (15%), European (17%), and Western Pacific (16%) regions (WHO 2018).

In 2018, the WHO launched a global action plan, the 2030 Agenda, to promote physical activity, provide updated guidance to countries, and promote a framework of effective and feasible policy actions to increase physical activity at all levels towards physical activity and sustainable development goals 2030 Agenda (WHO 2018; UN 2020). This action plan provides four strategic objectives achievable through 20 policy actions that are universally applicable to all Member States. To create active environments, some actions could be addressed by improving the level of service provided by walking network infrastructure (Action 2.2), strengthening access to good-quality public and green open spaces by all people, all ages, and of diverse abilities in urban, peri-urban, and rural communities (Action 2.4), and strengthening the design guidelines and frameworks at the national and subnational levels (Action 2.5) (UN Resolutions 2020). While the goal of this action plan is to improve activity in people, actions can be focused on enhancing the provision of and opportunities for more physical activity programs and promotion in parks (Action 3.3) and implementing whole-of-community initiatives, at the city, town or community levels (Action 3.6).

Forest bathing (Shinrin-yoku) is a cost-effective method that involve exposure to natural stimuli by practicing physical activity or relaxation in and around the forest. This approach aims at ”preventive medical effects” that induce physiological relaxation and improve immune functions to prevent diseases (Park et al. 2009, 2010; Lee et al. 2009, 2011, 2012; Tsunetsugu 2010; Miyazaki et al. 2015). Lee In the past two decades, forest and park therapy has been widely and intensively commanded in high income countries such as Japan, United States, China, South Korea, United Kingdom, Finland, and Canada (Kim et al. 2012; Song et al. 2013, 2014, 2015, 2019a, 2019b, Tyrväinen et al. 2014; Goto et al. 2016; Hassan et al. 2018; An et al. 2019; Ojala et al. 2019; Elsadek et al. 2019. Studies on healthy young adults have demonstrated that brief urban park walks and views could decrease the heart rate, pulse rate, and blood pressure, shift the sympathetic/parasympathetic balance, and improve the mood state among young Japanese (Song et al. 2013, 2014, 2015, 2019a, 2019b). Forest bathing in a bamboo forest landscape decreased blood pressure and induced positive effects on brain activity (Hassan et al. 2018), while a three-day forest bathing session in a bamboo forest increased aspects of positive mood such as vigor and decreased aspects of negative mood such as tension and anxiety, anger and hostility, depression, fatigue, and confusion among Chinese subjects (Lyu et al. 2019). The combination of viewing and walking in the forest reduced blood pressure, heart rate, and amylase concentration, alleviated anxiety, depression, anger, fatigue, and confusion (Ji et al. 2012), enhanced comfort and a natural feeling, and increased vitality and calm among Korean subjects (Kim et al. 2012).

The therapeutic effects of green spaces among different cultures have been shown, for instance, different garden styles have great psychological, emotional, and healing values for people (Elsadek et al. 2019). For both Japanese and Canadians, landscape garden could affect in feelings of natural and relaxed. Furthermore, Japanese participants felt that the architecture garden is more brilliant and static; Canadian participants felt more sensitive on Japanese garden compared to other garden styles. Despite the fact that forest and park therapy have been well known in sub-tropical countries, it has remained poorly understood whether park environment can similarly influence healthy people from different cultures, for example young adults from tropical countries.

In the present study, we develop park therapy program by examining psychophysiological effects and effective elements through landscape images between Japanese and Indonesian subjects which were expected to reduce academic or work stress in young adults. The aim of this study is to assess the physiological and psychological effects of walking and viewing forests in urban parks in autumn. The objectives are 1) to determine whether there were significant differences in physiological and psychological responses between Japanese and Indonesian young adults, 2) to analyze the attractive elements of the parks, and 3) to analyze the correlations between park images and psychophysiological responses.

6.3.2 Materials Methodology

6.3.2.1 Experimental sites

The selection criteria for a walking course and viewing spot in urban parks included safe and well-maintained urban parks (Song et al. 2019a, 2019b) with (1) a minimum one-trip length of 400 m; (2) a flat slope; (3) seasonal landscape plants along the course (Pratiwi et al. 2020); and (4) seasonal landscape scenes as view (Pratiwi et al. 2019). The on-site experiment was carried out from November to December 2019 in the Forest and Park for the 21st Century, Matsudo, Chiba Prefecture, Japan (Figure 48). Mito Highway Route 6, Matsudo, Chiba Prefecture was the urban area selected as the control site (Figure 49). The park, built in 1993 is one of the urban parks that respect and preserve nature from ancient times, such as wetlands and forests. One walking route, the Midori no Sato (Village of Green)-Gathering Square, and one viewing spot, a flowerbed seating area, were employed in this study (Table 26). The average environmental variables of the urban park and city area in autumn are presented in Table 27. The weather on the experimental day was sunny to cloudy, and the average temperature, relative humidity, wind speed, noise, and light intensity in the urban park were 14.88°C, 57.88%, 0.60 km/h, 48.51 dB, and 26,170.56 lx, respectively, while those in city area were 15.03°C, 39.66%, 2.35 km/h, 65.78 dB, and 26,223.60 lx. Furthermore, the tree leaves had turned red, orange, or yellow, with neither rain nor snow precipitation.

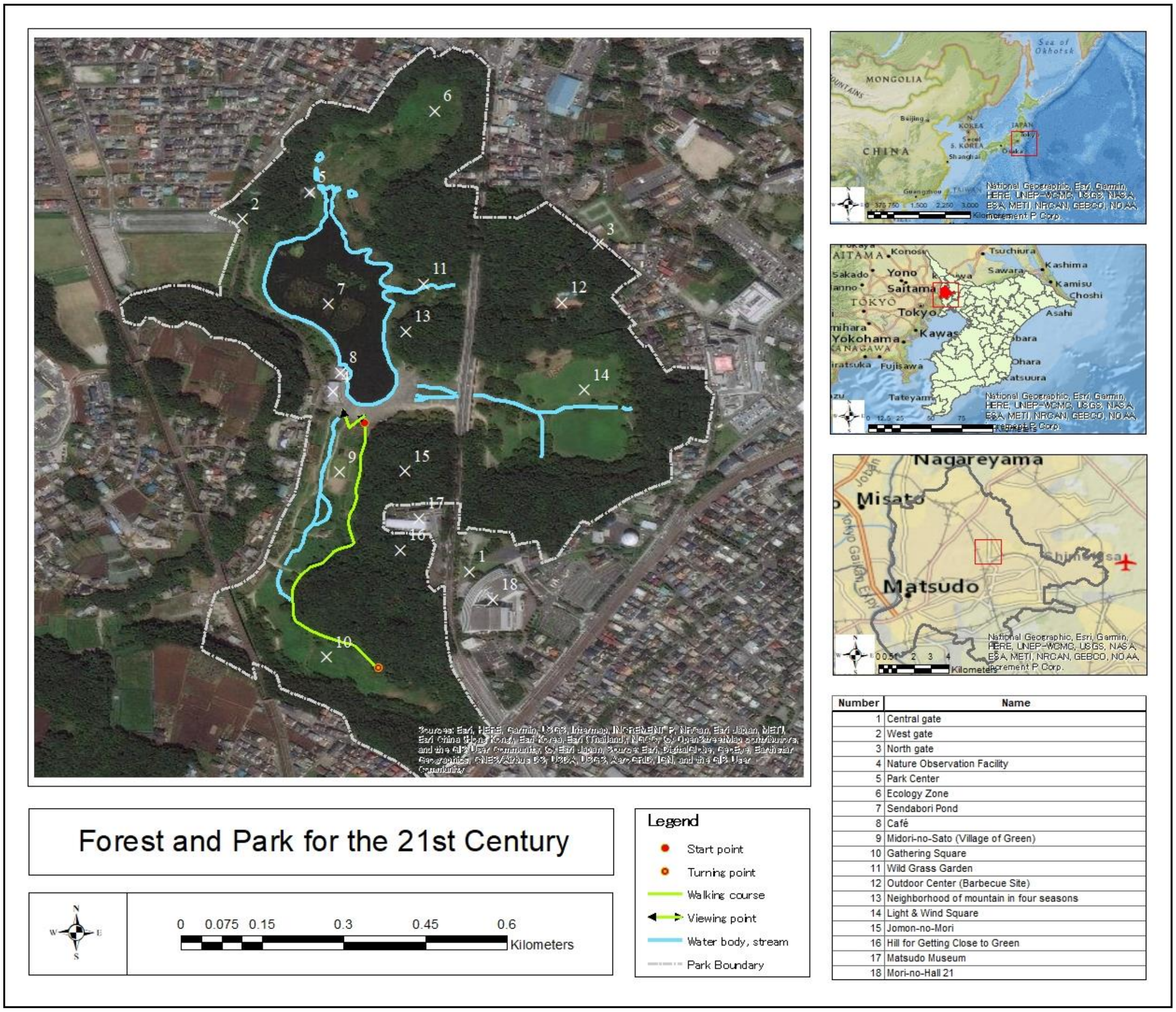


Figure 50. Experimental site of the walking course and viewing point.

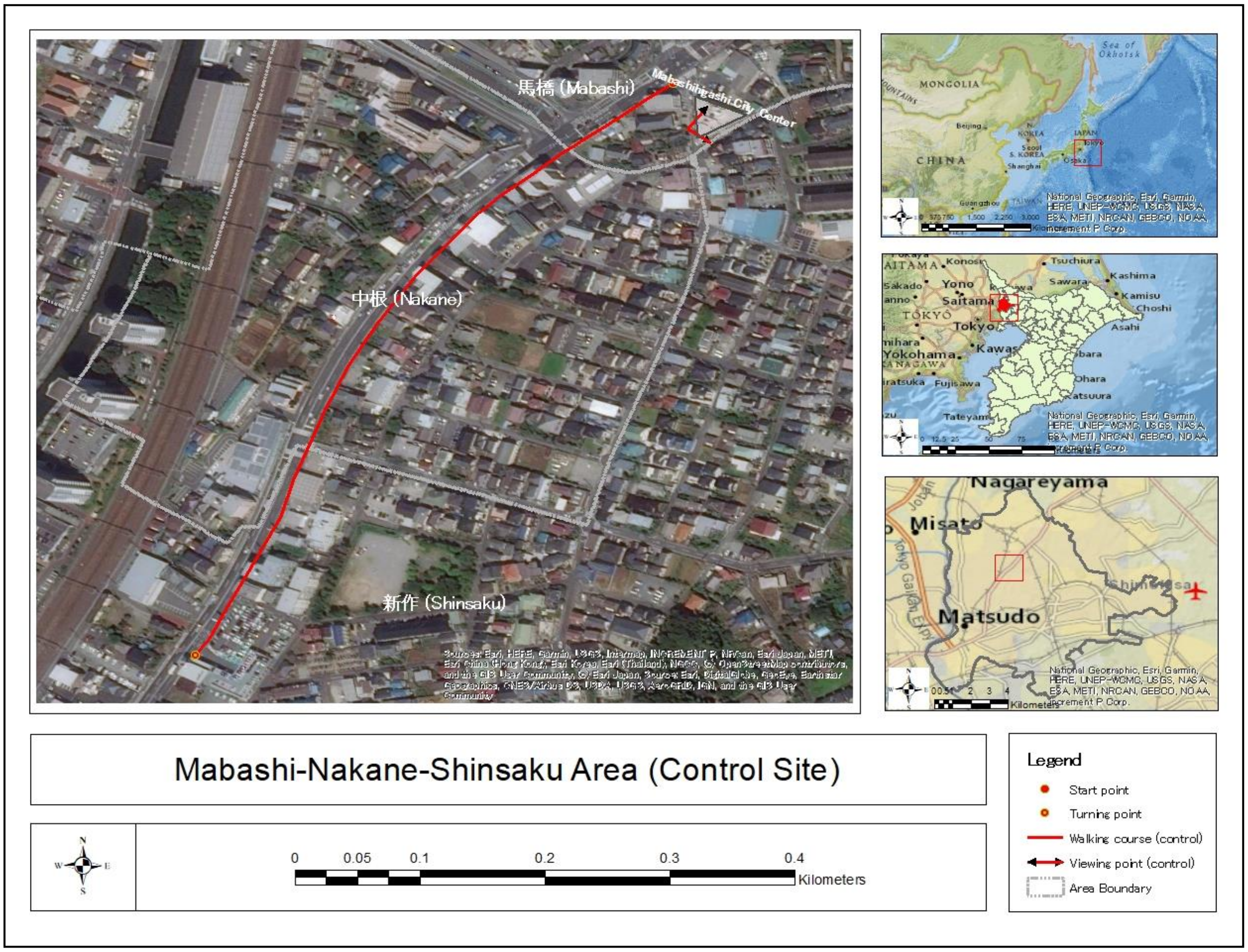


Figure 51. Control site for the walking course and viewing point

Table 26. Details regarding experiment and control sites of walking and seated viewing experiment.

Details	Walking course	Viewing spot
Sites	Park: Round trip of Village of Green-Wild Grass Garden (1.2 km) City: Roadside of Mito Highway Route 6 (control walking course 1, 1.2 km)	Park: Flower bed seating area City: In front of Mabashihigashi City Center
Experimental Period	November 21-December 18 2019	November 21-December 18 2019

Details	Walking course	Viewing spot
Land use	Park: Secondary forest White Oak (*Quercus myrsinifolia*), Red Oak (*Quercus acuta*), Zelkova (*Zelkova serrata*), Muku tree (*Aphananthe aspera*), Itajii (*Castanopsis sieboldii*), Jolcham Oak (*Quercus serrata*), Chino bamboo (*Pleioblastus chino),* Japanese Maple (*Acer palmatum*) City: Urban Area	Park: Artificial planting (short distance): Ornamental cabbage (*Brassica oleracea*), Evergreen azalea (*Rhododendron indicum*) Afforestation (medium distance): Japanese cedar (*Cryptomeria japonica*), Hinoki cypress (*Chamaecyparis obtuse*), Jolcham Oak (*Quercus serrata*) City: Urban Area

Table 27. Details regarding environmental variables of walking and seated viewing experiment

Environmental variables	Park	City
Temperature (Cº)		
Maximum	16.36	18.08
Minimum	11.81	14.86
Average	14.88	15.03
Relative humidity (%)		
Maximum	58.11	44.50
Minimum	43.00	34.82
Average	57.88	39.66
Wind speed (km/h)		
Maximum	1.22	4.70
Minimum	0.55	0.00
Average	0.60	2.35
Noise (db)		
Maximum	56.52	82.91

Environmental variables	Park	City
Minimum	43.50	57.61
Average	48.51	65.78
Light intensity (lux)		
Maximum	34291.01	37404.52
Minimum	23055.73	15042.68
Average	26170.56	26223.60

6.3.2.2 Participants

The participants were recruited using a snowball sampling method (Ghaljaie et al. 2017; Parker et al. 2020) with the three following steps: (1) delivery of flyers through social network service (SNS) using LINE, a freeware app for instant communications on electronic devices, to six key persons in laboratories, Matsudo Campus, Chiba University, and one Indonesian Student Association, Nishi Chiba Campus, Chiba University, (2) indication of willingness to participate in the experiment to the key persons, (3) explanation of the study aim and procedures one week before the experimental day, (4) experimental information follow-up through electronic mail and LINE, as mentioned above. The participants' eligibility criteria were: 1) Japanese or Indonesian, 2) young adults between the age of 20–29, and 3) who did not take any medication for blood pressure and heart rate. Finally, twenty students from two countries, Japan (7 males and 4 females) and Indonesia (5 males and 4 females), with mean age, 24 ± 2.6 years participated in the experiment. On the experimental day, the participants were instructed on the one-day experiment procedures and provided informed consent in a waiting room. The participants were restricted from consuming alcohol, tobacco, caffeine, and food during the experimental period. This study received ethical permission from the Ethics Committee of the Center for Environment, Health, and Field Sciences, Chiba University, Japan (Receipt code number: 19-04).

6.3.2.3 Experimental Design

The participants were randomly classified into two groups in which one group consisted of 2 to 6 individuals on a given day (Table 28). One group was sent to an urban park by walking from the nearest station, to experience a five-hour park therapy program (15 min each of walking and viewing), and the other group was sent to a city area. In the morning, participants received a brief experiment procedure, began continuously measurements of their heart rates, completed two physiological evaluations, and had their blood pressure measured. The participants walked along the designated walking course in the park or city area for 15 minutes. After finishing the walking experiment, participants returned to the waiting room, where they completed questionnaires, and their blood pressure was measured and measurements of their heart rates were stopped and had a 10-min break. They continued to the seated viewing experiment following the same procedures, with additional questionnaires of Landscape Image Sketching Technique (LIST) (Ueda et al. 2012; Pratiwi et al. 2014, 2020) in the post-experiment, especially in the urban park. The experiment was repeated in the opposite sites. They ate lunch and relaxed for 30 minutes. Figure 50 shows how participants walked the designated course with views of the Village of Green Gathering Square and viewed the flower bed, Sendabori pond, and forest in autumn.

Table 28. Time schedules during the walking and seated viewing experiment. POMS: Profile of Mood States; STAI: State-Trait Anxiety Inventory; LIST: Landscape Image Sketching Technique.

Time	**Activities (Location)**
08:30	Meeting of all park and city group, departure preparation (Tokiwadaira and Mabashi Station ticket gate)
08:30–09:00	Walking to park/city area guided by staff
09:00–09:20	Signing of consent forms, first measurement of heart rate, blood pressure, and assessment of POMS, STAI (waiting room)
09:20–09:40	Walking experiment with ongoing heart rate monitoring, including moving time from and to waiting room (park/city)
09:40–10:00	Second measurement of blood pressure, assessment of POMS and STAI, and discontinuation of heart rate measurement (waiting room)
10:00–10:10	Break
10:10–10:20	First measurement of heart rate, blood pressure, and assessment of POMS, STAI (waiting room)
10:20–10:40	Seated viewing with ongoing heart rate monitoring, including moving time from and to waiting room (park/city)
10:40–11:00	Post-measurement of blood pressure, assessment of POMS, STAI, LIST (only in park), and discontinuation of heart rate measurement (waiting room)
11:10–11:20	Departing to the opposite sites
11:20–11:40	First measurement of heart rate, blood pressure, and assessment of POMS, STAI (waiting room)

Time	Activities (Location)
11:40–12:00	Walking experiment with ongoing heart rate monitoring, including moving time from and to waiting room (park/city)
12:00–12:20	Second measurement of blood pressure, assessment of POMS, STAI, and discontinuation of heart rate measurement (waiting room)
12:20–12:50	Lunch and break
12:50–13:10	First measurement of heart rate, blood pressure, and assessment of POMS, STAI (waiting room)
13:10–13:30	Seated viewing with ongoing heart rate monitoring, including moving time from and to waiting room (park/city)
13:30–13:50	Post-measurement of blood pressure, assessment of POMS, STAI, LIST (only in park), and discontinuation of heart rate measurement (waiting room)

Figure 52. Experimental and control scenes in: (a) walking course in urban park; (b) walking course in city area; (c) viewing spot in urban park; (d) viewing spot in city area.

6.3.2.4 Measurement of Psychophysiological Indices and Physical Variables

The physiological indices measured during the walking and seated viewing period were heart rate and blood pressure. Heart rate was calculated continuously (Song et al. 2013, 2014, 2015, 2019a, 2019b) from the beginning of pre-experiment until post-experiment using a heart rate sensor (MyBeat WHS-3, Union Tool, Tokyo, Japan). Blood pressure was measured by an oscillometric method using a digital automatic sphygmomanometer pre-and post-experiment (Omron HEM-1021, Omron Corp., Kyoto, Japan) on the upper arm. The mean of these two measures was used in the analysis.

In this study, two psychological evaluations, namely the Profile of Mood States (POMS) 2 short version (Konuma et al. 2015; Heuchert and McNair 2012; Searight and Montone 2017) and the New State-Trait Anxiety Inventory (STAI) in Japanese and English versions (Fernández-Blázquez et al. 2015; Bandi et al. 2020) were administered using paper-and-pencil format pre- and post-experiment in both the urban park and city area. The POMS 2 instrument is used to assess the mood states of adults aged 18 years and older. It contains a subset of 35 items regarding six mood states: “anger–hostility” (A–H), “confusion–bewilderment” (C–B), “depression–dejection” (D–D), “fatigue–inertia” (F–I), tension–anxiety” (T–A), and “vigor–activity” (V–A), scored on a five-point scale from not at all to extremely (Konuma et al. 2015; Heuchert and McNair 2012, 2014). This tool has been used to measure participants’ affective traits, moods, and emotions in forest and park landscapes. The State-Trait Anxiety Inventory (STAI) instrument measures trait and state anxiety. Form Y, its most popular version, has 20 items for assessing trait anxiety and 20 for state anxiety. In this study, the state anxiety measure, consisting of 20 adjectives scored on a 4-point scale from not at all to very much so, was used to evaluate the current state of anxiety (Spielberger et al. 1983; Carmin and Ownby 2010; Julian 2011).

Temperature, relative humidity, light intensity, wind speed, and sound level were measured at each site of the urban park and city area. This measurement was performed close to each site where walking and seated viewing experiments took place. A portable heat index monitor (AD-5689, Tokyo, Japan) was used to measure the temperature and relative humidity; a portable wind speed meter (URCERI MT-915, Shenzen, China) to monitor wind speed; a portable lightmeter (URCERI-MT 912, Shenzen, China) to monitor light intensity; and a portable sound level meter (MT-9111A, Shenzen, China) to monitor noise levels.

6.3.2.5 Landscape Image Sketching Technique (LIST)

In this study, the Landscape Image Sketching Technique (LIST) was conducted to determine the subjective spatial preference and attractiveness of autumn forest in the urban park through a brief sketch, keywords referring to the park, and short verbal description of the park as perceived by the subjects (Ueda 2009, 2012; Pratiwi et al. 2014) This instrument could reflect subjects' views during walking and seated viewing of the values, meaning, attitude, and understanding of the experienced urban park. Pratiwi et al. stressed that linguistic knowledge might differ by type of subject (Pratiwi et al. 2020). As clearly stated by Ueda et al. (2012), three phases have four Fuukei (a Japanese word meaning landscape perception) conditions: (1) determination of landscape elements (through spatial view and linguistic knowledge), (2) structure of the person-environment relationship (as self-orientation), and (3) the meaning of place based on one's implied motives (Ueda et al. 2012). Figure 51 shows a diagram of an experienced park landscape image combining the elements of spatial view, linguistic knowledge, self-orientation, and social meaning. Each element above included a specific aspect experienced in the park: the spatial aspect, semiotic aspect, individual aspect, and social aspect, respectively. The park image survey consisting of keywords, short description, and a sketch of the experienced park was conducted after the two experiments in the urban park.

1. Keywords and short description

In the first step of the park image survey, participants were instructed to visualize the park experienced through the walking and seated viewing activities performed there, complete the words related to park therapy, and elucidate the park landscape during park therapy. The first step of the park image survey was an essential process that involved converting memories into conscious experiences.

2. Sketch of experienced park

The participants then were instructed to draw a brief sketch of the personal landscape experienced during park therapy. The second step of the park image survey spatially exhibited the person-environment relationship, especially people's orientation in the landscape. These following instructions were addressed to participants:

- What do you imagine about "park" during walking and seated viewing in a forest and park for the 21st Century?
- Fill in the words about the landscape experienced through walking and seated viewing in the park.
- Please explain the situation of the park with sentences.
- Please draw a simple sketch of the park (with keywords if necessary).

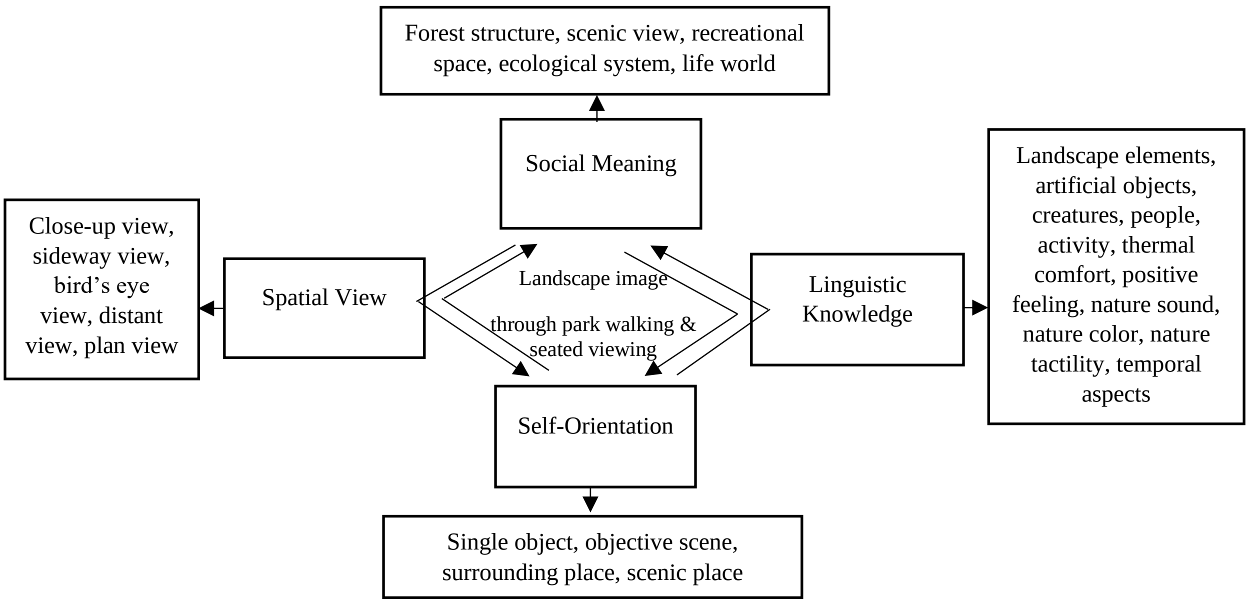


Figure 53. Diagram of landscape image through park therapy among young adults

Note. Adapted from "Landscape image sketches of forests in Japan and Russia", by H. Ueda, T. Nakajima, N. Takayama, E. Petrova, H. Matsushima, K. Furuya, and Y. Aoki, 2012, Forest Policy and Economics, 19, 20-30. Copyright 2012 by H. Ueda.

6.3.2.6 Data Analysis procedure

1. Physiological-Psychological Measures Analyses

The data from 20 participants were collected and analyzed. Both heart rate and blood pressure pre- and post-measurement data were averaged at each site. A t-test was applied to compare mean physiological measures between Japanese and Indonesian young adults; then it was also applied to compare mean physiological measures for each young adult between the urban park and the city area, as well as before and after walking in the urban park. The Mann-Whitney U test was used to examine the significant differences in reported psychological measures between Japanese and Indonesian young adults; the Wilcoxon signed-rank test was utilized to examine the significant differences among young adults between the urban park and the city area, as well as before and after walking in the urban park. To identify whether the type of environment (e.g., park and city), activity level (e.g., pre-experiment, post-walking, post-viewing), and nationality (e.g., Japanese and Indonesian) influenced the heart rate, blood pressure, mood state, and state anxiety, the interaction terms were analyzed with two-way repeated-measures (within-subjects) ANOVA. We conducted 2 (environment) × 2 (activity) × 2 (nationality) ANOVA for heart rate and 2 (environment) × 3 (activity) × 2 (nationality) ANOVA for blood pressure, POMS, and STAI for analysis. All statistical analyses were conducted using SPSS 26 (IBM Corporation, Armonk, NY, USA).

2. Park image analysis

- Analysis of Keywords and Sketches

An analysis of visual and verbal data through a brief sketch was determined into landscape image aspects using the checklist method. The presence of the variables in the landscape image sketches was defined as '1', while '0' indicated the absence of the variables in the landscape image sketches (Pratiwi et al. 2014). The Chi-Square Test was performed to compare the variables extracted from verbal data and visual data of park image between Japanese and Indonesian young adults. Spearman’s rho correlation was performed to analyze the correlation between park therapy images and psychophysiological measures.

- Quantitative Content Analysis of Short Description

Quantitative content analysis through short description was commanded with generating 1) the co-occurrence network of words to draw a network diagram that shows the similarity with high degrees of co-occurrence, connected by lines (Higuchi 2016) and 2) hierarchical cluster analysis of words to analyze which groups of words have similar attractive elements of park therapy displayed in a dendrogram (Higuchi 2014). To determine edge strength, Jaccard coefficients were calculated for all possible combinations of target words. Quantitative content analysis was conducted using KH Coder 3, an open-source program that is commonly used for semantic network analysis.

6.3.3 Results

6.3.3.1 Participants' Sociodemographic and Shinrin-yoku Experience

Table 29 shows the participants' socio-demographics and Shinrin-yoku experience. Based on the Mann-Whitney U test, the participants' characteristics during park therapy were significantly different for age (22.6 ± 1.9, 25.7 ± 2.4), alcohol use (90.9%, 0%), Shinrin-yoku knowledge (90.9%, 11.1%), and engagement in Shinrin-yoku (3.2 ± 5.8, 0). The participants consisted of Japanese (55%) and Indonesian (45%). The mean age of the participants was 24 ± 2.6; their mean height and weight were 1.65 ± 0.1 m and 61.4 ± 10.7 kg; and Body Mass Index (BMI) was 22.5 ± 3.3. The composition of gender was 60% male and 40% female. Most of the participants were undergraduate students (35%), followed by master's students (30%), doctoral students (25%) and other (10%). All the participants did not smoke (100%) and had sleeping time less than 7 h (60%); half of them did not drink alcohol (50%). Nearly half of them had knowledge of Shinrin-yoku (45%). They preferred to participate in Shinrin-yoku programs in weekend half-day and full-day programs (25%); half of them desired walking activities (50%), followed by water soaking (25%), breathing exercises (10%), seated-viewing, sensory enjoyment, and sleeping in a hammock (5%). They performed sports activities seven times and Shinrin-yoku two times a month on average. About 55% had a rare social attachment to their neighborhood, with one time of participation in the community per month.

Table 29. Participant characteristics of walking and seated experiment.

Parameter	**Japanese (*N* = 11)**	**Indonesian (*N* = 9)**	**Total (*N* = 20)**	***P*-Value**
Age (years)	22.6 ± 1.9	25.7 ± 2.4	24 ± 2.6	0.011*
Height (m)	1.7 ± 0.1	1.6 ± 0.1	1.65 ± 0.1	0.732
Weight (kg)	57.9 ± 7.5	65.7 ± 12.7	61.4 ± 10.7	0.208
BMI	21.2 ± 2.4	24.2 ± 3.7	22.5 ± 3.3	0.063
Gender				0.721
Male	7 (63.6%)	5 (55.6%)	12 (60%)	
Female	4 (36.4%)	4 (44.4%)	8 (40%)	

Parameter	**Japanese (*N* = 11)**	**Indonesian (*N* = 9)**	**Total (*N* = 20)**	***P*-Value**
Education				0.056
Undergraduate	5 (45.5%)	2 (22.2%)	7 (35%)	
Master	5 (45.5%)	1 (11.1%)	6 (30%)	
Doctor	1 (9.1%)	4 (44.4%)	5 (25%)	
Other	-	2 (22.2%)	2 (10%)	
Smoking behavior				1.000
No	11 (100%)	9 (100%)	20 (100%)	
Sleeping time (hours)				0.592
Less than 7 h	6 (54.5%)	6 (66.7%)	12 (60%)	
7–9 h	5 (45.5%)	3 (33.3%)	8 (40%)	
Alcohol use				0.000***
Yes	10 (90.9%)	-	10 (50%)	
No	1 (9.1%)	9 (100%)	10 (50%)	
Shinrin-yoku knowledge				0.001**
Yes	10 (90.9%)	1 (11.1%)	11 (55%)	
No	1 (9.1%)	8 (88.9%)	9 (45%)	
Desired Shinrin-yoku program				0.151
Half-day program on weekdays	-	1 (11.1%)	1 (5%)	
Weekend half-day program	2 (18.2%)	3 (33.3%)	5 (25%)	
Weekend full-day program	2 (18.2%)	3 (33.3%)	5 (25%)	
Two days to one week using a tent	3 (27.3%)	-	3 (15%)	
Two days to one week using ryokan	3 (27.3%)	1 (11.1%)	4 (20%)	
Holidays for several days to one week	1 (9.1%)	1 (11.1%)	2 (10%)	
Desired Shinrin-yoku activity				0.838
Walking	5 (45.5%)	5 (55.6%)	10 (50%)	
Seated viewing	-	1 (11.1%)	1 (5%)	
Sensory enjoyment	1 (9.1%)	-	1 (5%)	

Parameter	Japanese (N = 11)	Indonesian (N = 9)	Total (N = 20)	P-Value
River/lake/water soaking	4 (36.4%)	1 (11.1%)	5 (25%)	
Breathing exercise	1 (9.1%)	1 (11.1%)	2 (10%)	
Sleeping in hammock	-	1 (11.1%)	1 (5%)	
Sport activity (times/month)	6 ± 5.5	7.9 ± 12.6	6.85 ± 9.1	0.397
Engagement in Shinrin-yoku (times)	3.2 ± 5.8	0	1.75 ± 4.5	0.011*
Social attachment				0.180
Often	-	2 (22.2%)	2 (10%)	
Sometimes	1 (9.1%)	3 (33.3%)	4 (20%)	
Rarely	9 (81.8%)	2 (22.2%)	11 (55%)	
Almost never	1 (9.1%)	2 (22.2%)	3 (15%)	
Participation in community activity/month	0.4 ± 0.7	0.8 ± 1.1	0.55 ± 0.9	0.370

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

6.3.3.2 Reliability Analysis of Physiological and Psychological Parameters

Internal consistency reflects the extent to which items within an instrument measure various aspect of the same characteristic or construct. Cronbach's alpha was applied to measure the interrelatedness, which should be higher than 0.6 to evaluate reliability (Revicki 2014; van Griethuijsen et al. 2015). The internal consistency (Cronbach's alphas) of the physiological and psychological parameters of the 20 Japanese and Indonesian young adults is given in Table 30. All parameters showed acceptable to excellent internal consistency (0.733–0.990), except for STAI scores in seated viewing among Japanese, with the lowest acceptable threshold of internal consistency (0.634). The results established that heart rate and blood pressure had excellent internal consistency (0.928–0.990) and POMS scores had good to excellent internal consistency (0.832–0.960), while STAI scores had the lowest acceptable threshold to good internal consistency (0.634–0.873). Therefore, all physiological and psychological indices had acceptable validity and reliability in this study.

Table 30. Verification of internal consistency of physiological and psychological parameters of park therapy in autumn.

Parameter	Cronbach's α			
	Japanese		Indonesian	
	Walking	Seated viewing	Walking	Seated viewing
Heart rate	0.968	0.966	0.991	0.986
Blood pressure	0.945	0.948	0.928	0.934
POMS	0.922	0.960	0.832	0.851
STAI	0.733	0.634	0.873	0.867

6.3.3.3. Physiological Effects

Compared with walking in the city area, walking in the urban park resulted in lower blood pressure. Both Indonesian and Japanese participants' physiological responses showed no significant differences in diastolic blood pressure but significantly lower systolic blood pressure and heart rate. Compared with Indonesian participants, Japanese participants' physiological responses showed a lower heart rate in both walking and seated-viewing period. In the walking period, the mean Japanese blood pressure was lower in the urban park (systolic blood pressure: 105.1/67.2 mmHg) than in the city (113.2/71.8 mmHg; p = 0.04). The mean Indonesian blood pressure was lower in the urban park (systolic blood pressure: 108.7/69.7 mmHg) than in the city (117/66.6 mmHg; p = 0.009). In the seated-viewing period, although both Japanese and Indonesian blood pressures were lower in the urban park (Japanese: 110.2/66.2 mmHg; Indonesian: 110.9/66.4 mmHg) than in the city (Japanese: 112.1/72.8 mmHg; Indonesian: 111/70 mmHg), significant differences were not detected in the two environments. Figure 52 shows the average systolic and diastolic blood pressure post- urban park and city area walking among Japanese and Indonesian young adults. There was no significant difference in the changes in blood pressure in the two environments between post- and pre-viewing among young adults. In the walking period, the mean heart rate was lower when walking in the urban park than in the city (Japanese heart rate in urban park walking was 85.56 bpm, in city area viewing was 88.39 bpm, p = 0.001; Indonesian heart rate in urban park walking was 98.75 bpm, in city area walking was 105.37 bpm, p = 0.000). Figures 53a and 53b show the one-minute average heart rate during urban park walking in autumn among

Japanese and Indonesian young adults. In the seated-viewing period, the mean heart rate was slightly higher when viewing the urban park than when walking in the city (Japanese heart rate in urban park viewing was 66.67 bpm, city area viewing was 65.14 bpm; Indonesian heart rate in urban park viewing was 74.13 bpm, city area walking was 77.64 bpm; $p = 0.009$, $p = 0.000$). Figure 53c and 53d show the one-minute average heart rates during urban park viewing in autumn among Japanese and Indonesian young adults. Furthermore, Japanese heart rate was lower than that of Indonesian during urban park walking seated viewing ($p = 0.000$).

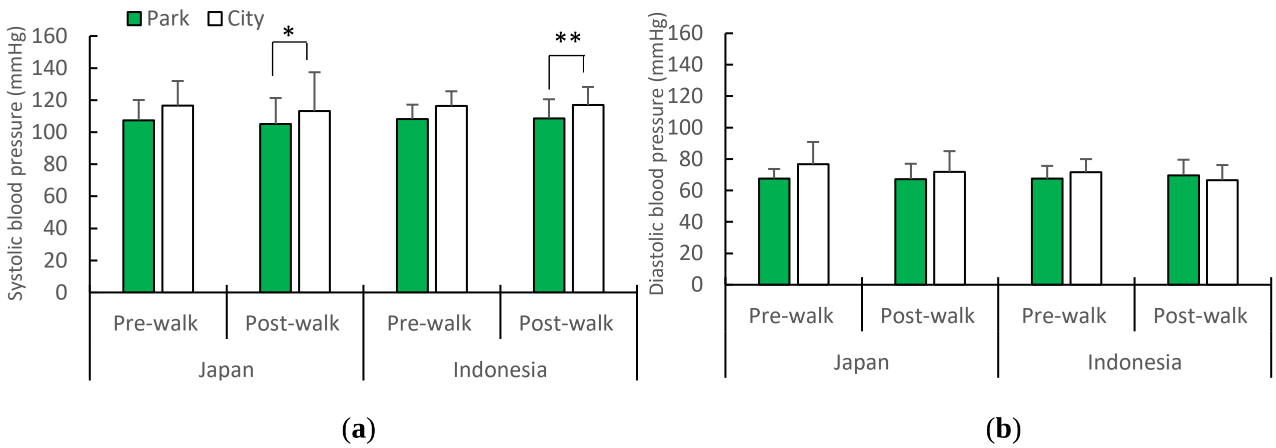


Figure 54. The average blood pressure after urban park and city walking among Japanese and Indonesians: a) systolic blood pressure and b) diastolic blood pressure. $N = 20$, mean ± standard deviation. *$p < 0.05$, **$p < 0.01$, determined by the t-test (two-sided).

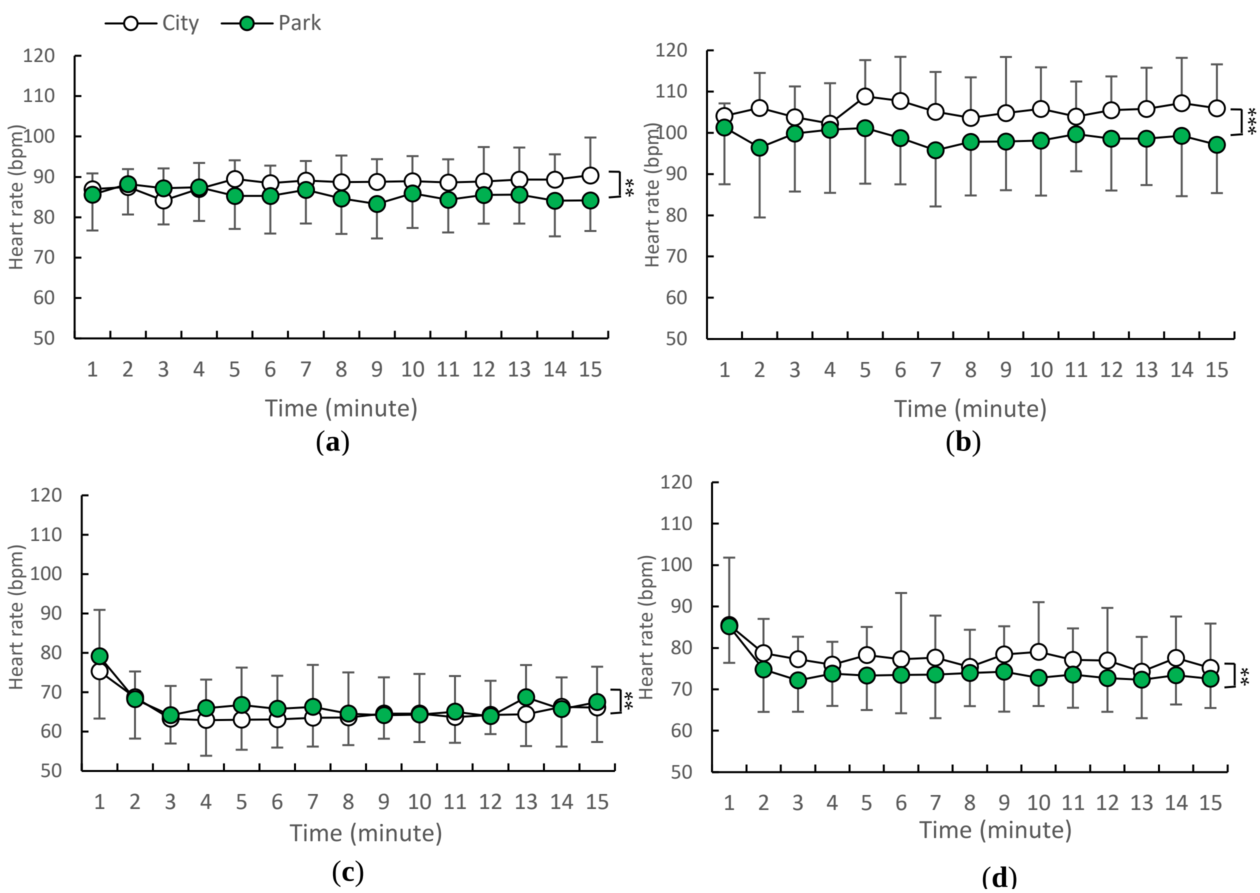
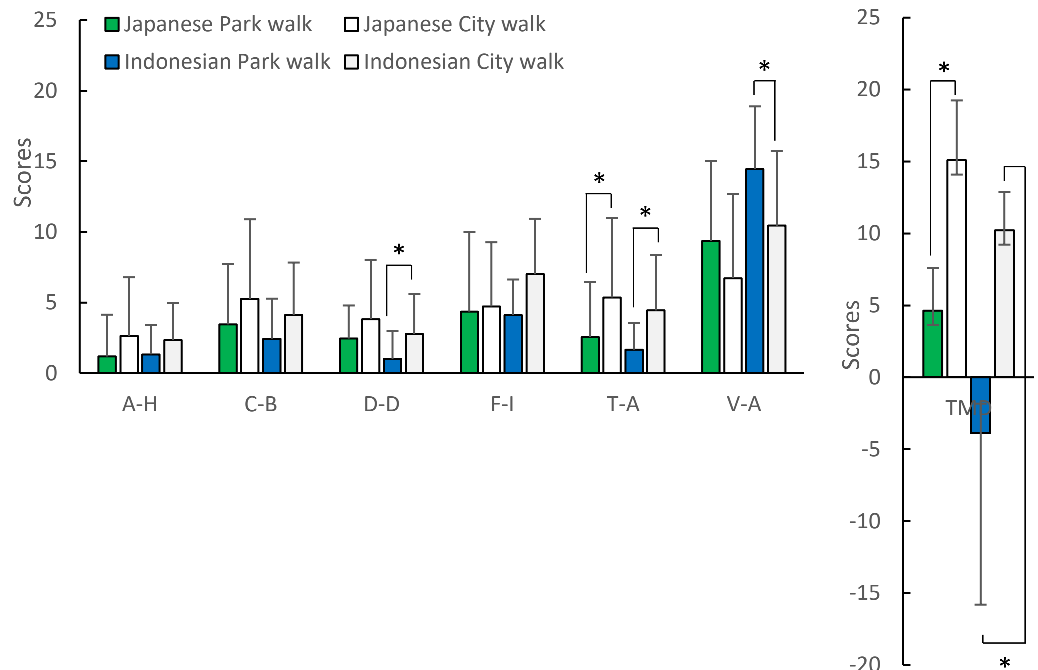


Figure 55. Average one-minute heart rate during: (a) urban park walking in Japanese; (b) urban park walking in Indonesians; (c) urban park viewing in Japanese; (d) urban park viewing in Indonesian. N = 20, mean ± standard deviation. $*p < 0.05$, $***p < 0.001$, determined by t-test (two-sided).

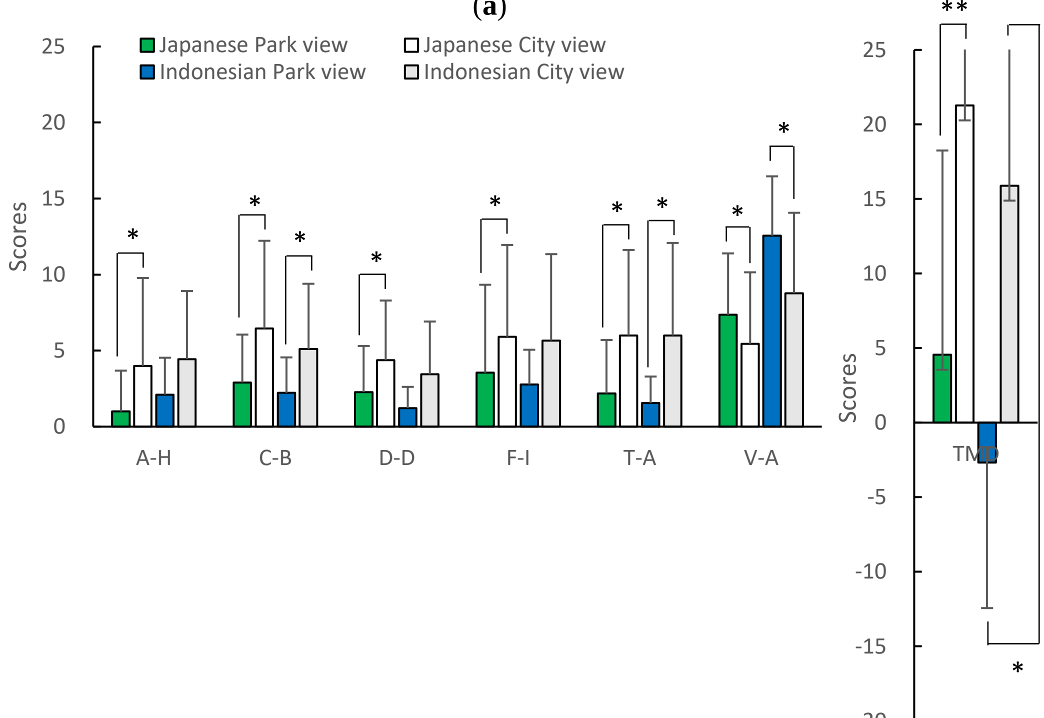
6.3.3.4 Psychological Effects

Compared with Indonesian participants, Japanese participants' psychological responses showed significantly different positive mood state, namely vigor-activity, in seated-viewing as the second activity. According to POMS and STAI, young adults exhibited greater alleviation of negative mood states and anxiety levels and elevation of positive mood states after conducting the second activity of viewing compared with walking in the urban park. In the walking period, significantly lower negative mood states were detected in "tension–anxiety" ($p = 0.018$) and Total Mood Disturbance ($p = 0.041$) among Japanese and in "depression–dejection" ($p = 0.016$), "tension–anxiety" ($p = 0.042$), and Total Mood Disturbance ($p = 0.015$) among Indonesians, while a significantly higher positive mood state was only detected in "vigor-activity" among Indonesians

(p = 0.042, Figure 54a). The significant decrease was detected in the negative mood states of "anger-hostility" (p = 0.041), "depression-dejection" (p = 0.021) and "tension-anxiety" (p = 0.011) as well as of Total Mood Disturbance (p = 0.008); the positive mood state of "vigor–activity" (p = 0.035) elevated post-walking over pre-walking in an urban park among Japanese. The mean values of the negative mood states of "confusion-bewilderment" (p = 0.016) and "tension-anxiety" (p = 0.026) and Total Mood Disturbance (p = 0.011) decreased; the positive mood state "vigor–activity" (p = 0.049) was elevated post-walking over pre-walking in an urban park among Indonesians. In the seated viewing period, significantly lower negative mood states were detected in "tension–anxiety" (p = 0.046), "confusion-bewilderment" (p = 0.021), "depression–dejection" (p = 0.01), "fatigue-inertia" (p = 0.032), "tension–anxiety" (p = 0.013), and Total Mood Disturbance (p = 0.008) among Japanese and "confusion-bewilderment" (p = 0.02), "tension–anxiety" (p = 0.028), and Total Mood Disturbance (p = 0.035) among Indonesians, while significantly higher positive mood state was detected in "vigor-activity" among both the Japanese (p = 0.028) and Indonesians (p = 0.021, Figure 54b). The significant decrease was detected in "fatigue–inertia" (p = 0.047), "tension–anxiety" (p = 0.026) and Total Mood Disturbance (p = 0.004), while the positive mood state "vigor–activity" (p = 0.024) increased post-viewing over pre-viewing in an urban park among the Japanese. There was no significant difference in the shift in mood state among Indonesians post- and pre-viewing. Moreover, Japanese positive mood "vigor-activity" was lower than that of Indonesian after seated-viewing in the urban park (p = 0.011). In walking, Indonesian young adults indicated a greater decline in anxiety levels after walking in the urban park than in the city area (p = 0.028; Figure 55a). In seated viewing, both Japanese and Indonesian young adults indicated a larger decline in anxiety levels after viewing in the urban park than in the city area (Japanese: p = 0.012; Indonesian: p = 0.011; Figure 55b). The mean values of anxiety level decreased in post-walking and viewing compared with pre-walking and viewing in an urban park among both Japanese (walking: p = 0.003; viewing: p = 0.02) and Indonesians (walking: p = 0.018; viewing: p = 0.05).



(**a**)



(**b**)

Figure 56. POMS scores in the urban park and city area among Japanese and Indonesians: (**a**) post-walk and (**b**) post-view. A–H: anger–hostility; C–B: confusion–bewilderment; D–D: depression–dejection; F–I: fatigue–inertia; T–A: tension–anxiety; V–A: vigor–activity. N = 20, mean ± standard deviation. *p < 0.05, **p < 0.01, determined by the Wilcoxon signed-rank test (two-sided).

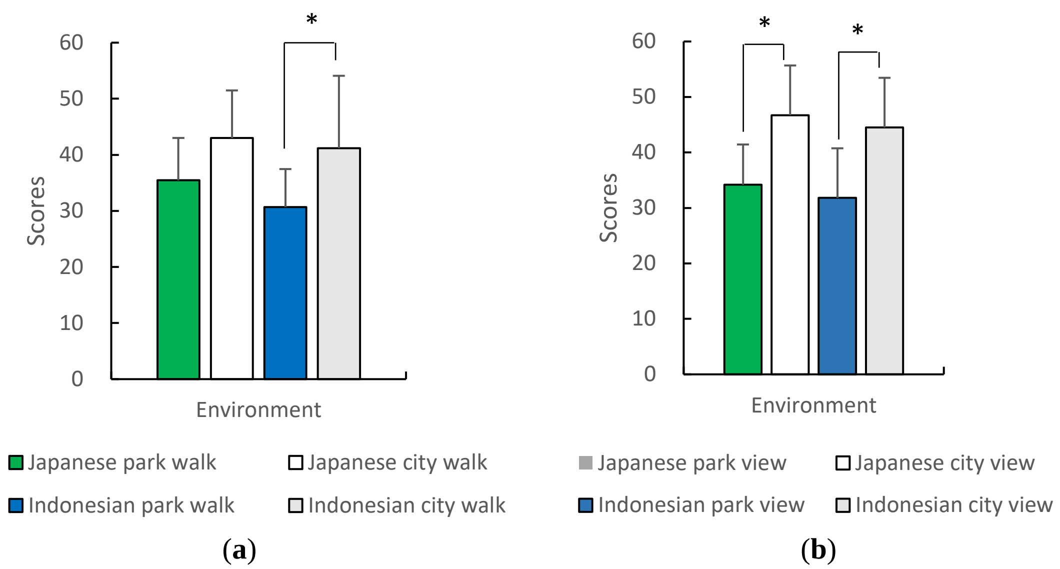


Figure 57. STAI scores in the urban park and city area among Japanese and Indonesians: (a) post-walk and (b) post-view. $N = 20$, mean ± standard deviation. *$p < 0.05$, determined by the Wilcoxon signed-rank test (two-sided).

6.3.3.5 Interaction Terms of Environment, Activity, and Nationality

Interaction terms (environment and activity, environment and nationality, and environment, activity, and nationality) were statistically significant ($p < 0.05$) for heart rate, POMS (anger-hostility, confusion-bewilderment, fatigue-inertia, tension-anxiety, total mood disturbance), and STAI (state-anxiety) (Table 31). Note that the heart rate was measured continuously during each experiment, unlike blood pressure, POMS, and STAI, which were measured twice (pre-experiment, post-walking, and post-seated viewing). Our results, except that for blood pressure in the urban park, showed that engaging in walking and viewing activities in an urban park brings greater physiological and psychological benefits. There were significant interactions between environment and activity in heart rate, confusion-bewilderment, tension-anxiety total mood disturbance (TMD), and state anxiety. This effect indicates that different environments affect the level of activity (pre-experiment, post-walk, and post-view). Both Japanese and Indonesian young adults derived physiological and psychological benefits from the combination of walking and seated views in an urban park. A significant interaction was also found between the environment and nationality in heart rate, indicating that the different nationalities were affected differently by the different environments. The other significant differences were found between activity and nationality in heart rate, anger-hostility, and fatigue-inertia, indicating that different nationalities were affected differently by the level of activity. Japanese had psychological benefits in the combination of walk and seated view in anger-hostility and fatigue-inertia. There was no significant interaction found between combination of the three parameters (environment × activity × nationality).

Table 31. Interaction terms by repeated-measures ANOVA.

Parameter	Subparameter	***P*-Value** Environment × Activity	Environment × Nationality	Activity × Nationality
Heart rate		0.000***	0.000***	0.000***
Blood pressure	Systolic blood pressure	0.055	0.272	0.715
	Diastolic blood pressure	0.229	0.216	0.955
POMS	A-H	0.402	0.492	0.022*
	C-B	0.046*	0.357	0.659
	D-D	0.288	0.631	0.109
	F-I	0.104	0.874	0.044*
	T-A	0.005**	0.858	0.347
	V-A	0.067	0.282	0.976
	TMD	0.015**	0.969	0.100
STAI	State-anxiety	0.001***	0.609	0.174

Note. $*p < 0.05$; $**p < 0.01$; $***p < 0.001$

6.3.3.6 Cross-cultural Comparison of Park Images

Park-therapy-related landscape images showed prominent landscape elements such as “autumn leaves” ($p = 0.043$) and “calm feeling” ($p = 0.013$) among Japanese and Indonesian young adults (Figures 56 and 57). Nine components of landscape elements, spatial view, and self-orientation were correlated with physiological-psychological responses among the Japanese (Table 32), six components among the Indonesians (Table 33). Among the Japanese, decreased heart rate was negatively correlated with the presence of trees in walking session ($p = 0.008$, $r = -0.751$). Decreased anger-hostility and fatigue-inertia were negatively correlated with autumn leaves in seated viewing session ($p = 0.026$, $r = -0.663$; $p = 0.014$, $r = -0.713$). Decreased fatigue-inertia and anxiety levels were negatively correlated with natural landscape elements like herbaceous plants and flowers in a viewing session (p = 0.045, r = −0.613; p = 0.034, r = −0.639, respectively). Decreased diastolic blood pressure and depression-dejection were negatively correlated with man-made landscape elements like benches in the walking session (p = 0.024, r = −0.671; p = 0.047, r = −0. 609); decreased heart rate, diastolic blood pressure, and fatigue-inertia were negatively correlated during seated viewing session (p = 0.024, r = −0.671; p = 0.023, r = −0.674; p = 0.045, r = −0.613). Decreased systolic blood pressure was negatively correlated with tea house during the seated viewing session (p = 0.036, r = −0.635) and vigor−activity was negatively correlated in all sessions (p = 0.036, r = −0.635; p = 0.033, r = −0.642). While increased anxiety levels were positively correlated with tea house during all sessions (p = 0.023, r = 0.675) among the Japanese. Decreased tension-anxiety was negatively correlated with spatial view such as “sideway views” during the walking period (p = 0.048, r = −0.606). Decreased confusion−bewilderment was negatively correlated with the diversity of objects in a scene during all sessions (p = 0.041, r = −0.622); decreased depression-dejection and tension-anxiety were negatively correlated during viewing session (p = 0.017, r = −0.698, p = 0.039, r = −0.626). Increased vigor-activity was positively correlated with surrounding place during the walking period among the Japanese (p = 0.047, r = 0.608). Only landscape elements had correlations with psychophysical responses among Indonesian. Increased vigor-activity was positively correlated with man-made landscape elements like Park Center during all sessions (p = 0.026, r = 0.728), reduced Total Mood Disturbance was negatively correlated during the walking session (p = 0.027, r = −0.725), and reduced anxiety level was negatively correlated during all periods (p = 0.023, r = −0.737; p = 0.026, r = −0.728). Increased vigor-activity was positively correlated with fences in all sessions (p = 0.026, r = 0.728), decreased Total Mood Disturbance was negatively correlated (p = 0.027, r = −0.725) in walking sessions, and decreased anxiety levels was negatively correlated during all sessions (p = 0.023, r = −0.737; p = 0.026, r = −0.728). Decreased systolic blood pressure was negatively correlated with other man-made landscape elements like plazas during all sessions (p = 0.027, r = −0.725; p = 0.026, r = −0.728), and decreased anger−hostility was negatively correlated with benches during viewing sessions (p = 0.019, r = −0.755). Increased vigor-activity was also positively correlated with viewing flowers (p = 0.013, r = 0.779). Decreased Total Mood Disturbance was negatively correlated with the subjective feeling of comfort during viewing sessions (p = 0.027, r = −0.725).

Table 32. Correlation matrix of park therapy images and psychophysiological responses among Japanese subjects.

Psychophysiological response \ Park Images		Linguistic Knowledge						Spatial view	Self-orientation	
		Tr	**Be**	**Th**	**Al**	**Hp**	**Fl**	**Sv**	**Os**	**Sp**
Heart rate		O**	-	-	-	-	-	-	-	-
Blood pressure	Systolic blood pressure	-	-	Δ*	-	-	-	-	-	-
	Diastolic blood pressure	-	O* Δ*	-	-	-	-	-	-	-
Mood state	Anger-hostility	-	-	-	Δ*	-	-	-	-	-
	Confusion-bewilderment	-	-	-	-	-	-	-	-	-
	Depression-dejection	-	O*	-	-	-	-	-	-	-
	Tension-anxiety	-	-	-	-	-	-	O*	-	-
	Fatigue-inertia	-	Δ*	-	Δ*	Δ*	-	-	-	-
	Vigor-activity	-	-	-	-	-	-	-	O*	O*
Anxiety level		-	-	-	-	-	Δ*	-	-	-

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, Tr: trees, Be: bench, Th: Tea house, Al: autumn leaves, Hp: herbaceous plants, Fl: flowers, Sv: sideway view, Os: Objective scene, Sp: surrounding place, O: walking, Δ: viewing.

Table 33. Correlation matrix of park therapy images and psychophysiological responses among Indonesian subjects.

Psychophysiological responses \ Park Images		Linguistic Knowledge					
		Be	**Fe**	**Fl**	**Pc**	**Pl**	**Co**
Blood pressure	Systolic blood pressure	-	-	-	-	O* Δ*	-
Mood state	Anger-hostility	Δ*	-	-	-	-	-
	Vigor-activity	-	O* Δ*	Δ*	O* Δ*	-	-
	Total Mood Disturbance	-	O*	-	O*	-	Δ*

Park Images / Psychophysiological responses	Linguistic Knowledge					
	Be	**Fe**	**Fl**	**Pc**	**Pl**	**Co**
Anxiety level	-	O* Δ*	-	O* Δ*	-	-

*p< 0.05, **p < 0.01, ***p < 0.001, Be: bench, Fe: fence, Fl: flowers, Pa: park center, Pl: plaza, Co: comfortable, o: walking, Δ: viewing.

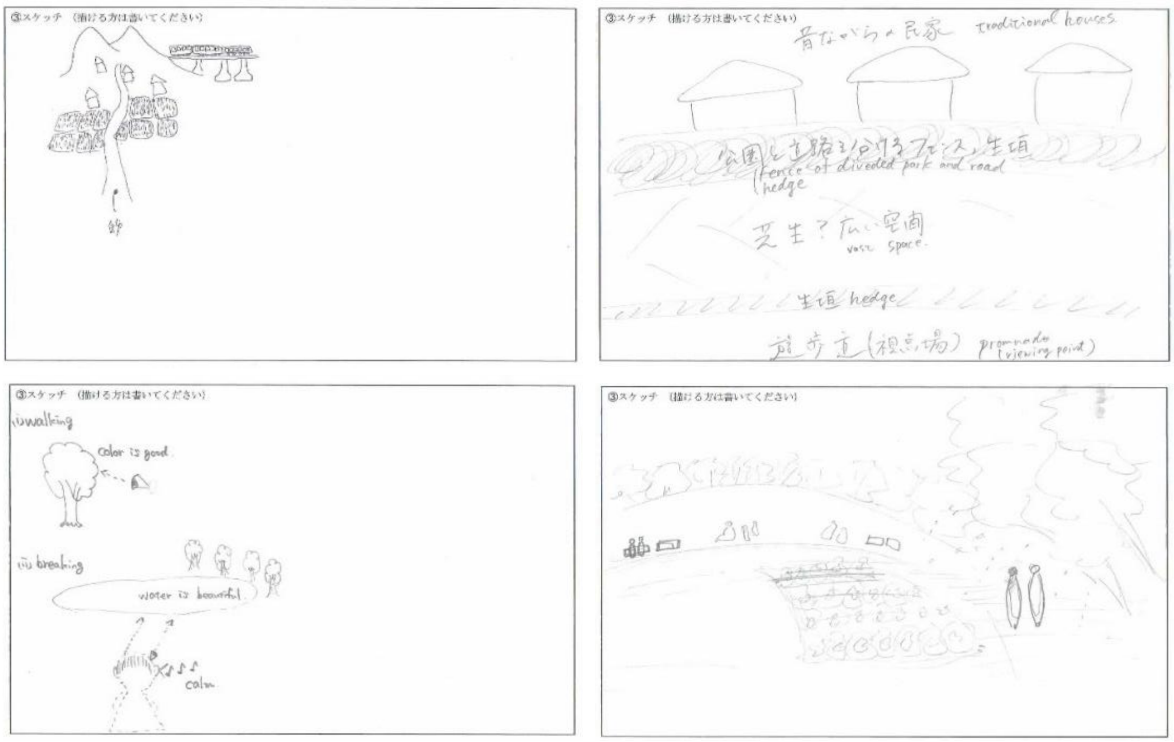


Figure 58. Park therapy image sketches of Japanese young adults

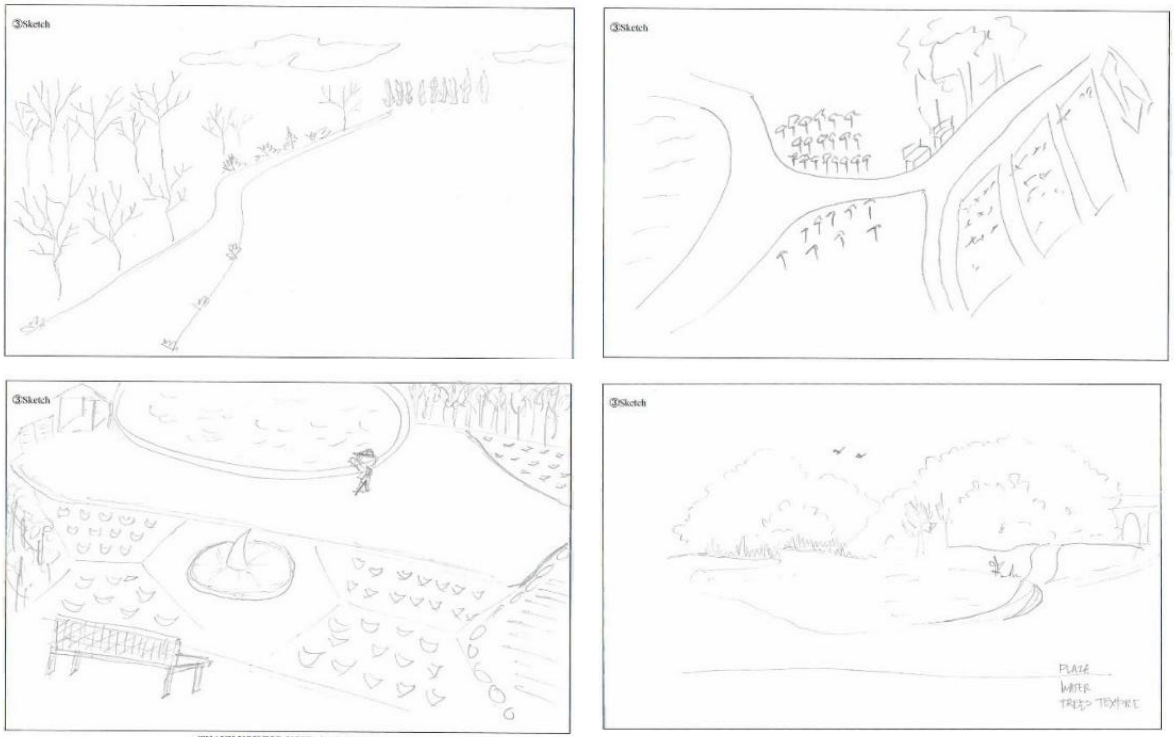


Figure 59. Park therapy image sketches of Indonesian young adults.

In order to obtain complete landscape images and investigate the seasonal verbal data, quantitative content analysis was applied. Co-occurrence network analysis showed the centrality of a particular node. The terms with the highest degree of centrality found during autumn park therapy were “sky,” “bridge,” and “pond” among Japanese (Figure 58) and “people” among Indonesians (Figure 59). The term “sky” was strongly associated with “autumn leaves,” “see,” and “sit” among Japanese. The term “see” was strongly associated with “pond,” “people,” and “maple” among Indonesians. There were seven groups of autumn landscape appreciation factors among the Japanese, 1) natural landscapes containing forest, river, and fields with some physical activities such as moving around, running, and enjoying nature, 2) maintained landscapes such as ponds, trees, shrubs, and flowerbeds, 3) creatures in the stream landscape, 4) a park and its elements with the scenery, 5) walking activities, 6) autumn leaves and the sky with many activities such as walking, viewing, strolling, and sitting, and 7) a beautiful season shown by trees and sun (Figure 60). Similarly, the six groups of autumn landscape appreciations among the Indonesians were 1) various scenery that refreshes the human mind, 2) conducting activities through maple trees and a river that refresh the human body, 3) trees, flowers, and bird sounds where people can sit and feel relaxed, 4) parks with beautiful views where people can enjoy themselves and feel comfortable, 5) many people walking and sightseeing, and 6) viewing water body and yellowish leaves as background (Figure 61).

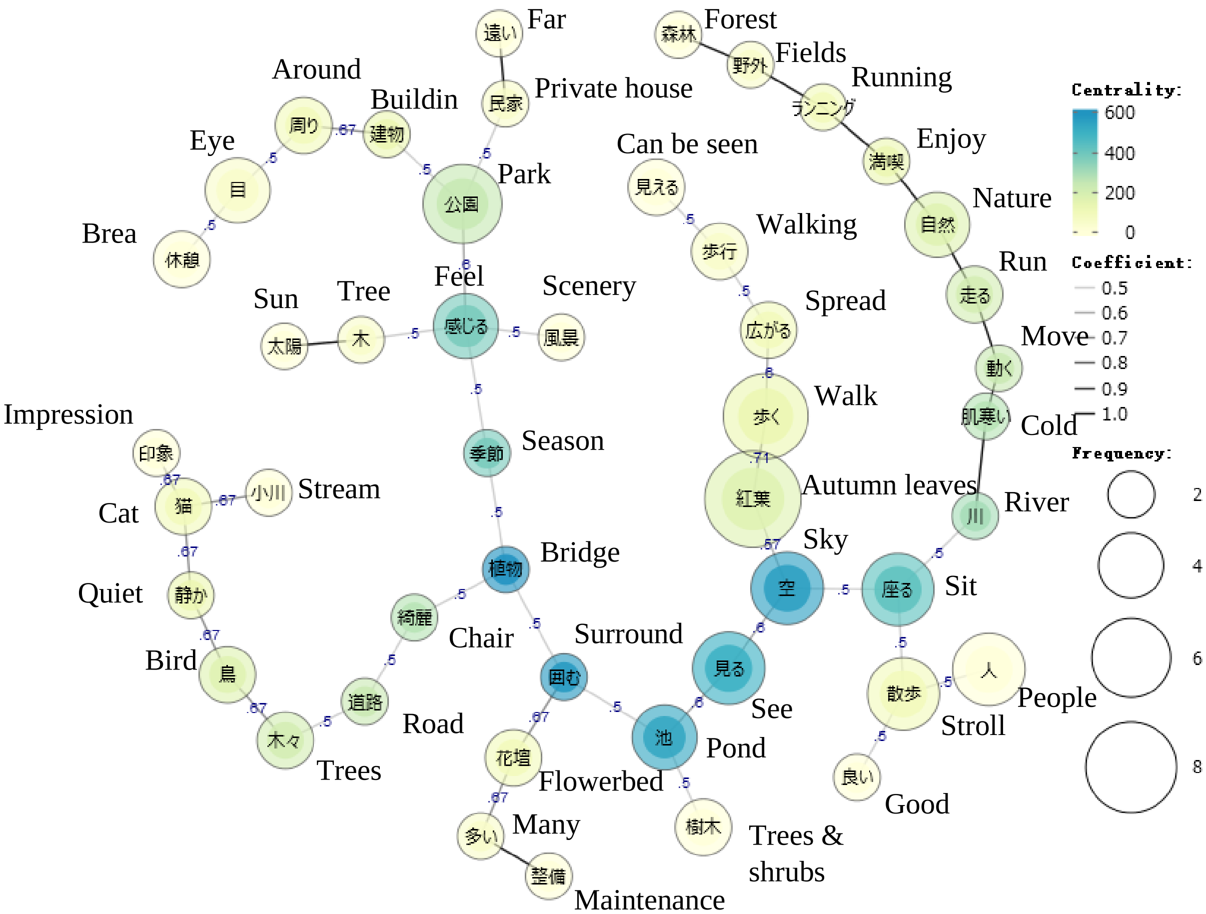


Figure 60. Co-occurrence network of park therapy images of Japanese young adults.

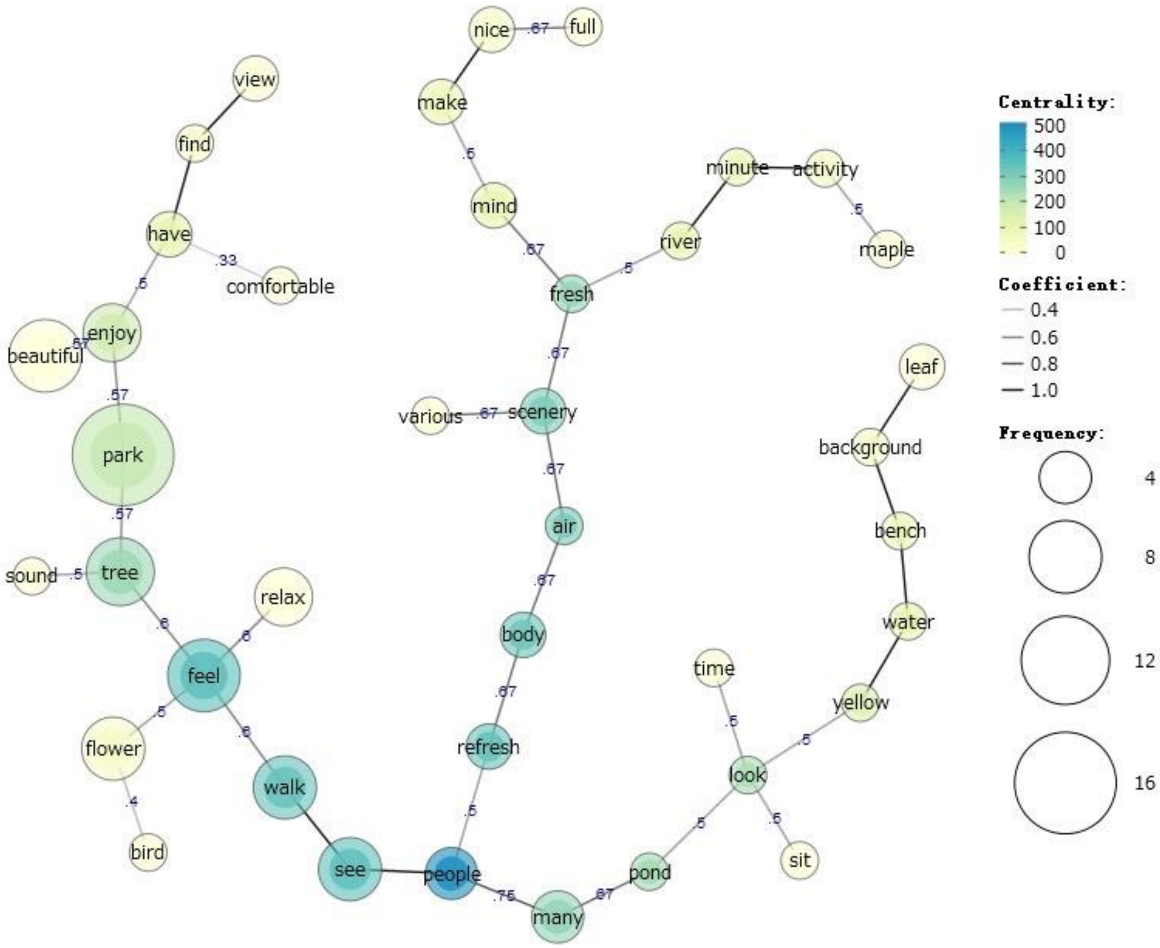


Figure 61. Co-occurrence network of park therapy images of Indonesian young adults.

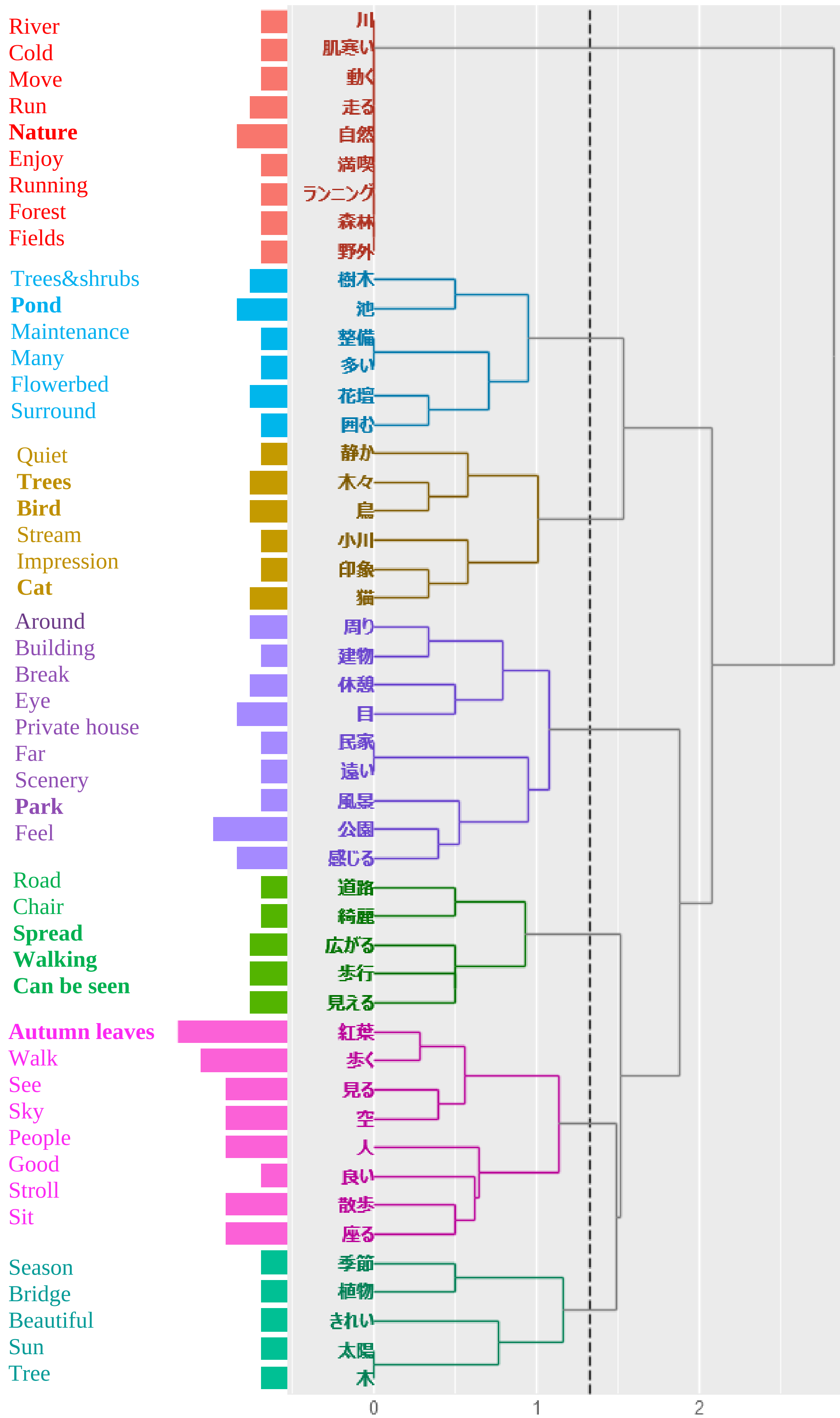


Figure 62. Dendrogram of Japanese young adults.

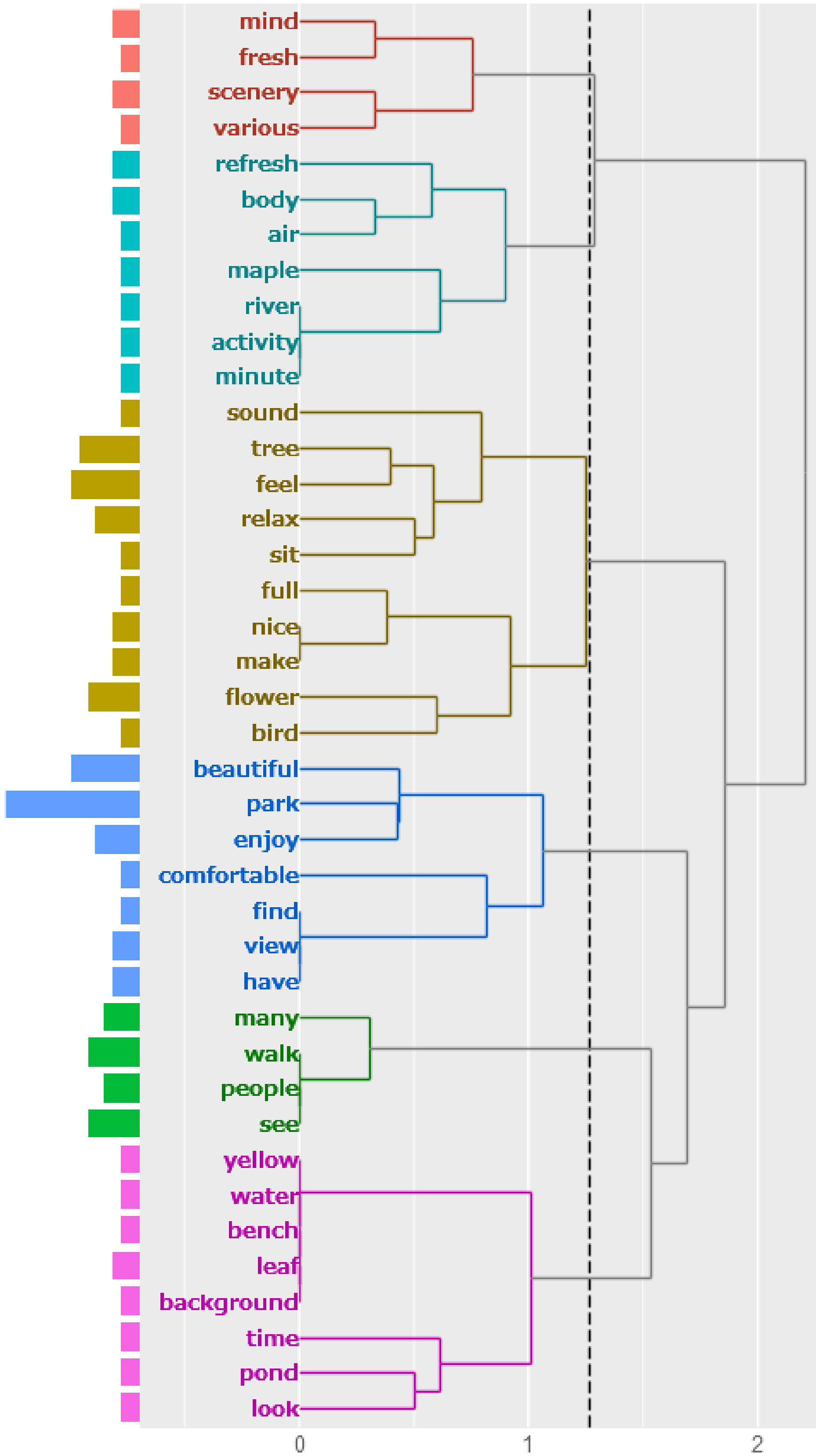


Figure 63. Dendrogram of Indonesian young adults.

6.3.3 Discussion

This study clarified the psychophysiological relaxation in young adults after performing park therapy (walking in and viewing forests) in autumn and appreciated park elements and correlations between park therapy images and psychophysiological responses. Walking in the edge of forests in an urban park is effective in decreasing heart rate and systolic blood pressure than walking in city areas in all adults. Viewing forests in urban parks led to a lower heart rate than in the city in Indonesian adults. There was a difference in physiological responses between Japanese and Indonesian young adults in which the Japanese heart rates were lower than Indonesian young adults in both environments. Moreover, the scores of tension–anxiety and Total Mood Disturbance were significantly lower in all adults; depression–dejection was significantly lower and vigor–activity was significantly higher in Indonesian adults after walking in an urban park than that in a city area. All negative and positive mood states were significantly different in Japanese adults; the scores of confusion–bewilderment, tension–anxiety, and Total Mood Disturbance were significantly lower and vigor–activity was significantly higher in Indonesian adults; and the state-anxiety level was significantly lower in Indonesian adults after walking and in all adults after viewing forests in an urban park than those in the city.

6.3.4.1 Different Physiological and Psychological Responses in Japanese and Indonesian Subjects

This study emphasizes the psychophysiological effects and attractiveness of landscape elements in an urban park during park therapy among Japanese and Indonesian young adults in autumn. The findings demonstrated different psychophysiological responses, especially in heart rate measure and vigor-activity, respectively. The Japanese showed lower heart rates in 15-minute walking in and viewing forest in an urban park, while the Indonesians exhibited higher vigor-activity in 15-minute viewing forest in an urban park. The heart rate responses might depend upon the mental health. This result is in line with previous studies that reported increased parasympathetic nervous activity among Japanese males and females and Canadian males when viewing a landscape garden compared to Canadian females (Elsadek et al. 2019). Lower Heart Rate Variability (HRV) has been linked to poorer mental health outcomes, including depression (Larsen and Christenfeld 2009) and anxiety (Tully et al. 2013). Interestingly, the Indonesian young adults reported feeling higher vigor-activity when viewing ornamental cabbages and Sendabori pond in the short distance and colored-leaved forest in the medium distance than did Japanese young adults. This is similar to the finding of Pratiwi et al. (2014) that Indonesian students preferred unusual, exotic, majestic, and landscapes they had not seen in their tropical country. Lehman et al. (2004) also stressed that a culture influences the perceptions, feelings, and behaviors of its members.

Both Japanese and Indonesian young adults had lower heart rates and blood pressure in 15-minute walking in an urban park than a city area. Only Indonesian young adults had lower heart rates in a brief viewing in urban park than the city. Furthermore, they showed a greater effect on negative mood state derivation, anxiety level, and positive mood elevation after seated viewing. Both walking in and seated viewing in an urban park might constitute an effective park therapy program for the health of young adults. This result is congruent with those of previous forest therapy studies (Tsunetsugu et al. 2007; Park et al. 2009, 2010; Rajoo et al. 2019; Janeczko et al. 2020). The mixed forests with coniferous and broad-leaved trees have the most abundant color diversity, so their beauty values are higher than those of pure forests (Zhang et al. 2020). In autumn, the variation of color from green and red trees to purple and orangish-brown trees is preferred, because they may be cues to the survival characteristics of a habitat (Kaufman and Lohr 2004). Thus, the old-growth forest in urban parks was an important resource to be preserved due to its value of physiological and psychological restoration (Simkin et al. 2020). In contrast, the higher heart rate among Japanese during viewing in an urban park than in a city area might have been caused by environmental stimuli (e.g., temperature, relative humidity, noise) (Pratiwi et al. 2019, Lyu et al. 2019). Both Japanese and Indonesian adults exhibited a greater impact on psychological responses than physiological ones. We found that most negative mood states and anxiety levels declined, while positive mood state increased after the last viewing session in the urban park in autumn. This result was in line with those of previous forest therapy studies (Song et al. 2015; Park et al. 2010; Joung et al. 2015; Takayama et al. 2019; Bielinis et al. 2019).

6.3.4.2 Comparison of Park Appreciation between Japanese and Indonesian subjects

After walking and viewing experiment, young adults created sketches containing elements, values, meaning, attitudes, and understandings of the experienced place. Experienced park images revealed objectively autumn-colored foliage (54.5%) with the sky as the background among the Japanese and tranquility feeling (44.4%) from viewing the elements of the park among the Indonesian. Regarding psychophysiological responses, the experienced park images, sketched attractive elements, viewing point, and attitudes showed correlations with decreased heart rates, blood pressures, negative mood states, anxiety levels, and increased positive mood state among Japanese young adults. Japanese young adults perceived trees, bench, Tea house, autumn leaves, herbaceous plants, flowers, sideway view, objective scene, and surrounding place. Only sketched man-made park elements and subjective feeling had correlations with decreased blood pressure, negative mood states, anxiety levels, and increased positive mood state among Indonesians. Indonesian young adults perceived flowers, relaxation rooms (Park Center), openness (plazas), bench, and comfortable feeling as relevant elements in urban parks. This finding shows that non-Japanese individuals can appreciate Shinrin-yoku through experienced attractive elements by expressing their feelings, while Japanese people, with higher familiarity with their spatio-temporal landscape, could describe the park images well (Pratiwi et al. 2014). This factor is driven by human memory and previous experiences with the landscape (Oku and Fukamachi 2006).

The current study showed that walking and viewing autumn-colored foliage in an urban park led to psychophysiological relaxation among young adults. Since there are many evidence-based studies on forest therapy in Japanese young adults, this study provides cross-cultural comparison showing a significant possibility of park therapy effect in tropic young adults for managing academic or work stress. This study argues that the long tradition of hunting for autumn foliage, called Koyo and Momiji, not only provides scenic beauty, but also affords physiological and psychological relaxation. Following WHO's global action regarding physical activity promotion, exotic and traditional landscape elements could be mingled with park therapy programs to improve physical and mental health. Park therapy programs highlighting Japanese exotic and traditional beauty sites for students' outdoor activity could be effective options for one's leisure time on weekends or holidays to reduce academic stress. This study has certain limitations, however. First, it measured only physiological, psychological, and spatial cognition. Other evaluations, such as landscape aesthetics and behavior using geo-tagged photography and virtual reality (VR), hold great promise for a wider range of findings. Second, this study was conducted during only one season due to limitations of time. In future studies, richer traditional-based seated viewing scenes and walking courses in each season are essential. These limitations must be addressed in future research.

6.3.5 Conclusion

Walking in an urban park led to a lower heart rate than walking in a city area. Walking in urban parks is more effective in decreasing systolic blood pressure than viewing city areas. There was a difference in physiological responses between Japanese and Indonesian young adults, such that the Japanese heart rates were lower than those of Indonesian young adults. Moreover, the scores of tension–anxiety and Total Mood Disturbance were significantly lower among adults; depression–dejection was significantly lower and vigor–activity was significantly higher among Indonesian adults after park walking. All negative and positive mood states were significantly different among Japanese adults; the scores of confusion–bewilderment, tension–anxiety, and Total Mood Disturbance were significantly lower and that of vigor–activity was significantly higher among Indonesian adults; and the state-anxiety level was significantly lower after park walking among Indonesian adults and after park viewing among adults. Park therapy images showed the "autumn-colored foliage" among Japanese young adults and "tranquility feeling" among Indonesian young adults. The correlation among park therapy images and psychophysiological response were high in "bench" among Japanese young adults, "fence" and "park center" among Indonesian young adults. Besides the natural elements, Man-made elements were also a necessary medium to support outdoor relaxation. The results of this study suggest that a combination of walking and viewing in the urban park can be useful outdoor activities for foreign adults to reduce stress and enhance physical and mental health.

CHAPTER 7. CONCLUSION AND FUTURE RESEARCH

7.1 Summary

This chapter includes the formulation of Perceived and Experienced Urban Green Space, in the case of Matsudo City. Paper I (Chapter 4) investigate how the residents with different dwelling type perception of surrounding Urban Green Space regarding merits, reluctances, and attitudes. The two prominent points of merits of UGS among residents were distance and dust absorption; the four points of attitudes towards UGS were creature recognition, community attachment, managed and convenient place. Paper II (Chapter 5) focuses on travel history-based preferences of nearby parks. The three prominent points of park preference were nearby and large parks, length of park visit, and park elements. Paper III (Subchapter 6.1) emphasizes the evidence-based physiological and psychological effects of walking in different seasons among middle-aged and older adults, as well as landscape images of experienced urban park and investigates how physiological and psychological parameters of park therapy correlates with the evaluation of landscape image which is important to develop a therapeutic park. Walking in urban parks leads to physiological, psychological relaxation, and varied landscape appreciation. This paper suggested special features of park landscape (accessible walking course, medium distance, diversity of seasonal landscape changes, e.g., greenery, flowers, birds, water, lawn, physical activity). Paper IV (Subchapter 6.2) stresses the evidence-based physiological and psychological effects of seated viewing in different seasons among middle-aged and old adults. Viewing urban parks results in physiological (blood pressure) and psychological relaxation. This paper suggested the composition of park therapy scenes by considering the significant natural elements (e.g., flowers, water bodies, and maintained greenery) as input for therapeutic park design to provide higher value of relaxation benefits. Paper V (Subchapter 6.3) discusses the cross-cultural comparison of evidence-based physiological and psychological effects of walking and seated viewing in autumn among young Japanese and Indonesian young adults. This paper showed a significant possibility of park therapy effect in tropic young adults to urban planners for managing academic or work stress. Finally, the last chapter discusses the demonstrated health benefit of urban green space, design guidelines for park therapy, novelty, limitations, and future research as well as possibilities. Table 34 shows the summary of the five included papers, their purpose, context, subject, method, and the type of data used.

Table 34. Summary table for the papers included in the dissertation. Perceived and experienced UGS framework is engaged in each paper but in different contexts, stressing different aspects of evidence-based green space planning and design.

Details	**Paper I (Chapter 4)**	**Paper II (Chapter 5)**	**Paper III (Subchapter 6.1)**	**Paper IV (Subchapter 6.2)**	**Paper V (Subchapter 6.3)**
Purpose	To clarify the differences in green space perception between housing complex and apartment residents, to examine what residents' attributes may influence their green space management experience, and to formulate factors inducing residents' awareness and attitude toward green spaces.	To investigate the neigbourhood park preference, length of park visit, activities, park elements, disturbances in the park between housing complex and apartment residents.and factors inducing preferences	To clarify the physiological and psychological effects of walking, to analyze park therapy images, and to analyze correlations between park therapy images and physiological-psychological responses in urban parks in winter, spring, and early summer.	To clarify the physiological and psychological relaxation effects of remaining sedentary while viewing cherry blossoms in spring and fresh greenery in early summer.	To determine whether there were significant differences in physiological and psychological responses between Japanese and Indonesian young adults, to analyze the attractive elements of the parks, and to analyze the correlations between park images and psychophysiological responses
Context	Urban green space	Neighborhood parks	Urban park	Urban park	Urban park
Subject	Residents in Tokiwadaira Area	Residents in Tokiwadaira Area	Middle-aged and older residents living in Tokiwadaira Area and surroundings	Middle-aged and older residents living in Tokiwadaira Area and surroundings	Domestic students (Japanese), foreign students (Indonesian) of Chiba University

Details	**Paper I (Chapter 4)**	**Paper II (Chapter 5)**	**Paper III (Subchapter 6.1)**	**Paper IV (Subchapter 6.2)**	**Paper V (Subchapter 6.3)**
Method	Statistical analysis with respondent's evaluation of Merits, Reasons for Reluctance, Attitudes towards UGS	Statistical analysis with Spatial park preference, potential activity, park visit, elements, disturbances	Real-time walking therapy in urban park and city area as control with cross design in winter, spring, and early summer	Real-time seated viewing in urban park and city area as control with cross design in spring, and early summer	Real-time walking and seated-viewing in urban park and city area as control with cross design in autumn
Data	Mail-back response (*N*=220)	Mail-back response (*N*=220)	Physiological response of heart rate, blood pressure, mood states, anxiety levels, visual and verbal data through landscape sketches (*N*=36), environmental variables (temperature, humidity), demography data	Physiological response of heart rate, blood pressure, mood states, and anxiety levels, environmental variables (temperature, humidity), demography data	Physiological response of heart rate, blood pressure, mood states, and anxiety levels, visual and verbal data through landscape sketches (*N*=20), environmental variables (temperature, humidity, wind speed, noise, light intensity), demography data

7.2 **Demonstrated Health Benefit of Urban Green Spaces**

The perceived and experienced UGS defines the merits of UGS, attitudes towards UGS, preferences toward nearby UGS, real-time cardiovascular and psychological benefit, and the relationship with the experienced park elements. Overall, the main theoretical concerns of this dissertation might be summarized in three basic questions: 1) what kind of categories the PE UGS ultimately describe, i.e. what they are, 2) which they are, i.e. how to best understand the essence of each PE UGS factor, and 3) how they might be understood in relation to each other. These concerns will all be addressed in this section. PE UGS defines middle-aged and older adults' perception characterized by proximity and environmental services of green spaces (e.g. controlling dust) (Rupprecht et al. 2015; Rupprecht 2017; Kim et al. 2019). They are corresponding to motivational factors regarding people's environmental relations (nature exposure needs). Their preferences toward large nearby green spaces (e.g. neighborhood parks), length of park visit, and park elements were characterized by the existence of green space in a residence and recognition of a quantity of surrounding green space. This finding is consistent with the previous study that diverse facilities of the park, number of parks, amount of park space, park proximity served as attracting factors of park use (Lackey et al. 2009; Dyck et al. 2013; Kaczynski et al. 2014). Individual factors (e.g. age, education, family status, BMI), neighborhood factors (perception of safety, aesthetic, and cohesion) associated with perceived-objective park proximity match. While neighborhood walkability and neighborhood income associated with the overall number of park visitors. They are corresponding to 3 dimensions of individual, neighborhood, and park attracting factors (Lackey et al. 2009). Figure 62 shows the continuum of human perception of UGS towards the multiple benefits of UGS.

Through experiencing urban parks in winter, spring, and early summer, associated elements, and subjective feelings were detected among middle-aged and older adults (Figure 63 and 64). Walking in winter was more effective in improving cardiovascular health (heart rate) reducing negative moods and state anxiety, walking in spring was more effective in improving cardiovascular health (heart rate and blood pressure) and positive mood and reducing state anxiety, walking in early summer was more effective in cardiovascular health (heart rate) and reducing negative moods and state anxiety. Seasonal variations of stimulus might affect cardiovascular and psychological health outcomes, such as deciduous trees, comfortable and relaxed feeling in winter, greenery, bird, activity, middle distance, and surrounding landscape in spring, flowers, tranquility, and middle distance in early summer. Seated viewing in spring was more effective in improving cardiovascular health (blood pressure) and vigor-activity, reducing total mood disturbance, seated viewing in early summer was more effective in improving cardiovascular health (blood pressure) and reducing state anxiety.

Surprisingly, cross-cultural comparison through a combination of two activities among young adults showed physiological and psychological relaxation in autumn (Figure 65). As Japanese adults get used to autumn colored-leaves, trees, and forests, they had improved cardiovascular (heart rate and blood pressure) especially after walking in an urban park, and psychological health after viewing in urban parks. Furthermore, Indonesian adults as foreign students who never participated in Shinrin-yoku before, they had improved cardiovascular (heart rate and blood pressure) especially after walking in an urban park, and psychological health after viewing in an urban park. The appreciated park elements among Japanese such as trees, herbaceous plants, flowers, middle distance, diverse sceneries, and surrounding landscape. The natural landscape elements, such as coniferous trees produce phytoncides (essential wood oils) investigated in previous forest therapy studies that this practice is believed to improve immunocompetence through plant-derived physiological relaxation (Li et al. 2006, 2007, 2008). A brief walk in green space therapy in an urban park during different seasons among young adults decreased heart rates, increased parasympathetic nervous activity, inhibited sympathetic nervous activity (Song et al. 2013, 2014, 2015). Sedentary activity, seated viewing in kiwifruit garden in summer among middle-aged women induced higher levels of ln (HF), increased parasympathetic nervous activity, and generated a state of physiological relaxation (Igarashi et al. 2015). Furthermore, seated viewing of the forest on a hospital rooftop among elderly patients requiring long-term care increased parasympathetic nervous activity and decreased sympathetic nervous activity (Matsunaga et al. 2011).

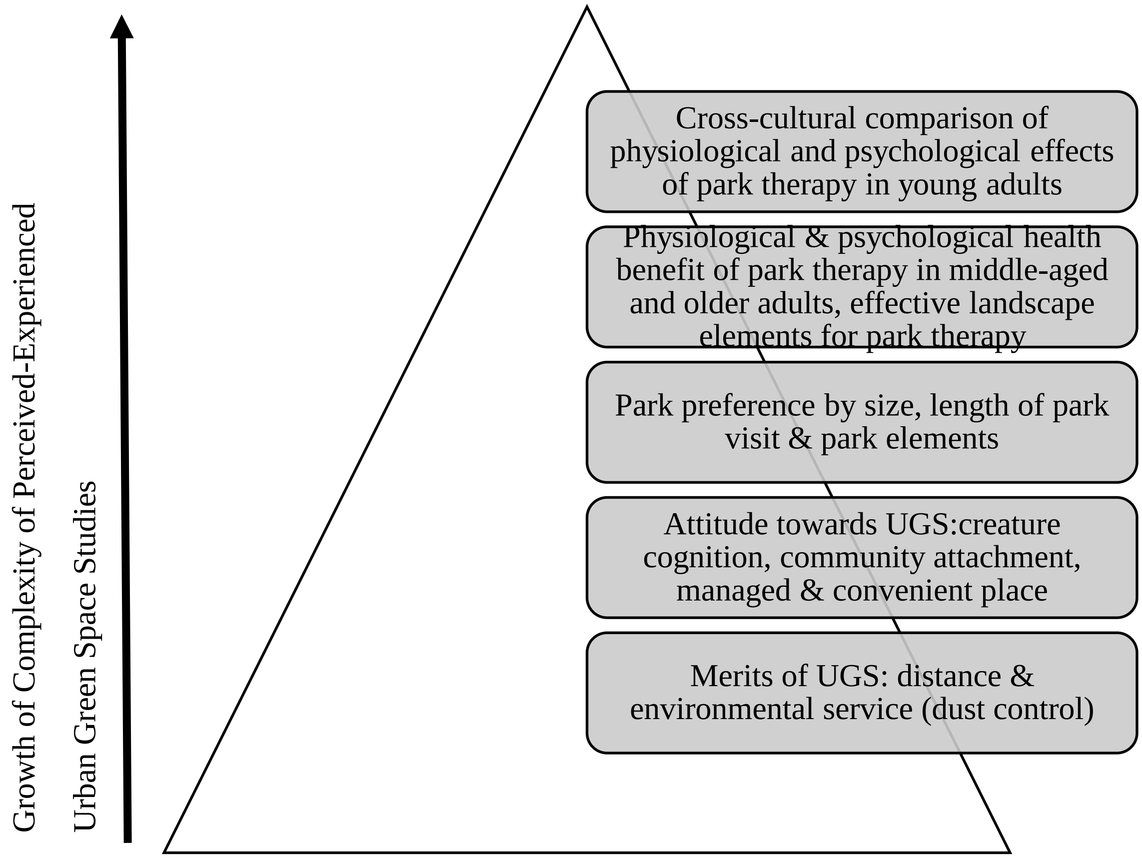


Figure 64. Growth of complexity of Perceived-Experienced Urban Green Space studies.

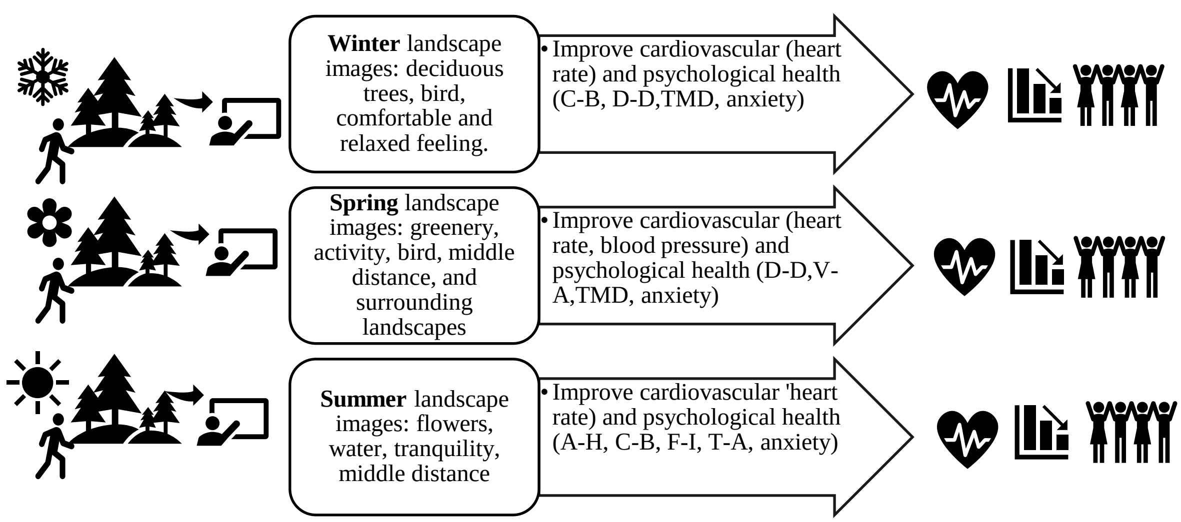


Figure 65. Schematic diagram of health benefit of walking on middle-aged and older adults.

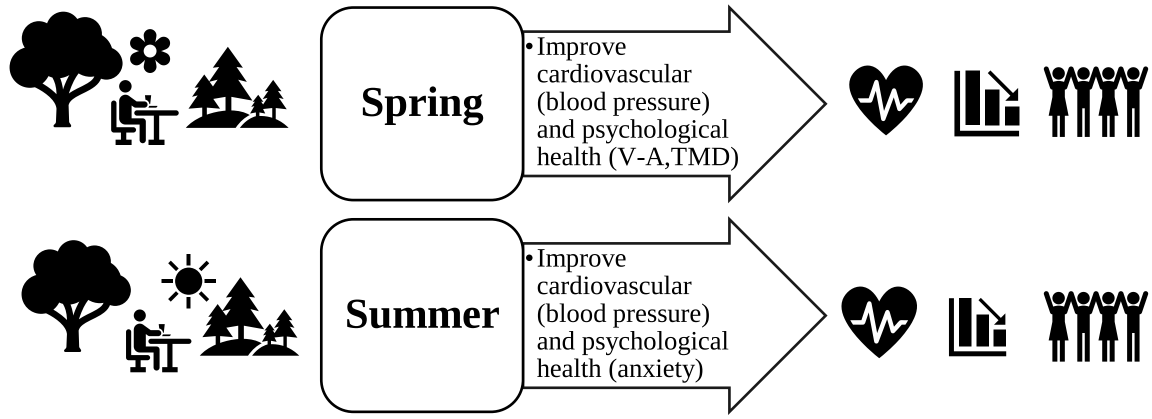


Figure 66. Schematic diagram of health benefit of seated viewing on middle-aged and older adults.

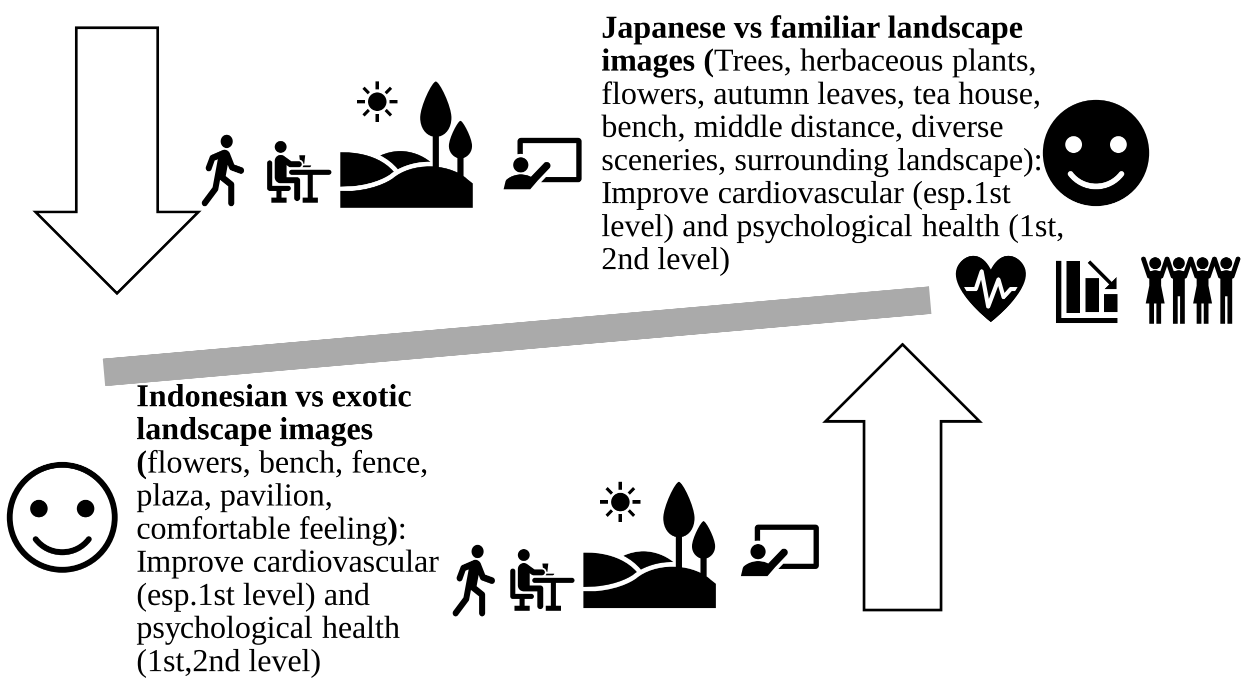


Figure 67. Schematic diagram of health benefit of walking and seated view among young adults.

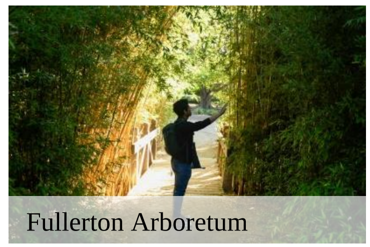
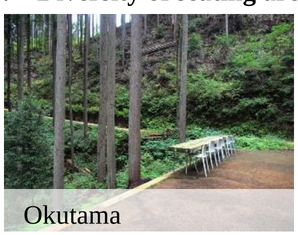
7.3 Design Guidelines for Park Therapy

The design principles of park therapy roads and viewing scene for adults are listed below (Morimoto et al. 2006; Zeisel 2007, Marcus & Sachs 2014; Plat et al. 2017, Table 35).

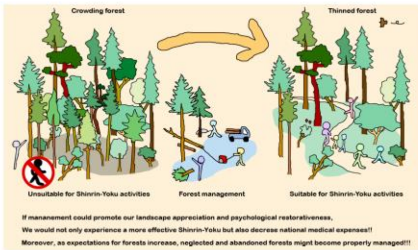
- Provide appropriate scenic spots and landmarks, such as lawn, pavilion, flowers, trees, pond and its promenade that has sufficient seating and large space to be used for social events or programmed activities organized by the staff.
- Provide plenty of choice in seating area, walking routes, viewing scenes, and destinations (scenic spots).
- Ensure that the garden is attractive, well maintained, and rich with amenities.
- Allow for views out to the wider landscape so that residents can feel community attachment.
- Emphasize plants with flowers or foliages in saturated colors such as red, yellow, or orange, since colors in the blue/ lavender range tend to be perceived as grey when older people develop cataracts.
- Emphasize intricate planting with varieties of color and texture at or below eye level, since some older people walk in a semi stooped posture.
- Provide some interesting planting to touch or smell at the height of someone using a wheelchair along the walking course and seating area.
- Provide water body as source of therapeutic landscape elements with its relaxed sound and cooling effect in the summer.
- Promote greening with native species while taking into account vegetative continuity to the natural conditions in the areas around the greenery which contribute to the networking of habitat for a wide variety of animals, and to be effective in conserving and restoring the biodiversity for urban areas.
- Include a range of scented flowering plants that can be enjoyed throughout the year.

- Consider Cherry and Maple tree which has special sacred cultural significance for adults.
- Use clear visual landmark as gate and signage for orientation, fence surrounding the site for security.
- Provide pathways and handrail for supporting people with dissabilities, as well as medical device facilities for visitor with cardiovascular disease such as AED (Automated External Defibrillator), etc.

Table 35. Design guidelines for park therapy.

Requirement	Park Image Components			
	Linguistic knowledge	Spatial view	Self-orientation	Social Meaning
1. Load  Hinohara  Okutama Lake Ikoino  Fullerton Arboretum Source: www.kankyo.metro.tokyo.lg.jp; www.okutama-therapy.com; www.ocregister.com	-	-	Easy to walk (1.5-2 m), sand, paved/wood path	-
2. Diversity of loads  Tomin-no-Mori  Okutama Source: www.google.com	-	-	• 1 km for middle-aged and older adults • 2 km for young adults	-
3. Diversity of seating areas  Okutama   Source: universe-mindfulness.com	-	-	Plenty of choice in seating area based on scenic spots	-

Requirement	Park Image Components			
	Linguistic knowledge	**Spatial view**	**Self-orientation**	**Social Meaning**
4. Feature of park landscape  Source: Matsudo city (2019), Pratiwi (2019)	Scenic spot: flowers, foliages, herbaceous plants, lawns, birds, activity, plaza, pavilion Landmark: trees, ponds	Bird's eye view, sideway view (medium distance, 100-200 m)	-	-
5. Diversity of landscape changes  Source: Pratiwi (2019)	Broadleaved and deciduous forest (secondary forest) with native species, a range of scented flowering plants that can be enjoyed throughout the year.	-	Diverse sceneries	-
6. Comfortable space  Source: Pratiwi (2019)	Comfortable, relaxed, tranquil, calm (subjective feeling), tea house and cafe (restaurants offering local specialties)	-	Surrounded by greenery but still allow borrowed view to have sense of belonging	-

Requirement	Park Image Components			
	Linguistic knowledge	Spatial view	Self-orientation	Social Meaning
7. Management  Source:Takayama et al. (2017)	Maintain park facilities, such as wooden benches, signs, fences	-	Cutting and clearing about 20 m from walking course	-
8. Road and viewing point sign  Source: www.google.com	-	-	Maintain signs at junctions, entrance, exit with the contents: inclination, distance, calorie consumption, physiological and psychological effects of park therapy	Cooperation in management with NPOs, NGOs,etc.
9. Access  Source: www.google.com	-	-	Give access information of people with dissability and provide safety path (equipped by ramp)	-

7.4 Novelty

These findings employing Perceived and Experienced UGS framework as tools for evidence-based park planning and design might help urban planners to conduct participatory planning and design, as follows:

1. Put some green space nearby housing complex at least 250 m from home and select dust and pollutants-absorbent plants in neighborhood green space, both in block parks, neighborhood parks, and green lane road.
2. Design and manage parks ecologically with good accessibility and security as well as clear orientation in order to grow nature affection and understanding of environment coexist.
3. Provide adequacy of seating areas and shade trees for relaxation in parks.
4. Promote both walking in and viewing in urban parks every season to have physiological and psychological relaxation, especially spring walking and viewing.
5. Promote those activities in order to have experience of thermal comfort, positive feeling, sensing of nature color, smell, sound, texture that characterized by sketched park therapy images using LIST (Landscape Image Sketching Technique) method.
6. Consider significant seasonal landscape elements' composition for walking course and viewing scene design, tree stands management for the accessible walking course and viewing scene, and select medium distance for viewing the scenes.
7. Consider exotic and traditional landscape elements as well as amenities such as pavilion and local restaurant in the urban park to be taken into account to maintain academic stress in young adults.

7.5 Limitations

This study has some limitations. First, middle-aged residents (over 40) accounted for more than half apartment respondents (59.06 %), while older residents (over 70) accounted for more than half of housing complex respondents (56 %). Therefore, it is assumed that the perception of the middle-aged and older residents has been reflected more strongly. However, this can be interpreted to provide a glimpse into the future Matsudo is heading towards due to the rapid aging process ongoing in Japan. Second, the number of ‘unreturned’ questionnaires to the perceived UGS were found in our survey responses. In the future, I propose used Social Networking Services (SNS) and online questionnaires by snowball sampling method to community association in each area or district. Third, we also used the printed Tokiwadaira area map as our study location, the selection of park preference is limited to a sheet of paper. If we use an online questionnaire, we could make a wider selection using Google Maps. In the second research, first among which is the small number of middle-aged and older adults participating in park therapy in each season. It was not easy to find middle-aged participants who did not use blood pressure and heart disease medication and could participate in park therapy experiments for 5.5 h. Therefore, further study using larger samples of middle-aged and older adults and a randomized controlled trial of city citizens with the cooperation with the city government is involved in order to obtain larger participants and draw more reliable and significant results. Second, physiological indices used only measured blood pressure and heart rate. Other physiological indices and landscape aesthetic preferences, such as eye movement, brain blood flow, geo-tagged photography, and VR (virtual reality) are necessary for comprehensive and advanced findings. Third, this study was conducted in only one seated viewing scene and walking courses per season in an urban park. For future studies, more seated viewing scenes and walking courses per set of the experiment are required. These limitations must be considered in future research. In the third research, the small number of young Japanese and Indonesian adults participating in park therapy. Based on Shinrin-yoku preference, experimental time become factors promoting their willingness to participate in Shinrin-yoku. Spring and summer holiday are the priority time to conduct park therapy in young adults. Therefore, further study using larger samples of young adults and a randomized controlled trial of university students with the cooperation with the Students Association are involved in order to obtain larger participants and draw more reliable and significant results. All limitations must be addressed in future research.

7.6 Future Research and Possibilities

This dissertation has investigated a human motivational towards green space model using perceived and experienced urban green space approach to environmental planning and design. It has examined by investigating a framework consisting of merits of UGS, attitudes towards UGS, park size, park elements, cardiovascular and psychological health, appreciated landscape elements. In line with a human motivational model with the global challenge such as urbanization, pandemic diseases, remote working, this opens the possible opportunity to employ a wide range of environmental design such as remote park therapy design using virtual green space using virtual reality (VR) technology, self-report activity in nearby green space using online questionnaires, preferred park elements while conducting physical activity using geo-tagged photographs, green space-related physical activity report using the application (big data analysis), and qualitative research on park therapy experience essays. For a country with established forest and park therapy research, a study on improvement of policies in promoting the development of the forest therapy industry. The related costs of forest therapy activities should be committed to adding in the national or regional medical insurance system, which should play a key role in enhancing the overall sense of well-being and balance in life (Zhang et al. 2020).

Therefore, a country without the experience of forest and park therapy research, such as Southeast Asian countries that has potential in its biodiversity like Indonesia, basic research should be conducted. Indonesia with its multiethnicity and biodiversity of flora and fauna in forest landscape would become a future challenge to be examined in the context of forest and park therapy. Indonesia is estimated to have 25% of flowering plant species that is in the world or is the seventh-largest country with a number of species reaching 20,000 species, 40% are endemic or native plants to Indonesia (Whitemore 1986 in Santoso 1996). In the micro-scale of green space, Indonesian has a typical home garden called by *pekarangan*, with high biodiversity of landscape plants using local knowledge in planning and design. In the meso scale, Indonesian has *alun-alun* or city square, with *Ficus benjamina* as vocal point surrounded by the mosque in West, city hall in South, and commercial business district in North and East. In the macro scale, Indonesia has a nature park that is utilized for tourism and nature recreation. In addition to tourism activities, this area has the function of protecting the life support system for the surrounding area. Furthermore, a national park has native ecosystems, managed by zoning systems that are utilized for research, science, education, supporting cultivation, tourism, and recreation. I believe that the collected research suggests the perceived and experienced urban green space (PE UGS) framework to offer an evidence-based scale of analysis which is applicable in various contexts and at different scales, including those of home garden, urban or rural green spaces, and regional green spaces in Indonesia. Moreover, in the era of 4.0 development due to climate change and pandemic diseases in Indonesia, Indonesia faces a new challenge to innovate all of the sectors. Especially in research and technology, conducting virtual forest and park therapy in adults would become the next bright milestone for promoting forest and park therapy research.

REFERENCES

1. Abdullah, Y.A.; Zulkifli, F.L. Concept and theories of happiness of population in urban neighbourhoods. *Env. Behav. Proceeding J*. **2016**, *1*, 260–268.

2. Alabbasi, A. M.; Said, I. Restorative effects of open spaces on the physiological health of obese adults in Saudi Arabia. *Env. Behav. Proceeding J***.** **2018**, *3*, 55–64.

3. An, B.Y.; Wang, D.; Liu, X.J.; Guan, H.M.; Wei, H.X; Ren, Z.B. The effect of environmental factors in urban forests on blood pressure and heart rate in university students. *J. Forest Res.* **2019**, *24*, 27–34.

4. Aono, Y.; Kazui, K.; Phenological data series of cherry tree flowering in Kyoto, Japan, and its application to reconstruction of springtime temperatures since the 9th century. *Int. J. Climatol.* **2008**, *28*, 905–914.

5. Bandi, A.N.Z.; Teleki, S.A.; Csokasi, K.; Rozsa, S.; Bandi, S.A. Development of the short version of the spielberger state—trait anxiety inventory. *Psychiatry Research* **2020**, *291*, 113223.

6. Bell, K.B.; Lindenfeld, L.; Speers, A.E.; Teisl, M.F.; Leahy, J.E. Creating Opportunity for Improving Lake-Focused Stakeholder Engagement: Knowledge-Action Systems, Pro-Environment Behavior and Sustainable Lake Management. *Lakes & Reservoirs: Research and Management* **2013**, *18*, 5–14.

7. Bielinis, E.; Lukowski, A.; Omelan, A.; Boiko, S.; Takayama, N.; Grebner, D.L. The effect of recreation in a snow-covered forest environment on the psychological wellbeing of young adults: Randomized controlled study. *Forests* **2019**, *10*, 1–17.

8. Calogiuri, G.; Litleskare, S.; Fagerheim, K.A.; Rydgren, T.L., Brambilla, E.; Thurston, M. Experiencing nature through immersive virtual environments: Environmental perceptions, physical engagement, and affective responses during a simulated nature walk. *Frontiers in Psychol*. **2018**, *8*, 2321.

9. Cameron, R.W.F.; Brindley, P.; Mears, M.; McEwan, K,; Ferguson, F.; Sheffield, D.; Jorgensen, A.; Riley, J.; Goodrick, J.; Ballard, L.; Richardson, M. Where the wild things are! Do urban green spaces with greater avian biodiversity promote more positive emotions in humans?. *Urban Ecosyst*. **2020**, *23*, 301–317.

10. Carmin, C.; Ownby, R.L. *Assessment of Anxiety in Older Adults*. In: Handbook of Assessment in Clinical Gerontology, Lichtenberg, P.A. Academic Press, 2010.

11. Chen, H.; Yu, C.; Lee, H. The effects of forest bathing on stress recovery: evidence from middle-aged females of Taiwan. *Forest* **2018**, *9*, 403.

12. Chiavacci, D. The Life We Longed For: Danchi Housing and the Middle Class Dream in Postwar Japan. *Social Science Japan Journal* **2019**, *22*, 320–323.

13. Clark, N.E.; Lovell, R.; Wheeler, B.W.; Higgins, S.; Depledge, M.H.; Norris, K. Biodiversity, cultural pathways, and human health: a framework. *Trends Ecol Evol*. **2014**, *29*, 198–204.

14. Cox, D.T.C.; Shanahan, D.F.; Hudson, H.L.; 1, Fuller, R.A.; Anderson, K.; 1, Hancock, S.; Gaston, K.J. Doses of nearby nature simultaneously associated with multiple health benefits. *Int. J. Environ. Res. Public Health* **2017**, *14*, 172.

15. Cox, E., Turley, A., Davies, B., Harrison, M., et al. (2013). The condition of Britain. Love thy neighbourhood: People and place in social reform. IPPR North. Retrieved from http://www.ippr.org/assets/media/images/media/files/publication/2013/11/love-thy-neighbourhood Nov2013 11478.pdf. Retrieved: August 2018.

16. de Pinho, J.R.; Grilo, C.; Boone, R.B.; Galvin KA.; Snodgrass JG. Influence of Aesthetic Appreciation of Wildlife Species on Attitudes towards Their Conservation in Kenyan Agropastoralist Communities. *PLOS ONE* **2014,** 9, 2, e88842.

17. Deborah, F. C., & Evans, K. L. Visits to urban green-space and the countryside associate with different components of mental well-being and are better predictors than perceived or actual local urbanisation intensity. *Landsc. Urban Plan.* **2018**, *175*, 114–122.

18. Diener, E.; Biswas-Diener, R. Epilogue: about the science of happiness. In *Happiness: Unlocking the Mysteries of Psychological Wealth*; Blackwell Publishing Ltd: Oxford, United Kingdom, 2008: pp. 244-253.

19. Dijk, E.; Weffers, M. Breathe with the ocean: A system for relaxation using combined audio and haptic stimuli. In Proceedings of the Special Symposium on Haptic and Audio-Visual Stimuli: Enhancing Experiences and Interaction, Amsterdam, The Netherlands, 7 July, 2010.

20. Dosmann, M.S.; Iles, J.K.; Widrlechner, M.P. Stratification and light improve germination of katsura tree seed. *HortTechnology* **2000**, *10*, 571–573.

21. Dyck, D.; Van, Sallis, J.F.; Cardon, G.; Deforche, B.; Adams, M. A.; Geremia, C. Associations of neighborhood characteristics with active park use: an observational study in two cities in the USA and Belgium. *Int J of Health Geographics* **2013**, *12*, 1–9.

22. Elias, N. *Die hofische Gesselschaft.* Suhrkamp: Frankfurt, 1983.

23. Elsadek, M.; Sun, M.; Sugiyama, R.; Fujii, E. Cross-cultural comparison of physiological and psychological responses to different garden styles. *Urban Forest. Urban Green.* **2019**, *38*, 74–83.

24. Ewert, A.; Chang, Y. Levels of nature and stress response. *Behav. Sci.* **2018**, *8*, 49.

25. Fernández-Blázquez, M.A.; Ávila-Villanueva, M.; López-Pina, J.A.; Zea-Sevilla, M.A.; Frades-Payo, B. Psychometric properties of a new short version of the State-Trait Anxiety Inventory (STAI) for the assessment of anxiety in the elderly. *Neurología* **2015**, *30*, 352–358.

26. Fraenkel, J.R.; Wallen, N.E. *How to Design and Evaluate Research in Education*. McGraw-Hill Inc: Singapore, 1993.

27. Franco, L.S.; Shanahan, D.F.; Fuller, R.A. A review of the benefits of nature experiences: More than meets the eye. *Int J of Env Res Public Health* **2017**, 14, 8.

28. Gao, T.; Zhang, T.; Zhu, L.; Gao, Y.; Qiu, L. Exploring psychophysiological restoration and individual preference in the different environments based on virtual reality. *Int. J. Environ. Res. Public Health* **2019**, *16*, 3102.

29. Gay L.R.; Diehl, P.L. *Research Methods for Business and Management*. Macmillan: New York (US), 1992.

30. GBD 2015 Disease and Injury Incidence and Prevalence Collaborator. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet Lond. Engl*. **2016,** *388,* 1545–1602.

31. GBD 2015 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet Lond. Engl*. **2016,** *388,* 1659–1724.

32. Ghaljaie, F.; Naderifar, M.; Goli, H. Snowball Sampling: A Purposeful Method of Sampling in Qualitative Research. *Strides in Development of Medical Education* **2017**, *14*, e67670.

33. Goto, S.; Gianfagia, T.J.; Munafo, J.P.; Fujii, E.; Shen, X.; Sun, M.; Shi, B.E.; Liu, C.; Hamano, H.; Herrup, K. The power of traditional design techniques: the effects of viewing a Japanese garden on individuals with cognitive impairment. Health Environ. Res. Des. J. **2016**, *10*, 74–86.

34. Grahn, P.; Stigsdotter, U.K. The relation between perceived sensory dimensions of urban green space and stress restoration. *Landsc. Urban. Plan.* **2020**, *94*, 264–275.

35. Gunawan, A.; Pratiwi, P.I. User behaviour on specific environment in bogor botanical garden. *ASEAN Journal on Hospitality and Tourism* **2015**, *14*, 3–12.

36. Hake, B. J. Gardens as Learning Spaces: Intergenerational Learning in Urban Food Gardens. *Journal of Intergenerational Relationship*s **2017**, *15*, 26–38.

37. Harris, V.; Kendal, D.; Hahs, A.K.; Threlfall, C.G. Green space context and vegetation complexity shape people's preferences for urban public parks and residential gardens. *Landscape Research* **2017.** *43*, 150–162.

38. Hartig, T.; Mitchell, R.; de Vries, S.; Frumkin, H. Nature and health. *Annu. Rev. Public Health* **2014**, *35*, 207– 228.

39. Hashim, H.A. *Application of Psychometrics in Sports and Exercise*; Universiti Sains Malaysia: Gelugor, Pulau Pinang, Malaysia, **2018.**

40. Hassan, A.; Tao, J.; Li, G.; Jiang, M.; Aii, L.; Zhihui, J.; Zongfang, L.; Qibing, C. Effects of Walking in Bamboo Forest and City Environments on Brainwave Activity in Young Adults. *Evidence Complementary Alt Med.* **2018**, 1–9.

41. Heuchert*, J.P.; McNair, D.M. Profile of Mood States, 2nd Edition: POMS 2;* Multi-health Systems. Inc: North Tonawanda, New York, Unites States of America, 2012.

42. Heuchert, J.P.; McNair, D.M. *Test Review: The Profile of Mood States 2nd Edition*. *J. Psychoedu. Assess.* **2014**, *32*, 273-277.

43. Hidayat, Istiadah. *Panduan Lengkap Menguasai SPSS 19 untuk Mengolah Data Statistik Penelitian*. Media Kita: Jakarta, 2011.

44. Higuchi, K. *Quantitative Text Analysis for Social Researchers: A Contribution to Content Analysis;* Nakanishiya Publishing: Kyoto, Japan, 2014.

45. Higuchi, K. A Two-Step Approach to Quantitative Content Analysis: KH Coder Tutorial using Anne of Green Gables (Part I). *Ritsumeikan Social Sciences Review* **2016**, *52*, 77-91.

46. Hofmann, M.; Young, C.; Binz, T.M.; Baumgartner, M.R.; Bauer, N. Contact to Nature Benefits Health: Mixed Effectiveness of Different Mechanisms. *Int. J. Environ. Res. Public Health* **2018**, *15*, 31.

47. Hunter, M.; Eickhoff, S.; Pheasant, R.; Douglas, M.; Watts, G.; Farrow, T. The state of tranquility: Subjective perception is shaped by contextual modulation of auditory connectivity. *Neuroimage* **2010**, *53*, 611–618.

48. Igarashi, M.; Miwa, M.; Ikei, H.; Song, C.; Takagaki, M.; Miyazaki, Y. Physiological and psychological effects of viewing a kiwifruit (*Actinidia deliciosa* 'Hayward') orchard landscape in summer in Japan. *Int. J. Environ. Res. Public Health* **2015**, *12*, 6657–6668.

49. Ikei, H.; Komatsu, M.; Song, C.; Himoro, E.; Miyazaki, Y. The physiological and psychological relaxing effects of viewing rose flowers in office workers. *J. Physiol. Anthropol.* **2014**, *33*, 6.

50. Iwata, N.; Mishima, N.; Shimizu, T.; Mizoue, T.; Fukuhara, M.; Hidano, T.; Spielberger, C.D. The Japanese Adaptation of the STAI Form Y in Japanese Working Adults -The Presence or Absence of Anxiety. Industrial Health **1998**, 36, 8–13.

51. Janeczko, E.; Bielinis, E.; Wojcik, R.; Woźnicka, M.; Kędziora, W.; Łukowski, A.; Elsadek, M.F.; Szyc, K.; Janeczko, K. When Urban Environment Is Restorative: The Effect of Walking in Suburbs and Forests on Psychological and Physiological Relaxation of Young Polish Adults. *Forests* **2020**, 11, 591.

52. Janicas K. Exercise as a treatment in intellectual and developmental disability. *Journal on Develop Disabilities* **2014**, 20, 1, 122–127.

53. Ji, G.B.; Kim, K.N.; Han, G.S. Physiological and psychological effects of viewing and walking in forest and urban area. *J. Environ. Sci. Int*. **2012**, *21*, 605–611.

54. Julian LJ. Measures of anxiety: State-Trait Anxiety Inventory (STAI), Beck Anxiety Inventory (BAI), and Hospital Anxiety and Depression Scale-Anxiety (HADS-A).*Arthritis Care Res (Hoboken)*. 2011;63 Suppl 11(0 11):S467-S472.

55. Joung, D.; Kim, G.; Choi, Y.; Lim, H.; Park, S.; Woo, J.-M.; Park, B.-J. The Prefrontal Cortex Activity and Psychological Effects of Viewing Forest Landscapes in Autumn Season. *Int. J. Environ. Res. Public Health* **2015**, *12*, 7235-7243.

56. Kaczynski, A.T.; Besenyi, G.M.; Stanis, S.A.W.; Koohsari, M.J.; Oestman, K.B.; Bergstrom, R.; Potwarka, L.R.; Reis, R.S. Are park proximity and park features related to park use and park-based physical activity among adults? Variations by multiple socio-demographic characteristics. *Int J Behav Nutri Physic Activity* **2014,** 11, 46.

57. Kaplan, S. The restorative benefits of nature: Toward an integrative framework. *J Environ Psychol.* **1995**, 15, 169–182.

58. Kaplan, R., Kaplan, S. *The experience of nature: A psychological perspective.* Cambridge: Cambridge University Press 1989.

59. Karan, PK. *Japan in the 21st Century: Environment, economy, and society*. Kentucky: The University Press of Kentucky, 2004.

60. Kaufman, A. J.; Lohr, V. I. Does plant color affect emotional and physiological responses to landscapes? *Acta Hort.* **2004**, *639*, 229–233.

61. Kellert S.R,;Wilson E.O.; editors. *The Biophilia Hypothesis*. Washington, DC: Island Press **1993**.

62. Kim, J, K.; Omi, T. Gendai kazoku no bunsan kyojyu no jittai to kyojyu network no keisei [The actual conditions of dispersed residence and the formation of residential networks in the modern family] Nippon Kenchiku Gakkai Keikaku-kei Ronbun-syu [Journal of Architecture, Planning and Environmental Engineering] **1994**, *456*, 209–216.

63. Kim M, Rupprecht CDD, Furuya K. 2017. Spatial typology in informal urban green spaces: The case of Ichikawa city, Japan [abstract]. In: *Program Book of Japan Geosciences Union Meeting 2017*; 2017 May 20–25; Chiba.

64. Kim, M.; Rupprecht, C.D.D.; Furuya, K. Residents' Perception of Informal Green Space—A Case Study of Ichikawa City, Japan. *Land* **2018**, *7*, 1–20.

65. Kim, K.M.; Shin, W.S.; Park, B.J.; Oh, D.K. The psychological relaxation effects on forest space type. *J. KIFR* **2012**, 16, 87–92.

66. Kohori, F.; Furuya, K. The characteristics of Indonesian open space image based on the space configuration. *J. Japan. Inst. Lands. Arch.* **2017**, *80*, 579-584.

67. Konuma, H.; Hirose, H.; Yokoyama, K. Relationship of the Japanese translation of the profile of mood states second edition (POMS 2®) to the first edition (POMS®). *Juntendo Med. J.* **2015**, *61*, 517–519.

68. Kusnanto, H.; Dibyosaputro, S.; Hadisusanto, S.; Saraswati, S.P. Community engagement with urban river improvement: the case of Yogyakarta city. *Jurnal Manusia dan Lingkungan* **2016**, *23*, 390–393.

69. Kusuma, A.W.A.; Srinadi, I.G.A.M.; Sari, K. Aplikasi analisis korespondensi untuk melihat karakteristik usaha pariwisata di provinsi bali. *E- Jurnal Matematika* **2016**, *5*, 76–81.

70. Lackey, K.J., Kaczynski, A.T. Correspondence of perceived vs. objective proximity to parks and their relationship to park-based physical activity. *Int J Behav Nutri Physic Activity* **2009**, *9*, 1–9.

71. Larsen, B.; Christenfeld, N.J.S. Cardiovascular disease and psychiatric comorbidity: the potential role of perseverative cognition. *Cardiovasc. Psychiatry Neurol.* **2009**, 791017.

72. Laurens, J.M. Changing behavior and environment in a community-based program of the riverside community. Procedia-Social and Behavioral Sciences **2012**, *36*, 372–382.

73. Lee, J.; Park. B.J.; Tsunetsugu, Y.; Kagawa, T.; Miyazaki, Y. Restorative effects of viewing real forest landscapes, based on a comparison with urban landscapes. S*candinavian J. Forest Res.* **2009**, *24*, 227–234.

74. Lee, J.; Li, Q.; Tyrvainen, L.; Tsunetsugu, Y.; Park, B.J.; Kagawa, T.; Miyazaki, Y. Nature therapy and preventive medicine. In *Public Health—Social and Behavioral Health*; Maddock, J., Ed.; Intech: Rijeka, Croatia, 2012; pp. 325–350.

75. Lee, J.; Park, B.; Ohira, T.; Kagawa, T.; Miyazaki, Y. Acute effects of exposure to traditional rural environment on urban dwellers: A crossover field study in terraced farmland. *Int. J. Environ. Res. Public Health* **2015**, *12*, 1874–1893.

76. Lehman, D.R.; Chiu, C.Y.; Challer, M. Psychology and culture. *Annu. Rev. Psychol.* **2004**, *55*, 689–714.

77. Li, Q.; Morimoto, K.; Kobayashi, M.; Inagaki, H.; Katsumata, M.; Hirata, Y. A forest bathing trip increases human natural killer activity and expression of anti-cancer proteins in female subjects. *J. Biol. Regul. Homeost. Agents* 2008, 22, 45–55.

78. Li, Q.; Kobayashi, M.; Kumeda, S.; Ochiai, T.; Miura, T.; Kagawa, T.; Imai, M.; Wang, Z.; Otsuka, T.; Kawada, T. Effects forest bathing on cardiovascular and metabolic parameters in middle-aged males. *Evid.-Based Complementary Alt. Med*. **2016**, 2587381.

79. Lucas OWR. *The Design of Forest Landscape*. Oxford University Press: New York, 1991.

80. Lyle, J. T. Design for Human Ecosystems: Landscape, Landuse and Natural Resources. : Van Nostrand Company: New York, 1985.

81. Lyu, B.; Zeng, C.; Deng, S.; Liu, S.; Jiang, M.; Li, N.; Wei, L.; Yu, Y.; Chen, Q. Bamboo forest therapy contributes to the regulation of psychological responses. *J. For. Res*. **2019,** 24, 61–70.

82. Manteghi, G.; Iimit, H.; Remaz, D. Water bodies an urban microclimate: A review. *Mod. Appl. Sci*. **2015**, *9*, 1–12.

83. Mao, G.; Cao, Y.; Wang, B.; Wang, S.; Chen, Z.; Wang, J.; Xing, W.; Ren, X.; Lv, X.; Dong, J.; Chen, S.; Chen, X.; Wang, G.; Yan, J. The salutary influence of forest bathing on elderly patients with chronic heart failure. Int. J. Environ. Res. Public Health **2017**, *14*, 4, 368.

84. Marcus, C.C.; Sachs, N.A. Therapeutic landscapes: An evidence-based approach to designing healing gardens and restorative outdoor spaces: John Wiley & Sons, 2014.

85. Masai, Y. Tokyo: From a Feudal Million City to a Global Supercity. *Geographical Review of Japan* **1990**, 63, l–16.

86. Matsuba, N.; Lee, J.; Park, B.; Lee, M.; Song, C.; Miyazaki, Y. Physiological effects of walking in Shinjuku Gyouen, a large-scale urban green area. *Japan Soc. Physio. Anthropol*. **2011**, *16*, 133–139.

87. Matsunaga, K.; Park, B.; Kobayashi, H.; Miyazaki, Y. Physiologically relaxing effect of a hospital rooftop forest on older women requiring care. *J. Am. Geriatr. Soc*. **2011**, *59*, 2162–2163.

88. Meltzer, G. Cohousing: Verifying the Importance of Community in the Application of Environmentalism. *Journal of Architecture and Planning Research* **2000**, *17*, 110–132.

89. MHLW. 2006. *Kosei rodo hakusho*, Heisei 18 (White book) [internet]. [accessed 2018 May 8]. Available at: http://www.mhlw.go.jp/wp/hakusyo/kousei/06/index.html.

90. Min, K.; Jun, B.; Lee, J.; Kim, H.; Furuya, K. Analysis of environmental issues with an application of civil complaints: the case of Shiheung City, Republic of Korea. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1018.

91. Miyazaki, Y. *Shinrinyoku: The Japanese Way of Forest Bathing for Healthy and Relaxation*; Aster: London, UK, 2018.

92. Miyazaki, Y.; Ikei, H.; Song, C. Forest medicine research in Japan. *Jpn. J. Hyg*. **2014**, *69*, 122–135.

93. Miyazaki, Y.; Song, C.; Ikei, H. Preventive medical effects of nature therapy and their individual differences. *Jpn. J. Physiol. Anthropol*. **2015**, *20*, 19–32.

94. Morimoto K.; Miyazaki. Y.; Hirano H. *Forest Medicine*; Asakura Publishing Co., Ltd.: Tokyo, Japan **2006**. (In Japanese)

95. Mulyati, A.; Soewarno, N.; Ronald, A.; Sarwadi, A. Karakteristik spasial permukiman vernakular perairan di Sulawesi Tengah. *Jurnal Manusia dan Lingkungan* **2016**, *23*, 122–128.

96. Mutiara, S., & Kinoshita, I. Characteristics of public small park usage in Asia pacific countries: case study in Jakarta and Yokohama city. *Procedia-Social and Behavioral Sciences* **2012**, *35*, 412–419.

97. Ng, K.S.T.; Sia, A.; Ng, M.K.W.; Tan, C.T.Y.; Chan, H.Y.; Tan, C.H.; Rawtaer, I.; Feng, L.; Mahendran, R.; Larbi, A.; et al. Effects of horticultural therapy on Asian older adults: a randomized controlled trial. *Int. J. Environ. Res. Public Health* **2018**, *15,* 1705.

98. Nordin, N.; Nakamura, H. Social capital among ageing residents of housing complexes in suburban Tokyo: The case of Haraichi-Danchi and Oyamadai-Danchi in Ageo City. *Planning Malaysia* 2018, *16*, 38–49.

99. Ochiai, H.; Ikei, H.; Song, C.; Kobayashi, M.; Takamatsu, A.; Miura, T.; Kagawa, T.; Li, Q.; Kumeda, S.; Imai, M. Physiological and psychological effects of forest therapy on middle-age males with high-normal blood pressure. *Int. J. Environ. Res. Public Health* **2015**, *12,* 2521–2531.

100. OECD. *OECD Reviews of Public Health: Japan: A Healthier Tomorrow*; OECD Publishing: Paris, France, 2019. https://doi.org/10.1787/9789264311602-en

101. Ojala, A.; Korpela, K.; Tyrväinen, L.; Tiittanen, P.; Lanki, T. Restorative effects of urban green environments and the role of urban-nature orientedness and noise sensitivity: A field experiment. *Health Place* **2019**, *55*, 59-70.

102. Oku, H.; Fukamachi, K. The differences in scenic perception of forest visitors through their attributes and recreational activity. *Land Urban Plan.* **2006**, *75,* 34–42.

103. Oleksiichenko, N.; Gatalska, N.V.; Mavko, M. The colour-forming components of park landscape and the factors that influence the human perception of the landscape colouring. *Theo. Emp. Res. in Urban Man*. **2018**, *13*, 38–52.

104. Omar, K. A., Omar, D., Othman, S., Yusoff, Z. M. Reviewing youth facility requirements for low-cost housing in Malaysia. Procedia - Social and Behavioral Sciences **2016**, *222*, 702–709.

105. Othman A.R.; Fadzil, F. Influence of Outdoor Space to the Elderly Wellbeing in a Typical Care Centre. *Procedia - Social and Behavioral Sciences* **2014**, *170*, 320–329.

106. Park, B.J.; Tsunetsugu, Y.; Kasetani, T.; Morikawa, T.; Kagawa, T.; Miyazaki, Y. Physiological effects of forest recreation in a young conifer forest in Hinokage Town, Japan. *Silva Fennica* **2009**, *43*, 291–301.

107. Park, B.J.; Tsunetsugu, Y.; Kasetani, T.; Kagawa, T.; Miyazaki, Y. The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing): Evidence from field experiments in 24 forests across Japan. *Environ. Health Prev. Med.* **2010**, *15*, 18–26.

108. Park, B.J.; Furuya, K., Kasetani, T.; Takayama, N.; Kagawa, T.; Miyazaki, Y. Relationship between psychological responses and physical environments in forest settings. *Land*. *Urban Plan*. **2011**, *102*, 24–32.

109. Parker, C.; Scott, S.; Geddes, A. Snowball Sampling. In P. Atkinson, S. Delamont, A. Cernat, J.W. Sakshaug, & R.A. Williams (Eds.), *SAGE Research Methods Foundations*, 2020.

110. Paul, S.; Nagendra, H. Factors influencing perceptions and use of urban nature: surveys of park visitors in Delhi. *Land* **2017**, *6*, 27.

111. Pearson, A.L.; Bentham, G.; Day, P., Kingham, S. Associations Between neighbourhood characteristics and obesity and related behaviours among adult New Zealanders. *BMC Public Health* **2014**, *14*, 553.

112. Platz A. 2011. Living apart together: anticipated home, family, and social networks in old age. In: Ronald R, Alexy A, editor. *Home and Family in Japan: Continuity and transformation.* London: Routledge Taylor and Francis Group.

113. Pleson, E; Nieuwendyk L.M.; Lee, K.K.; Chaddah, A.; Nykiforuk, C.I.J.; Schopflocher D. Understanding Older Adults' Usage of Community Green Spaces in Taipei, Taiwan. *Int. J. Environ. Res. Public Health* **2014**, *11*, 1444-1464.

114. Polat, A. T.; Güngör, S.; Demir, M. The Design Principles of Therapeutic Gardens. Int. *J. Lands. Arch. Res*. **2017**, 1, 2, 37–42.

115. Pouya, S.; Bayramoğlu, E.; Demirel, Ö. restorative garden as a useful way to relieve stress in megacities, a case study in Istanbul. İnönü Univ. *J. Art. Des*. **2016**, *6*, 355–369.

116. Pratiwi PI, Furuya K, Sulistyantara B. The difference in people's response toward natural landscape between university students of Japan and Indonesia. *Jurnal Manusia dan Lingkungan* **2014**, *21*,247–253.

117. Pratiwi, P.I.; Kim, M.; Furuya, K. Difference in perception of urban green spaces between housing complex and apartment residents in Tokiwadaira, Matsudo city, Japan. 2018. Manuscript submitted for publication.

118. Pratiwi, P.I.; Furuya, K. The neighbourhood park preferences and its factors among elderly residents in Tokiwadaira, Japan. *Asian J. Behav. Stud.* **2019**, *4*, 64–79.

119. Pratiwi, P.I.; Sulistyantara, B.; Gunawan, A.; Furuya, K. A comparative study on the perception of forest landscape using LIST method between university students of Japan and Indonesia. *J. Man. Hut. Trop*. **2014**, *20*, 167–178.

120. Pratiwi, P.I.; Xiang, Q.; Furuya, K. Physiological and psychological effects of viewing urban parks in different seasons in adults. *Int. J. Environ. Res. Public Health*. **2019**, *16*, 21, 4279.

121. PRB analysis of data from WHO, *Noncommunicable Disease Country Profiles 2014*.

122. Rajoo, K. S., Karam, D. S., & Abdul Aziz, N. A. Developing an effective forest therapy program to manage academic stress in conservative societies: A multi-disciplinary approach. *Urban Forest. Urban Green*. **2019**, *43*, 126353.

123. Ratcliffe, E.; Gatersleben, B.; Sowden, P.T. Bird sounds and their contributions to perceived attention restoration and stress recovery. *J Environ Psychol*. **2013**, *36*, 221–228.

124. Rattan, J.K.; Eagles, P.F.J.; Mair, H.L. Volunteer tourism: its role in creating conservation awareness. *Journal of Ecotourism* **2011**, *11,* 1–15.

125. Revicki, D. *Internal Consistency Reliability*. In: Michalos A.C. (eds) Encyclopedia of Quality of Life and Well-Being Research. Springer, Dordrecht, 2014.

126. Ronald R, Alexy A. *Home and Family in Japan*. Routledge, Taylor and Francis Group: London, 2001.

127. Roscoe, J. *Fundamental Research Statistics for The Behavioral Sciences*. Holt, Rinehart, & Winston: New York, 1975.

128. Ross S, Wall G. Evaluating ecotourism: the case of North Sulawesi, Indonesia. *Tourism Management* **1999**, *20*, 673–682.

129. Rupprecht, C.D.D.; Byrne, J.A., Ueda, H., Lo, A.Y. 'It's real, not fake like a park': Residents' perception and use of informal urban green-space in Brisbane, Australia and Sapporo, Japan. *Land Urb Plan*. **2015**, *143,* 205–218.

130. Rupprecht, C.D.D. Informal Urban Green Space: Residents' Perception, Use, and Management Preferences across Four Major Japanese Shrinking Cities. *Land* **2017,** *6*, 59.

131. Saito, H.; Horiuchi, M.; Takayama, N.; Fujiwara, A. Effects of managed forest versus unmanaged forest on physiological restoration from a stress stimulus, and the relationship with individual traits. *J. For. Res*. **2019**, 24, 77–85.

132. Salmond, J. A.; Tadaki, M.; Vardoulakis, S.; Arbuthnott, K.; Coutts, A.; Demuzere, M.; Dirks, K.M.; Heaviside, C.; Lim, S.; Macintyre, H.; McInnes, R,N.; Wheeler, B. W. Health and climate related ecosystem services provided by street trees in the urban environment. *Environ Health* **2016**, 15(Suppl 1), 36.

133. Sandifer, P.A.; Sutton-Grier.; A.E., Ward, B.P. Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: opportunities to enhance health and biodiversity conservation. *Ecosystem Services* **2015,** *12*, 1–15.

134. Searight H.R.; Montone K. *Profile of Mood States*. In: Zeigler-Hill V., Shackelford T. (eds) Encyclopedia of Personality and Individual Differences. Springer, Cham, 2017.

135. Simkin, J.; Ojala, A.; Tyrväinen, L. Restorative effects of mature and young commercial forests, pristine old-growth forest and urban recreation forest - A field experiment. *Urban Forest. Urban Green*. **2020**, *48*, 126567.

136. Sinery A,S.; Manusawai, J. Partisipasi masyarakat dalam program pengelolaan Hutan Lindung Wosi Rendani. *Jurnal Manusia dan Lingkungan* **2016,** *23*, 394–401.

137. Soga, M.; Gaston, K.J. Extinction of experience: The loss of human-nature interactions. *Front. Ecol. Environ*. **2016**, *14*, 94–101.

138. Song, C.; Joung, D.; Ikei, H.; Igarashi, M.; Aga, M.; Park, B.J.; Miwa, M.; Takagaki, M.; Miyazaki, Y. Physiological and psychological effects of walking on young males in urban parks in winter. J. Physiol. Anthro. **2013**, *32*, 18.

139. Song, C.; Ikei, H.; Igarashi, M.; Miwa, M.; Takagaki, M.; Miyazaki, Y. Physiological and psychological responses of young males during spring-time walks in urban parks. *J. Physiol. Anthropol.* **2014**, *33*, 8.

140. Song, C.; Ikei, H.; Igarashi, M.; Takagaki, M.; Miyazaki, Y. Physiological and psychological effects of a walk in urban parks in fall. *Int. J. Environ. Res. Public Health* **2015**, *12*, 14216–14228.

141. Song, C.; Ikei, H.; Miyazaki, Y. Physiological effects of nature therapy: A review of the research in Japan. *Int. J. Environ. Res. Public Health* **2016**, *13*, 781.

142. Song, C.; Ikei, H.; Kobayashi, M.; Miura, T.; Li, Q.; Kagawa, T.; Kumeda, S.; Imai, M.; Miyazaki, Y. Effect of viewing forest landscape on middle-aged hypertensive men. *Urban For. Urban Green.* **2017**, *21*, 247–252.

143. Song, C.; Ikei, H.; Kagawa, T.; Miyazaki, Y. Effects of walking in a forest on young women. *Int. J. Environ. Res. Public Health* **2019**, *16*, 229.

144. Song, C.; Ikei, H.; Kagawa, T.; Miyazaki, Y. Physiological and psychological effects of viewing forests on young women. *Int. J. Environ. Res. Public Health* **2019**, *10*, 635.

145. Song, H.; Lane, K.J.; Kim, H.; Kim, H.; Byun, G.; Le, M.; Choi, Y.;Park, C.R.; Lee, J. T. Association between urban greenness and depressive symptoms: Evaluation of greenness using various indicators. *Int. J. Environ. Res. Public Health* **2019**, *16*, 173.

146. Spielberger, CD. *State-Trait Anxiety Inventory*. Consulting Psychologists Press; Palo Alto (CA), 1983.

147. Spielberger, C.D.; Sarason, I.G. *Stress and Anxiety*, Volume 9; Hemisphere Publishing Corporation: New York, USA, 1985.

148. Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. *Manual for the State-Trait Anxiety Inventory*. Consulting Psychologists Press: Palo Alto, CA, 1983.

149. Statistics Bureau. Statistic Handbook of Japan 2017; Statistics Bureau Ministry of Internal Affairs and Communications Japan: Tokyo, Japan, 2017. http://www.stat.go.jp/english/data/handbook/index.htm

150. Stigsdotter, U.K.; Corazon, S.S.; Sidenius, U.; Kristiansen, J.; Grahn, P. It is not all bad for the grey city - A crossover study on physiological and psychological restoration in a forest and an urban environment. *Health Place* **2017**, *46*, 145–154.

151. Suda, R.; Yamaguchi, M.; Hatakeyama, E.; Kikuchi, T.; Miyazaki, Y.; Sato, M. Effect of visual stimulation (I)-in the case of good correlation between sensory evaluation and physiological response. *J. Physiol. Anthropol. App. Hum. Sci*. **2001**, *20*, 303.

152. Sulistyantara B, Pratiwi P.I. Perencanaan penataan lanskap kawasan wisata dan penyusunan alternatif program wisata di Grama Tirta Jatiluhur, Kabupaten Purwakarta, Provinsi Jawa Barat. *Jurnal Lanskap Indonesia* **2011**, *3*, 58–65.

153. Stuster, J. Bold Endeavors: *Lessons from Polar and Space Exploration*; Naval Institute Press: Annapolis, MD, USA, 2011

154. Susanto, S.; Saraswati, S.P. Community engagement with urban river improvement: the case of Yogyakarta city. *Jurnal Manusia dan Lingkungan* **2016**, *23*, 390–393.

155. Takano, T.; Nakamura, K.; Watanabe, M. Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *J. Epidemiol. Community Health* **2002**, *56*, 913–918.

156. Takayama, N.; Fujiwara, A.; Saito, H.; Horiuchi, M. Management effectiveness of a secondary coniferous forest for landscape appreciation and psychological restoration. *Int. J. Environ. Res. Public Health* **2017**, *14*, 800.

157. Takayama, N.; Korpela K.; Lee, J.; Morikawa, T.; Tsunetsugu, Y.; Park, B.J.; Li, Q.; Tyrväinen, L.; Miyazaki, Y.; Kagawa, T. Emotional, restorative and vitalizing effects of forest and urban environments at four sites in Japan. *Int. J. Environ. Res. Public Health* **2014,** *11*, 7207–7230.

158. Takayama, N.; Morikawa, T.; Bielinis, E. Relation between Psychological Restorativeness and Lifestyle, Quality of Life, Resilience, and Stress-Coping in Forest Settings. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1456.

159. Talbot, J. F.; Kaplan, R. (1991). The Benefits of Nearby Nature for Elderly Apartment Residents. 33:2: 119-130.

160. Tamaki, T. Live and die in solitude away from the family: issues relating to unattended death kodokushi in Japan. *Housei Riron* **2014**, *46*, 203–218.

161. Ter, U. Quality criteria of urban parks: The case of Alaaddın Hill (Konya-Turkey). *Afr. J. Agric. Res*. **2011**, *6*, 5367–5376.

162. Tsunetsugu, Y.; Park, B.; Miyazaki, Y. Trends in research related to Shinrin-yoku (taking in the forest atmosphere or forest bathing) in Japan. *Environ. Health Prev. Med*. **2010**, *15*, 27–37.

163. Tsunetsugu, Y.; Lee, J.; Park, B.; Tyrvainen, L.; Kagawa, T.; Miyazaki, Y. Physiological and psychological effects of viewing urban forest landscapes assessed by multiple measurements. *Land. Urban Plan*. **2013**, *113*, 90-93.

164. Turan SO, Pulatkan M, Beyazli D, Özen BS. 2015. User Evaluation of the Urban Park Design Implementation with Participatory Approach Process. *Procedia - Social and Behavioral Sciences* 216(2016): 306 – 315.

165. Tyrväinen, L.; Ojala, A.; Korpela, K.; Lanki, T.; Tsunetsugu, Y.; Kagawa, T. The influence of urban green environments on stress relief measures: A field experiment. *J. Environ. Psychol.* **2014**, 38, 1–9.

166. Ueda H. 2006. A comparative study on forest image in Japan and German [in Japanese]. *Journal of the Japanese Institute of Landscape Architecture* 67(5):691–694.

167. Ueda, H. A Study on Construction of Landscape Image Sketching Technique. *J. City Plan. Inst. Jpn.* **2009**, *44*, 37–42.

168. Ueda, H. A study on resident landscape perception through landscape image-four case studies in Germany and Japan rural communities. Doctoral Thesis, University of Kassel, Kassel, July 15 2009.

169. Ueda, H., Takayama, N. Study on the spatial conditions constituting the image of bathing in a forest atmosphere. *Lands. Res. Japan Online* **2011**, *4*, 1-6.

170. Ueda, H.; Nakajima, T.; Takayama, N.; Petrova, E.; Matsushima, H.; Furuya, K.; Aoki, Y. Landscape image sketches of forests in Japan and Russia. *Forest Pol. Eco.* **2012**, *19*, 20–30.

171. Uijtdewilligen, L.; Waters, C.N.H.; Aw, S.; Wong, M.L.; Sia, A.; Ramiah, A.; Wong, M.; Riemenschneider, F.M. The Park Prescription Study: Development of a community-based physical activity intervention for a multi-ethnic Asian population. *PLoS ONE* **2019**, *14*, 6, e0218247.

172. Ulrich, R.S. *Aesthetic and affective response to natural environment*. In: Altman I (eds). Behaviour and the National Environment. Boston, MA: Springer **1983**, 85–125.

173. United Nations. *World Urbanization Prospects: The 2018 Revision, Key Facts*; United Nations: New York, NY, USA, 2018.

174. United Nations Resolution A/RES/70/1: Transforming our world: the 2030 Agenda for Sustainable Development; adopted by the United Nations Seventieth General Assembly, 20 July 2020.

175. van Griethuijsen, R.A.L.F.; van Eijck, M.W.; Haste, H.; den Brok, P.J.; Skinner, N.C.; Mansour, N.; Gencer, A.S.; BouJaoude, S. Global Patterns in Students' Views of Science and Interest in Science. *Res Sci Educ.* **2015**, *45*, 581–603.

176. Veitch, J.; Ball, K., Crawford, D.; Abbott, G.R.; Psych, G.D.; Salmon, J. Park improvements and park activity: a natural experiment. *American Journal of Preventive Medicine* **2012**, *42*, 616–619.

177. White, M.; Smith, A.; Humphryes, K.; Pahl, S.; Snelling, D.; Depledge, M. Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *J. Environ. Psychol.* **2010**, *30*, 482–493.

178. Whitemore TC, Sidiyasa K. Composition and structure of a lowland rain forest at Toraut, Northern Sulawesi. *Kew Bull* **1986**, *41*, 747-756.

179. Willemse, L. (2015). Some perceptions and preferences of residents' use of community neighbourhood parks in Mitchells Plain, Cape Town. Town and Regional Planning, 2015(66), 15–30.

180. Wilson, E.O. *Biophilia*. Harvard University Press, Cambridge, MA, 1984.

181. World Health Organization (WHO). *Global Recommendations on Physical Activity for Health*; World Health Organization: Geneva, Switzerland 2010.

182. World Health Organization (WHO). *Global Status Report on Noncommunicable Diseases*: Geneva, Switzerland 2014.

183. World Health Organization (WHO). *Global Action Plan on Physical Activity 2018-2030: More Active People for a Healthier World.* Geneva: Switzerland, 2018.

184. World Health Organization (WHO). *Noncommunicable Diseases (NCD) Country Profiles:* Geneva, Switzerland 2018.

185. Xie, B.; An, Z.; Zheng, Y.; Li, Z. Healthy aging with parks: Association between park accessibility and the health status of older adults in urban China. *Sustain. Cities Soc.* **2018**, *43*, 476–486.

186. Yu, C.; Lin, C.; Tsai, M.; Tsai, Y.; Chen, C. Effects of short forest bathing program on autonomic nervous system activity and mood states in middle-aged and elderly individuals. *Int. J. Environ. Res. Public Health* **2017**, *14*, 897.

187. Tully, P.J.; Cosh, S.M.; Baune, B.T. A review of the affects of worry and generalized anxiety disorder upon cardiovascular health and coronary heart disease. Psychol. *Health Med.* **2013**, *18*, 627–644.

188. Zeisel, J. Creating a therapeutic garden that works for people living with Alzheimer's. *Journal of Housing for the Elderly* **2007**, *21*, 13–33.

189. Zhang, Z.; Wang, P.; Gao, Y.; Ye, B. Current Development Status of Forest Therapy in China. *Healthcare* **2020**, *8*, 61.

ACKNOWLEDGEMENT

First, the author gives praise and gratitude to Allah the Almighty for all of his gift and guidance, thus the Doctoral Thesis entitled Landscape Perception toward Green Spaces and The Physiological and Psychological Benefits of Green Space Therapy – A Case Study of Matsudo City, Japan could be completed.

The author sincerely thanks to:

1. Professor Katsunori Furuya as an advisor for the great advice, motivation, support, and help for completing the dissertation. Prof. Furuya supported to join International conferences and submit original papers in International journal. He provided many great opportunities to learn and gain knowledge, skill, and experiences. Furthermore, his instruction and motivation in completing this Doctoral Thesis was very valuable.
2. Professor Takahide Kagawa of Forestry and Forest Products Research Institute as the chief of Doctoral Thesis examiner for the suggestion and additional input of this Doctoral Thesis. As the chief examiner, Prof. Kagawa provided kind guidance in arranging this Doctoral Thesis and extracting the essential novelty of this study. Besides that, he also supported the conception of research design regarding forest therapy.
3. Professor Tatsuaki Kobayashi of the Graduate School of Horticulture, Chiba University as a member of Doctoral Thesis examiner for the suggestion of this Doctoral Thesis. He emphasized the fundamental aspects of the study and encouraged the author to deeply understand the benefits of urban green spaces.
4. Associate Professor Takeshi Kinoshita of the Graduate School of Horticulture, Chiba University as a member of Doctoral Thesis examiner for the suggestion and definition of this Doctoral Thesis. He provided valuable advice and suggested insightful implications for this study. Furthermore, he also gave inspiration when the author took the Ecological Design II course.

5. Associate Professor Yutaka Iwasaki of the Graduate School of Horticulture, Chiba University as a member of Doctoral Thesis examiner for suggestions, additional input, and motivation. His input helped to explore the research trend regarding green space therapy and find detailed novelty regarding the correlation of landscape image and psychophysiological responses. Moreover, he also encouraged to continue this study when the author took the Advanced People-Plant Relationships course.
6. MEXT Scholarships who gave full scholarships to study in Chiba University. It is valuable pride to study in Chiba University supported by MEXT Scholarships.
7. Department of Landscape Architecture, Faculty of Agriculture, IPB University as author’s workplace, all professors, lecturers, and supporting staffs for the support while completing study in Chiba University.
8. Ms. Aya Utsumi of Forest and Park for the 21st Century for room usage schedule management in the park.
9. Mr. Takayoshi Enomoto of NPO Matsudo Creative for support in participants’ recruitment and transportation in the experimental period.
10. Ms. Sumiko Yamada, Dr. Atik Nurwanda, Dr. Sigit Mulyansyah Effendy, and Abdul Jalil, B.Sc for support in participants’ recruitment.
11. Laboratory of Landscape Planning member, especially Ms. Qiongying Xiang, Ms. Mao Yingming, Ms. Fumeng Zhang, Ms. Hanqiu Zhang, Ms. Xie Zijiao, Ms. Lu Tingyu, Mr. Luo Shixian, Ms. Mai Uemura, Ms. Indira Dwi Imara, Ms. Rosyidamayanti, and Ms. Dibyanti Danniswari for help in research preparation and experimental period, and all lab members that author cannot mention one by one for the support in daily life.
12. Undergraduate and graduate students of Chiba University, residents of Tokiwadaira area, middle-aged and older participants of Matsudo city as respondents.
13. Husband Mr. Ayip Ridwan Akbar, SP, son Muhammad Farihan Akbar, mother Ir. Keni Kenranikanti, little brother Miladio Rizky Prabowo, S.A.P, parents-in-law, Drs. N. Rusdiaman, Cicih Kursih, S.Pd., and all big family for the prayer, help, support, and big motivation.

APPENDIX

Appendix 1 Questionnaire sheet of Urban Green Space Perception (Translated in English).

I Experience toward green spaces（The choice is one for every question）

1. Have you participated in volunteer activities？

Public activities for urban green space？

It is a part of conservation activities like volunteering for improving the public environment in parks, forests, and rivers. The main activities are tree planting, weeding, cleaning, observing fauna and flora, and monitoring.

①. No ②Yes（about 回 times）

2. How many hours per year do you participate in volunteer activities?

（_____________）hours a day、 a total of（___________）hours a year

3. **Do you engage in gardening activities?**

Individual activities on green spaces?

It is gardening activity to grow and manage plants in the home garden or veranda

①. Never ②Sometimes ③Ongoing

4. **What is your housing type?**

①. Detached house with green space ②Detached house without green space

③Apartment with shared green space ④Apartment without shared green space

5. **Do you feel there is plentiful green space in your life?**

①. Strongly lacking ②Lacking ③Moderate ④Considerable

⑤ Plenty

6. **Do you often use the green spaces in your neighborhood?**

①. Never ②1-3 times a year ③1-3 times a month ④1-3 times a week ⑤Everyday

II Overall awareness of urban green spaces (The choice is one for every question)

What is the merit of the green space around you?		Strongly disagree	disagree	Neither disagree nor agree	agree	Strongly agree
1	It makes the urban landscape beautiful.	①	②	③	④	⑤
2	You can feel nature in the city.	①	②	③	④	⑤
3	It is near.	①	②	③	④	⑤
4	You can engage in free activities (sports, walking, plant watching, rest, gardening activities, etc.).	①	②	③	④	⑤
5	It is a place where children can play.	①	②	③	④	⑤
6	It allows one to inhabit life.	①	②	③	④	⑤
7	It can control the dust.	①	②	③	④	⑤
8	The plants are useful for air conditioning.	①	②	③	④	⑤
What are the reasons for reluctance to use the green spaces around you?						
1	Worried about conflict with owner.	①	②	③	④	⑤
2	They are hard to get to.	①	②	③	④	⑤
3	There is a risk of injury.	①	②	③	④	⑤
4	They are full of garbage.	①	②	③	④	⑤

5	They are contaminated.	①	②	③	④	⑤
6	The plants are not well maintained.	①	②	③	④	⑤
7	They are narrow, small.	①	②	③	④	⑤
8	The site is highly likely to be developed someday.	①	②	③	④	⑤

III Attitude toward urban green space (The choice is one for every question)

Questions		Strongly disagree	disagree	Neither disagree nor agree	agree	Strongly agree
1	I cherish nature in cities such as animals and plants.	①	②	③	④	⑤
2	Nature in the city cheers up my daily life.	①	②	③	④	⑤
3	Urban environments where animals, plants, and people can coexist is important.	①	②	③	④	⑤
4	I am willing to volunteer for nature preservation.	①	②	③	④	⑤
5	I am willing to spend my time holding nature.	①	②	③	④	⑤
6	I am willing to spend money on nature preservation.	①	②	③	④	⑤

Questions		Strongly disagree	disagree	Neither disagree nor agree	agree	Strongly agree
7	I know the plants, animals, and insects that are common in the area.	①	②	③	④	⑤
8	I feel affection for the region through the plants, animals, and insects in the area.	①	②	③	④	⑤
9	The green space is well-managed.	①	②	③	④	⑤
10	The green space is convenient to use.	①	②	③	④	⑤

IV Respondent Characteristics

1. Gender ① Male ② Female

2. Age ① Under20 ② 20-29 ③ 30-39 ④ 40-49 ⑤ 50-59 ⑥ 60-69 ⑦Over70

3. Do you have children? (until Elementary school) ①No ②Yes

4. Do you currently work? ①No ②Yes

5. How long have you lived in the current region? (years)

6**.** What is your zip code? (〒)

Appendix 2 Questionnaire Sheet of Neighborhood Park Preferences (Translated in English)

Questions about park preferences

1. Which park do you like prefer? Please choose 3 preferred parks. (Please draw a line directly on the map and draw a line around the park you like and fill in the order from 1st to 3rd)

2. How often do you go to the preferred park ?
1st park ( ) hours/month, 2nd park ( ) hours/month, 3 rd park ( ) hours/month

3. What are you doing in the preferred park? (Multiple answers)
①Interaction with people ②Relaxation ③Exercise ④Sports match ⑤Accompanied children ⑥Walking a dog ⑦Enjoying nature ⑧Maintenance of green space ⑨Spend time with family / friends ⑩Participate in sports events ⑪I do not spend time

4. What elements do you like in the first preferred park ? (Multiple answers)
①Well-maintained green space ②Good promenade ③Bench ④Many trees ⑤Well-managed children's playground ⑥Good quality sports field ⑦Security ⑧Parking lot ⑨Quiet place

5. If there is something lacking about the first preferred park, please select it. (Multiple answers)
①Inadequate green space ②Crowded promenade ③Lack of benches ④Lack of trees ⑤Unmaintained children's playground ⑥Poor quality sports field ⑦Insufficient security ⑧Lack of parking lot ⑨Noise from playground ⑩Noise outside the park (cars, etc.) ⑪Nothing

Legend
Building | Green space | Road | Commercial Area | Station | Area Boundary

Map of Tokiwadaira Area, Matsudo, Chiba

N

0 100 200 M

Appendix 3 Basic Information of Parks in Tokiwadaira Area.

Number	Name	Year	Area (Ha)
1	Himawari Park	1962	0.1963
2	Fuyou Park	1962	0.1421
3	Aberia Park	1962	0.2370
4	Shoubu Park	1962	0.9520
5	Hanamizuki Park	1962	0.2479
6	Kanegasaku Park	1962	4.0469
7	Tsubaki Park	1962	0.3110
8	Sakura Park	1962	0.3953
9	Sarubia Park	1973	0.2301
10	Kunugi Park	1962	0.1814
11	Mucho Park	-	0.1263
12	Yamabuki Park	1962	0.6730
13	Popura Park	1962	0.1904
14	Shirakashi Park	1962	0.2856
15	Wakaba Park	1970	0.0600
16	Yanagimachi Children Playground	-	0.2145
17	Tokiwadaira Park	1977	1.0562
18	Kanna Park	1984	0.2213
19	Kodemari Park	1962	0.1983

Appendix 4 Parks in Tokiwadaira Area.

Source: Google Street View (2018)


11. Mucho


12. Yamabuki


13. Popura


14. Shirakashi


15. Wakaba


16. Yanagimachi


17. Tokiwadaira


18. Kanna


19. Kodemari

Source: Google Street View (2018)

Appendix 5 Questionnaire Sheet of Park Therapy Attributes in middle-aged and older adults (Translated in English).

Survey on health effects of walking and seated viewing on middle-aged and older adults in urban park

In this research, we aim to know the effect of middle and young people walking and seated viewing in the urban park. In addition, heart rate and blood pressure are also measured.

I. It is a question to the respondent. (Please give a circle (○) for each question)

1. Gender	:① Male	② Female	
2. Age	:① <20years old	② 20-29 years old	③ 30-39 years
	old	④ >39years old	
3. Status of Employment	:① Yes	② No	
4. Education	①Senior High School	②Undergraduate	③ Graduate
	④ Other (…….)		
5. Income	:① <¥150,000	② ¥150,000-200,000	③ ¥200,000-
	250.000	④¥250.000	
6. Smoking	:① Yes	② No	
7. Alcohol use	:① Yes	② No	
8. Sleep time	:①<7 hours	②7-9 hours	③>9 hours
9. Physical/sport activity	:①Everyday	②1-2 times/week	③1-3
	times/month	④1-3 times/yea	⑤Never
10. Shinrin-yoku experience	:①Everyday	②1-2 times/week	③1-3
	times/month	④1-3 times/year	⑤Never

11. Social attachment in local area : ①Often ②Sometimes ③Rarely ④Almost never ⑤Never

12. Participation in community activity : ①Yes ( ) times/month. ②No

Blood pressure measurement results of walking survey

1. Survey in the park: before walking (/ mmHg), after walking (/ mmHg)
2. Survey in the city: before walking (/ mmHg), after walking (/ mmHg)

Blood pressure measurement results of seated viewing survey

1. Survey in the park: before viewing (/ mmHg), after viewing (/ mmHg)
2. Survey in the city: before viewing (/ mmHg), after viewing (/ mmHg)

II. Abbreviated Profile of Mood State. (A list of words that describe feelings people have. Please circle the number that best describes how you feel right now)

Item		Not at All	A Little	Quite a Bit	Moderately	Extremely
1	Friendly	①	②	③	④	⑤
2	Tense	①	②	③	④	⑤
3	Angry	①	②	③	④	⑤
4	Worn out	①	②	③	④	⑤
5	Lively	①	②	③	④	⑤
6	Confused	①	②	③	④	⑤
7	Considerate	①	②	③	④	⑤
8	Sad	①	②	③	④	⑤
9	Active	①	②	③	④	⑤
10	Grouchy	①	②	③	④	⑤
11	Energetic	①	②	③	④	⑤

Item		Not at All	A Little	Quite a Bit	Moderately	Extremely
12	Panicky	①	②	③	④	⑤
13	Hopeless	①	②	③	④	⑤
14	Uneasy	①	②	③	④	⑤
15	Unable to concentrate	①	②	③	④	⑤
16	Fatigued	①	②	③	④	⑤
17	Helpful	①	②	③	④	⑤
18	Nervous	①	②	③	④	⑤
19	Miserable	①	②	③	④	⑤
20	Muddled	①	②	③	④	⑤
21	Resentful	①	②	③	④	⑤
22	Exhausted	①	②	③	④	⑤
23	Anxious	①	②	③	④	⑤
24	Good natured	①	②	③	④	⑤
25	Gloomy	①	②	③	④	⑤
26	Weary	①	②	③	④	⑤
27	Desperate	①	②	③	④	⑤
28	Furious	①	②	③	④	⑤
29	Trusting	①	②	③	④	⑤
30	Bad-tempered	①	②	③	④	⑤
31	Worthless	①	②	③	④	⑤
32	Full of pep	①	②	③	④	⑤
33	Uncertain about things	①	②	③	④	⑤
34	Bushed	①	②	③	④	⑤
35	Vigorous	①	②	③	④	⑤

III. State-Trait Anxiety Inventory. (Read each statement and then circle the number that indicates how you feel right now)

Item		Not at All	Some What	Moderate so	Very much so
1	I feel calm	①	②	③	④
2	I feel secure	①	②	③	④
3	I am tense	①	②	③	④
4	I feel strained	①	②	③	④
5	I feel at ease	①	②	③	④
6	I feel upset	①	②	③	④
7	I am presently worrying over possible misfortunes	①	②	③	④
8	I feel satisfied	①	②	③	④
9	I feel frightened	①	②	③	④
10	I feel comfortable	①	②	③	④
11	I feel self-confident	①	②	③	④
12	I feel nervous	①	②	③	④
13	I feel jittery	①	②	③	④
14	I feel indecisive	①	②	③	④
15	I am relaxed	①	②	③	④
16	I feel content	①	②	③	④
17	I'm worried	①	②	③	④
18	I feel confused	①	②	③	④
19	I feel steady	①	②	③	④
20	I feel pleasant	①	②	③	④

IV. Image of park therapy in Forest and Park for the 21st Century

In this survey we examine the image relating to the experience of walking and seated-viewing in the parks by words, sentences, and sketches in order to clarify the image of park therapy. (15 minutes required)

<Procedure>

What do you imagine from walking and seated-viewing in Forest and Park for the 21st Century?

Please answer three questions about that image.

① Fill in the word about the landscape which is experienced from walking and seated-viewing in the park (Please fill in 3 or more.) 2 minutes

② Please explain the situation of the park with sentences (About 100 to 300 characters) 5 minutes

③ Please draw a simple sketch of the image of park therapy on the next page. (Please write keywords if necessary) 5 minutes

① Keywords

② Explanation

③Sketch

Appendix 6 Questionnaire Sheet of Park Therapy Attributes in young adults (Translated in English).

Survey on health effects of walking and seated viewing on young adults in the urban parks

In this research, we aim to know the effect of walking and seated viewing on young adults in the urban park. In addition to the questionnaire, heart rate and blood pressure are also measured.

I. It is a question to the respondent. (Please give a circle (○) for each question)

1. Gender :① Male ② Female

2. Age :① <20years old ② 20-29 years old ③ 30-39 years old ④ >39years old

3. Height/weight : cm/ kg

4. Education ①Undergraduate ②Master ③ Doctor ④ Other ( )

5. Smoking :① Yes ② No

6. Alcohol use :① Yes ② No

7. Sleep time :①<7 hours ②7-9 hours ③>9 hours

8. Physical/sport activity :①Everyday ②1-2 times/week ③1-3 times/month ④1-3 times/year ⑤Never

9. Do you know forest bathing/therapy before? :① Yes ② No

10. Which one of forest bathing/therapy programs do you prefer?

① Weekend half-day program ② Weekend full-day program

③ Half-day program on weekdays ④ One-day program on weekdays

⑤ Two days and 1 night using a tent ⑥ Two days and 1 night using a ryokan

⑦ Holidays for a several days to a week

11. What activities are you interested in?

① Walking ② Seated-viewing ③ Sensory enjoyment ④ River/lake/water soaking

⑤ Laying on the forest ground ⑥ Breathing exercise ⑦ Sleeping in hammock

12. Shinrin-yoku experience : ①Yes ( ) times. ②No

13. Social attachment in local area : ①Often ②Sometimes ③Rarely ④Almost never ⑤Never

14. Participation in community activity : ①Yes ( ) times/month. ②No

Blood pressure measurement results of walking survey

3. Survey in the park: before walking (/ mmHg), after walking (/ mmHg)
4. Survey in the city: before walking (/ mmHg), after walking (/ mmHg)

Blood pressure measurement results of seated viewing survey

3. Survey in the park: before viewing (/ mmHg), after viewing (/ mmHg)
4. Survey in the city: before viewing (/ mmHg), after viewing (/ mmHg)

II. Abbreviated Profile of Mood State. (A list of words that describe feelings people have. Please circle the number that best describes how you feel right now)

Item		Not at All	A Little	Quite a Bit	Moderately	Extremely
1	Friendly	①	②	③	④	⑤
2	Tense	①	②	③	④	⑤
3	Angry	①	②	③	④	⑤
4	Worn out	①	②	③	④	⑤
5	Lively	①	②	③	④	⑤
6	Confused	①	②	③	④	⑤
7	Considerate	①	②	③	④	⑤
8	Sad	①	②	③	④	⑤
9	Active	①	②	③	④	⑤
10	Grouchy	①	②	③	④	⑤
11	Energetic	①	②	③	④	⑤
12	Panicky	①	②	③	④	⑤
13	Hopeless	①	②	③	④	⑤
14	Uneasy	①	②	③	④	⑤
15	Unable to concentrate	①	②	③	④	⑤
16	Fatigued	①	②	③	④	⑤
17	Helpful	①	②	③	④	⑤
18	Nervous	①	②	③	④	⑤
19	Miserable	①	②	③	④	⑤
20	Muddled	①	②	③	④	⑤
21	Resentful	①	②	③	④	⑤
22	Exhausted	①	②	③	④	⑤
23	Anxious	①	②	③	④	⑤
24	Good natured	①	②	③	④	⑤

Item		Not at All	A Little	Quite a Bit	Moderately	Extremely
25	Gloomy	①	②	③	④	⑤
26	Weary	①	②	③	④	⑤
27	Desperate	①	②	③	④	⑤
28	Furious	①	②	③	④	⑤
29	Trusting	①	②	③	④	⑤
30	Bad-tempered	①	②	③	④	⑤
31	Worthless	①	②	③	④	⑤
32	Full of pep	①	②	③	④	⑤
33	Uncertain about things	①	②	③	④	⑤
34	Bushed	①	②	③	④	⑤
35	Vigorous	①	②	③	④	⑤

III. State-Trait Anxiety Inventory. (Read each statement and then circle the number that indicates how you feel right now

Item		Not at All	Some What	Moderate so	Very much so
1	I feel calm	①	②	③	④
2	I feel secure	①	②	③	④
3	I am tense	①	②	③	④
4	I feel strained	①	②	③	④
5	I feel at ease	①	②	③	④
6	I feel upset	①	②	③	④
7	I am presently worrying over possible misfortunes	①	②	③	④
8	I feel satisfied	①	②	③	④
9	I feel frightened	①	②	③	④

Item		Not at All	Some What	Moderate so	Very much so
10	I feel comfortable	①	②	③	④
11	I feel self-confident	①	②	③	④
12	I feel nervous	①	②	③	④
13	I feel jittery	①	②	③	④
14	I feel indecisive	①	②	③	④
15	I am relaxed	①	②	③	④
16	I feel content	①	②	③	④
17	I’m worried	①	②	③	④
18	I feel confused	①	②	③	④
19	I feel steady	①	②	③	④
20	I feel pleasant	①	②	③	④

IV. Image of park therapy in Forest and Park for the 21st Century

In this survey we examine the image relating to the experience of walking and seated viewing in the parks by words, sentences, and sketches in order to clarify the image of park therapy. (15 minutes required)

<Procedure>

What do you imagine from walking and seated-viewing in Forest and Park for the 21st Century?

Please answer three questions about that image.

④ Fill in the word about the landscape which is experienced from walking and seated-viewing in the park (Please fill in 3 or more.) 2 minutes

⑤ Please explain the situation of the park with sentences (About 100 to 300 characters) 5 minutes

⑥ Please draw a simple sketch of the image of park therapy on the next page. (Please write keywords if necessary) 5 minutes

① Keywords

② Explanation

③Sketch

Appendix 7 Principal Component Analysis of Merits of UGS (Chapter 4).

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.855
Bartlett's Test of Sphericity	Approx. Chi-Square	623.704
	df	28
	Sig.	0.000

Component Matrix[a]

	Component
	1
Near_the_house	0.779
Air_purification	0.761
Feel_the_nature	0.747
Children_play	0.722
Beautiful_city	0.717
Habitat	0.707
Activity	0.698
Dust_reduction	0.640

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Appendix 8 Principal Component Analysis of Reasons for reluctance to use UGS (Chapter 4).

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.823
Bartlett's Test of Sphericity	Approx. Chi-Square	559.407
	df	28
	Sig.	0.000

Rotated Component Matrix[a]

	Component	
	1	2
Not_well_maintained	0.817	
Narrow	0.751	
Contaminated	0.670	0.397
A_lot_of_garbage	0.566	0.368
Likely_to_be_lost	0.529	
Risk_of_injury		0.863
Owner_conflict		0.787
Hard_to_enter		0.781

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Appendix 9 Principal Component Analysis of Attitudes Towards UGS (Chapter 4)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.753
Bartlett's Test of Sphericity	Approx. Chi-Square	967.402
	df	45
	Sig.	0.000

Rotated Component Matrix[a]

	Component		
	1	2	3
Cheers_up_life	0.737		
Environment_coexist	0.734		
Cherish_nature	0.733		
Affection_for_nature	0.626	0.338	
Know_the_creatures	0.583		
Time_for_nature		0.895	
Willing_to_volunteer		0.829	
Money_for_nature		0.800	
Well_managed			0.909
Convenient_to_use			0.898

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

CHIBA UNIVERSITY

A Ph.D Thesis Defense

A Study on Landscape Perception toward Green Spaces and The Physiological and Psychological Benefits of Green Space Therapy on Adults in Matsudo City

Presented by the Ph.D Candidate:
Prita Indah Pratiwi
Supervisor:
Prof. Katsunori Furuya

1

1

Table of Contents

Doctoral Thesis Review **2020** 2

2

List of Acronyms

- A-H — Anger–hostility
- **C-B — Confusion–bewilderment**
- D-D — Depression–dejection
- F-I — Fatigue–inertia
- LIST — Landscape Image Sketching Technique
- NCDs — Non-communicable Diseases
- PE UGS — Perceived and Experienced Urban Green Space
- POMS — Profile of Mood States
- SRT — Stress Reduction Theory
- STAI — State-Trait Anxiety Inventory
- T-A — Tension–anxiety
- TMD — Total Mood Disturbance
- UGS — Urban Green Space
- V-A — Vigor–activity

Doctoral Thesis Review **2020** 3

3

List of Abbreviation

- Ac — Activity
- Al — Autumn leaves
- Be — Bench
- Bi — Bird
- Br — Broad
- Bv — Bird's eye view
- Co — Comfortable
- Fe — Fence
- **Fl — Flowers**
- Gr — Greenery
- Hp — Herbaceous plants
- La — Lawn

Doctoral Thesis Review **2020** 4

4

List of Abbreviation

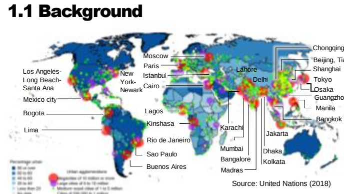
- Os — Objective scene
- Pa — Pavilion
- Pe — People
- Qu — Quiet
- Re — Relaxed
- Rs — Recreational space
- Sp — Surrounding place
- Sv — Sideway view
- Th — Tea house
- Tr — Tree
- Wa — Water

Doctoral Thesis Review **2020** 5

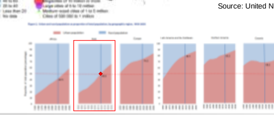
5

1.1 Background

World's Urban Population



Source: United Nations (2018)



30% In 1950s

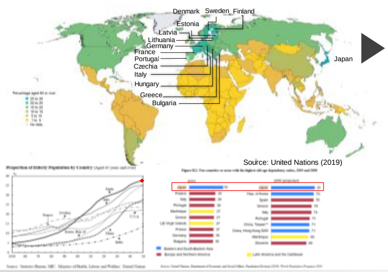
60% In 2030s

68% In 2050s

Doctoral Thesis Review **2020** 6

6

1.1 Background



Aging and population growth have led to increasing cases of atherosclerotic vascular disease worldwide

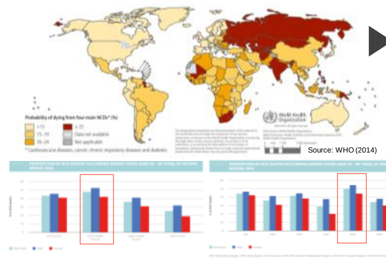
Effective method for senior citizen quality of life&well-being?

Turning one's attention to nature

Perceived and Experienced UGS (Park therapy method)

7

1.1 Background



NCDs with leading behavioural risk factors (tobacco, alcohol, physical inactivity, unhealthy diet): →premature NCD mortality

Effective method for young tropics physical&mental health?

Turning one's attention to nature

Experienced UGS (Park therapy method)

8

1.2 Statement of The Problem

Residents' Perception and Preference towards UGS

1. What are local residents **perceive** their surrounding UGS?
2. What is local residents' **preference** regarding their nearby parks?

Experience of UGS in middle-aged and older adults

1. What kind of **health effects** that middle-aged and older adults get from the urban park?
2. When the **best time** to get a great impact from the urban park?
3. Is there any significant difference in the **park characters** perceived seasonally by residents?
4. Is there any **correlation** between **landscape cognition** and **psycho-physiological** responses?
5. What is the implication for the urban planning for creating healthy and accessible green space for middle-aged and older adults?

Experience of UGS in young adults

1. What are the differences in **health effects** between Japanese and Indonesian young adults?
2. Is there any significant difference in the **park characters** perceived by Japanese and Indonesian young adults?
3. Is there any correlation between **landscape cognition** and **psycho-physiological** responses?

9

1.3 Research Hypothesis

1) There is a significant difference in **perception** between residents based on dwelling type towards UGS
2) There is a significant difference in **preference** of residents based on dwelling type towards their nearby parks.
3) There is a significant difference in the **psycho-physiological responses** of walking and viewing in two **environments** in different seasons among middle-aged and older adults.
4) There is a significant difference in the **psycho-physiological responses** of walking in and seated viewing in urban parks in autumn among Japanese and Indonesian young adults.
5) **Park therapy image** would correlate with reduced **psycho-physiological** parameters of **negative moods and state anxiety**, as well as **increased mood** in adults.

10

1.4 Aim and Objectives

The aim of the study was to investigate **the Perceived and Experienced UGS (PE UGS) framework as a tool for evidence-based park planning and design from perception, preference, and health benefits of green space.** Specific objectives were as follows**:**

1) To clarify the differences in green space **perception, attributes, and factors** inducing perception between danchi and apartment residents.
2) To investigate the **park preference, length of park visit, activities, park elements, disturbances, and factors** inducing preference between danchi and apartment residents.
3) To clarify the **physiological and psychological** effects of walking in urban parks, **park therapy images** in winter, spring, and early summer, and their correlations.
4) To clarify the **physiological and psychological** relaxation effects of remaining sedentary while viewing cherry blossoms in spring and fresh greenery in early summer.
5) To determine the **difference in physiological and psychological** responses between Japanese and Indonesian young adults, the **attractiveness of specific elements**, and their **correlations.**

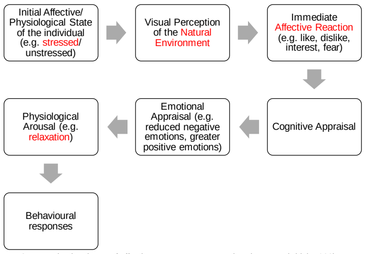
11

Chapter 2. Literature Review

- 2.1 Human and Nature Relationship
- 2.2 Urban Green Space Therapy

12

2.1 Human and Nature Relationship



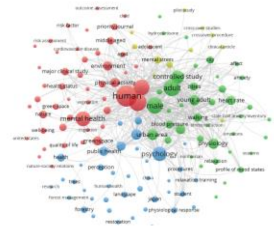
Stress reduction theory of affective response to a natural environment (Ulrich 1983).

Doctoral Thesis Review **2020** 13

13

2.2 Urban Green Space Therapy

The determinants of health and well-being in the urban context (Barton & Grant 2006 developed from a concept by Whitehead Dahlgren 1991)

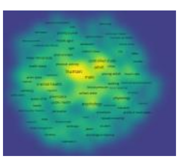


Network visualization of "Nature Therapy AND (shinrin-yoku OR forest bathing) AND park therapy AND urban green space AND green space therapy" (Pratiwi 2020)

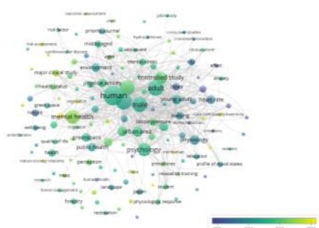
Doctoral Thesis Review **2020** 14

14

2.2 Urban Green Space Therapy



Density visualization (Pratiwi 2020)



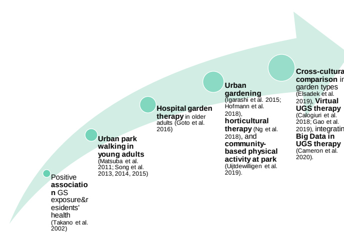
CO-authorship by countries (Pratiwi 2020)

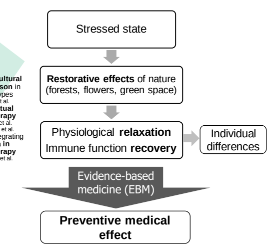
Research trends by year (Pratiwi 2020)

Doctoral Thesis Review **2020** 15

15

2.2 Urban Green Space Therapy



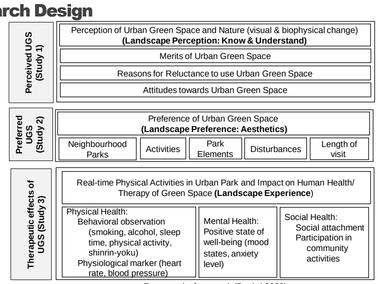


The concept of nature therapy (Miyazaki et al. 2015)

Doctoral Thesis Review **2020** 16

16

3.1 Research Design



Framework of research (Pratiwi 2020)

Doctoral Thesis Review **2020** 17

17

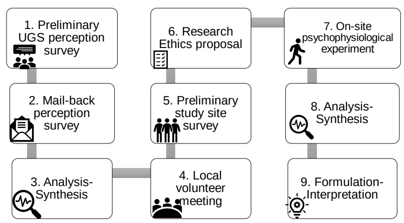
3.1 Research Design - Structure of Study

Study	Perceived UGS	Preferred UGS Property	Therapeutic effects		
			Middle aged and older adults		Young adults
Original papers	**Subchapter 4** (Pratiwi, P.I. & Furuya, *K. J People Env*. **2018**, under review)	**Subchapter 5** (Pratiwi, P.I. & Furuya, K. *Asian J. Behav. Studies* **2019**, 4, 64-79)	**Subchapter 6.1** (Pratiwi, P.I., Xiang, Q.& Furuya, K. *Sustainability* **2020**, 12, 4003)	**Subchapter 6.2** (Pratiwi, P.I., Xiang, Q.& Furuya, K. *Int J. Environ. Sci. Public Health* **2019**, 16, 4279)	**Subchapter 6.3** (Pratiwi, P.I., Xiang, Q., Zijiao, X & Furuya, K. *Forest* **2020**, under review)
Objectives	To clarify the differences in green space perception, attributes, and factors inducing perception between danchi and apartment the residents.	To investigate the neigbourhood park preference, length of park visit, activities, park elements, disturbances in the park between danchi and apartment residents, and factors inducing preferences.	To clarify the physiological and psychological effects of walking in urban parks, park therapy images, and their correlations in winter, spring, and early summer.	To clarify the physiological and psychological relaxation effects of remaining sedentary while viewing cherry blossoms in spring and fresh greenery in early summer.	To determine the differences in physiological and psychological responses between Japanese and Indonesian young adults, attractiveness of specific elements, and their correlations in autumn.

Doctoral Thesis Review **2020** 18

18

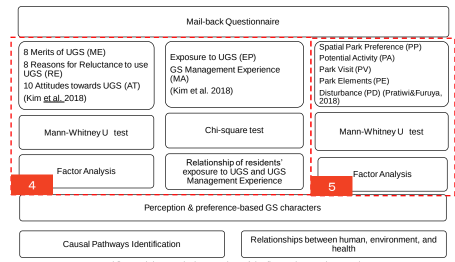
3.1 Research Design - Workflow of general research design



Doctoral Thesis Review **2020** 19

19

3.2 Data Analysis Procedure

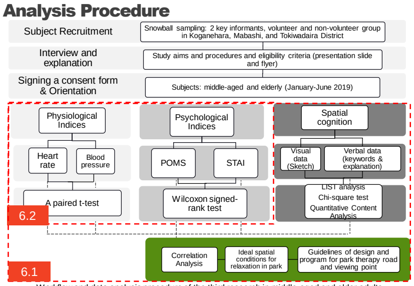


Workflow and data analysis procedure of the first and second research

Doctoral Thesis Review **2020** 20

20

3.2 Data Analysis Procedure

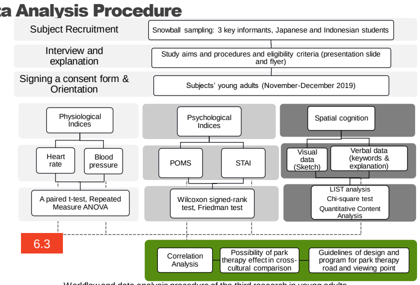


Workflow and data analysis procedure of the third research in middle-aged and older adults

Doctoral Thesis Review **2020** 21

21

3.2 Data Analysis Procedure



Workflow and data analysis procedure of the third research in young adults

Doctoral Thesis Review **2020** 22

22

23

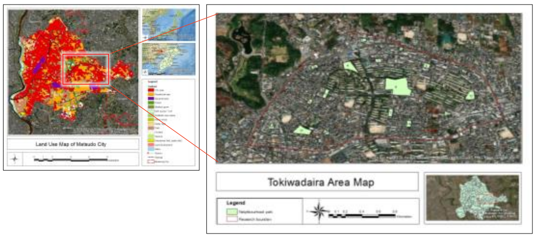
4.1 Objectives

1) To clarify the differences in **green space perception** between the residents of danchi (housing complex) and the private apartments.
2) To examine what **residents' attributes** may influence their green space **management experience.**
3) To formulate **factors inducing residents' awareness and attitude toward green spaces.**

Doctoral Thesis Review **2020** 24

24

4.2 Method - Study area



4.2 Method - Data collection

- Preliminary study
  - Students workshop 2018/01 → Organizing questions for residents → 67 responses
- Distribution of questionnaires with stratified random sampling.
  - 1000 postal kits on 5 blocks of danchi, 1000 postal kits on apartment on main roads 2018/2 → 220 responses from 2020 posted questionnaires (11% reply rate) → Use 220 valid responses

Apartment

Danchi

4.2 Method – Survey of awareness toward UGS

II Overall awareness of urban green spaces (The choice is one for every question)

	What is the merit of the green space around you?	Strongly disagree	disagree	Neither disagree nor agree	agree	Strongly agree
1	It makes the urban landscape beautiful.	①	②	③	④	⑤
2	You can feel nature in the city.	①	②	③	④	⑤
3	It is near.	①	②	③	④	⑤
4	You can engage in free activities (sports, walking, plant watching, rest, gardening activities, etc.).	①	②	③	④	⑤
5	It is a place where children can play.	①	②	③	④	⑤
6	It allows one to inhabit life.	①	②	③	④	⑤
7	It can control the dust.	①	②	③	④	⑤
8	The plants are useful for air conditioning.	①	②	③	④	⑤

	What are the reasons for reluctance to use the green spaces around you?	Strongly disagree	disagree	Neither disagree nor agree	agree	Strongly agree
1	Worried about conflict with owner.	①	②	③	④	⑤
2	They are hard to get to.	①	②	③	④	⑤
3	There is a risk of injury.	①	②	③	④	⑤
4	They are full of garbage.	①	②	③	④	⑤
5	They are contaminated.	①	②	③	④	⑤
6	The plants are not well maintained.	①	②	③	④	⑤
7	They are narrow, small.	①	②	③	④	⑤
8	The site is highly likely to be developed someday.	①	②	③	④	⑤

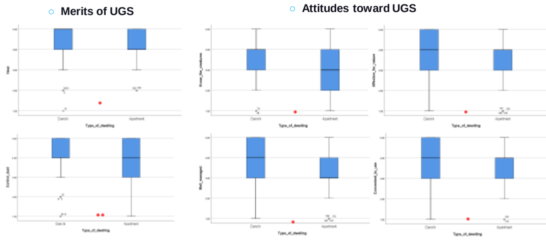
4.2 Method – Survey of attitude toward UGS

III Attitude toward urban green space (The choice is one for every question)

	Questions	Strongly disagree	disagree	Neither disagree nor agree	agree	Strongly agree
1	I cherish nature in cities such as animals and plants.	①	②	③	④	⑤
2	Nature in the city cheers up my daily life.	①	②	③	④	⑤
3	Urban environments where animals, plants, and people can coexist is important.	①	②	③	④	⑤
4	I am willing to volunteer for nature preservation.	①	②	③	④	⑤
5	I am willing to spend my time holding nature.	①	②	③	④	⑤
6	I am willing to spend money on nature preservation.	①	②	③	④	⑤
7	I know the plants, animals, and insects that are common in the area。	①	②	③	④	⑤
8	I feel affection for the region through the plants, animals, and insects in the area.	①	②	③	④	⑤
9	The green space is well-managed.	①	②	③	④	⑤
10	The green space is convenient to use.	①	②	③	④	⑤

4.3 Results - Difference of awareness and attitude toward UGS

- Merits of UGS
- Attitudes toward UGS



4.3 Results - Attributes influencing green space management experience among Danchi residents

Resp. identity \ Activity	Volunteering activity	Number of activity	Expected volunteering hours per day	Expected volunteering hours per year	Gardening activity	Frequency of activity in green space
Age	0.639	0.937	0.693	0.946	0.587	0.110
Gender	0.419	0.660	0.097	0.171	0.023*	0.335
Children in family	0.993	0.619	0.625	0.751	0.106	0.634
Employment status	0.334	0.916	0.768	0.705	0.781	0.076
Length of stay	0.112	0.534	0.479	0.188	0.251	0.088
Green space in residence	0.359	0.463	0.641	0.962	0.019*	0.330

Note. $p^* < 0.05$, $p^{**} < 0.01$, $^{***}p < 0.001$

4.3 Results - Attributes influencing green space management experience among Apartment residents

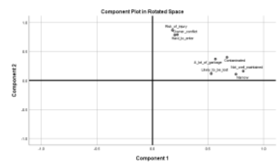
Activity / Resp. identity	Volunteering activity	Number of activity	Expected volunteering hours per day	Expected volunteering hours per year	Gardening activity	Frequency of activity in green space
Age	0.047*	0.000***	0.078	0.106	0.013*	0.066
Gender	0.693	0.705	0.432	0.220	0.863	0.550
Children in family	0.314	0.392	0.053	0.166	0.146	0.105
Employment status	0.851	0.307	0.209	0.117	0.343	0.590
Length of stay	0.381	0.820	0.917	0.003**	0.064	0.490
Green space in residence	0.234	0.186	0.704	0.896	0.830	0.357

Note. $p^* < 0.05$, $p^{**} < 0.01$, $^{***}p < 0.001$

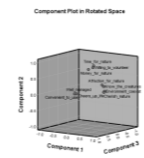
31

4.3 Results - Factors inducing residents' awareness and attitude toward UGS

Reluctance for reasons to use UGS



Attitudes toward UGS

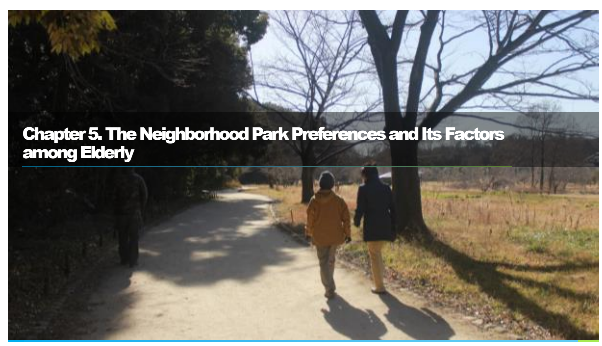


32

4.4 Conclusion

1. Differences in merits of UGS: **distance and controlling dust.**
2. Attitudes toward UGS: **knowing the names of creatures, feeling affection for nature, and well-managed and convenient places.**
3. Residents of Tokiwadaira danchi had a **higher level of perception** than apartment residents, except for usage for children's play.
4. The attributes influencing perception for danchi residents: **gender and green space in residence**, while for apartment residents: **age and length of stay.**
5. There were three factors related to residents' attitude toward UGS: 1) **high, 2) moderate, 3) low attitude level toward UGS.**

33



Chapter 5. The Neighborhood Park Preferences and Its Factors among Elderly

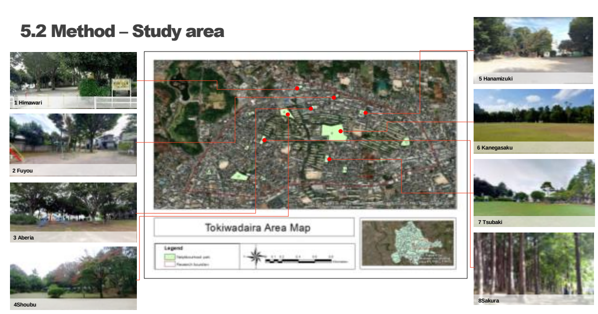
34

5.1 Objectives

1. To determine the significant difference in **park preference, length of park visit, activities, park elements, and disturbances** in the park between danchi and apartment residents.
2. To analyze **factors of park preference**.

35

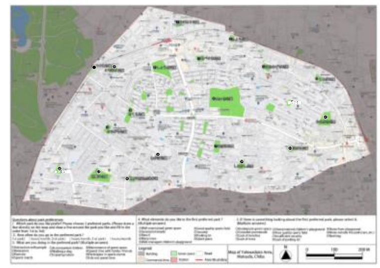
5.2 Method – Study area



36

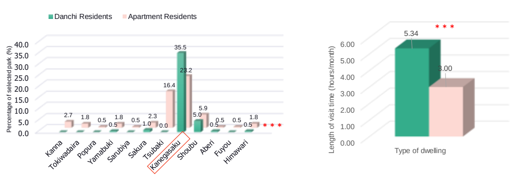
37

5.2 Method – Survey of park preferences



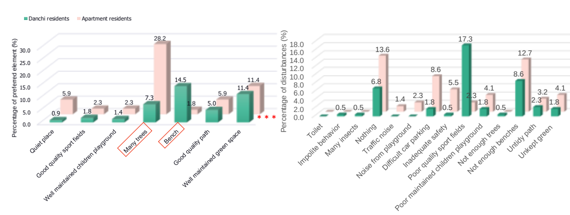
38

5.3 Results - Preference of parks and length of park visit



39

5.3 Results - Preference of elements and disturbances



40

5.3 Results - Attributes influencing park preference

Danchi residents ▶

Respondent	Neighbourhood park preferences				
	Park	Visit time	Activity	Element	Disturbance
Attribute					
Gender	0.453	0.397	0.414	0.137	0.491
Age	0.200	0.738	0.948	0.000***	0.857
Children in family	0.052	0.578	0.936	0.831	0.558
Employment status	0.350	0.277	0.488	0.371	0.386
Length of stay	0.682	0.004**	0.036*	0.079	0.886
Exposure to green space					
GS in residence	0.322	0.909	0.172	0.821	0.222
Recognition of UGS	0.453	0.653	0.715	0.881	0.957
Frequency of visiting UGS	0.019*	0.373	0.642	0.319	0.832

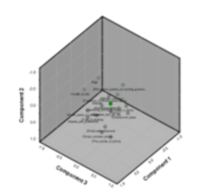
Apartment residents ▶

Respondent	Neighbourhood park preferences				
	Park	Visit time	Activity	Element	Disturbance
Attribute					
Gender	0.500	0.749	0.086	0.062	0.998
Age	0.027*	0.626	0.127	0.100	0.569
Children in family	0.170	0.322	0.001**	0.171	0.405
Employment status	0.540	0.518	0.188	0.343	0.618
Length of stay	0.984	0.806	0.951	0.956	0.543
Exposure to green space					
GS in residence	0.601	0.831	0.384	0.881	0.761
Recognition of UGS	0.068	0.996	0.355	0.004**	0.099
Frequency of visiting UGS	0.864	0.219	0.000***	0.754	0.911

41

5.3 Results - Principal Component Analysis of Park Preference

Survey Item	Component						
	1	2	3	4	5	6	7
Type of dwelling	**.650**	-.084	.032	.170	-.194	.336	.071
Green volunteer activity	.004	**.943**	-.046	.040	.073	-.015	-.033
The number of activities	.054	**.930**	.008	.112	.045	.024	.011
Expected hour per day	.053	.194	.137	**.805**	.021	.070	.008
Expected hour per year	-.018	-.027	.016	**.851**	-.044	-.169	-.152
Gardening activity	.083	.176	-.066	.131	**.663**	.039	.031
Green space in residence	**.591**	-.130	-.147	-.067	.240	-.117	.293
Feeling in surrounding greenery	-.672	-.041	-.236	.046	-.046	.113	-.061
Frequency of visitting green space	-.273	.034	-.104	-.177	**.583**	.204	-.032
Gender	.035	-.018	-.053	-.189	.048	**.790**	-.136
Age	-.331	-.122	-.572	-.115	.204	-.376	-.182
Children in family	-.051	.057	.351	.166	.077	.426	.122
Employment status	.229	-.063	**.638**	.133	.086	.084	.149
Length of stay	.102	.039	-.715	-.011	.029	.077	.119
Spatial park preference	**.556**	.108	-.012	-.007	-.144	.114	-.175
Park visit time	-.082	-.122	.193	-.034	**.569**	-.185	-.314
Activity	.181	.001	.384	-.284	-.231	-.142	-.227
Preferred Park Element	.492	.165	.267	-.009	-.265	-.297	-.158
Disturbance in the Park	.012	-.022	.062	-.121	-.134	-.055	**.847**



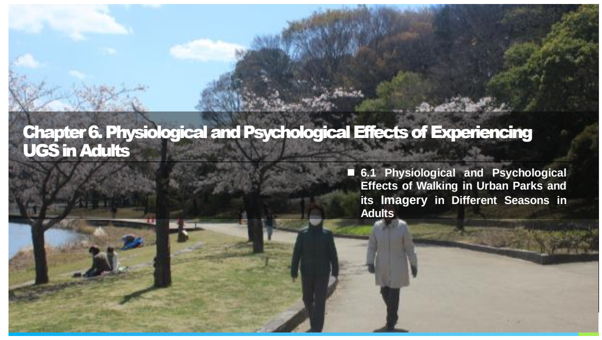
Factor 1: the **existence of shared green space**.
Factor 2: engagement in **green volunteering** activity.
Factor 3: **employment** status.
Factor 4: a willingness to **spend time** in volunteering activity.
Factor 5: **green space visit** and **management experience.**
Factor 6: **gender**
Factor 7: **disturbances** in the park.

42

5.4 Conclusion

1. Differences in preference: **park preference, length of park visit, and park element**.
2. The only attribute influencing danchi residents': **length of stay**, while the only attribute influencing apartment residents': **children in family** and **recognition of quantity of surrounding green space**.
3. There are **seven factors** of park preferences.

43



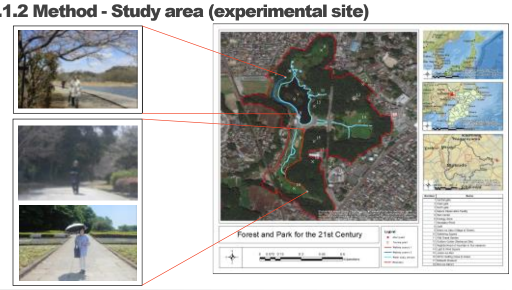
44

6.1.1 Objectives

1. To clarify **physiological and psychological effects of walking**.
2. To analyze **images of park therapy.**
3. To analyze correlations between **image of park**, and **psycho-physiological responses** in an urban park in winter, spring, and early summer.

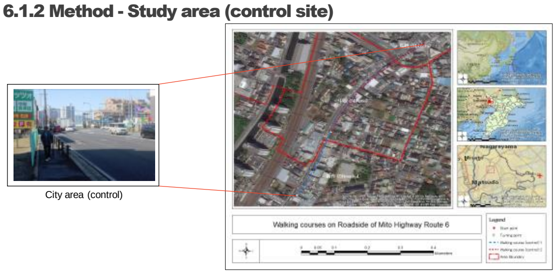
45

6.1.2 Method - Study area (experimental site)



46

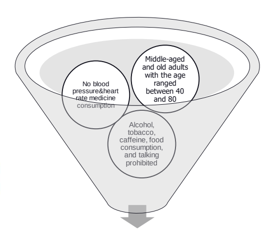
6.1.2 Method - Study area (control site)



47

6.1.2 Method - Participants

Snowball sampling

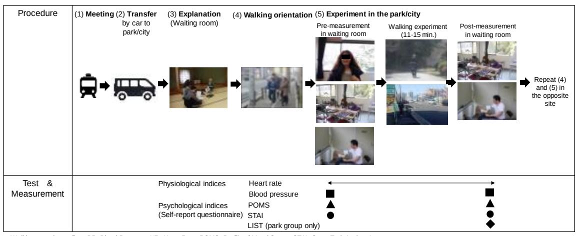


Eligible subjects for enrollment

Approved by: Ethics Committee of the Center for Environment, Health, and Field Sciences, Chiba University, Japan (no 18-06)

48

6.1.2 Method - Experimental Design



Walking experiment flow. BP: Blood Pressure, HR: Heart Rate, POMS: Profile of Mood States, STAI: State-Trait Anxiety Inventory

49

6.1.2 Method - Physiological and Psychological indices

50

6.1.2 Method－Profile of Mood States (POMS)

$$TMD=(AH+CB+DD+FI+TA)-VA$$

	Item	Not at All	A Little	Quite a Bit	Moderately	Extremely
1	Friendly	①	②	③	④	⑤
2	Tense	①	②	③	④	⑤
3	Angry	①	②	③	④	⑤
4	Worn out	①	②	③	④	⑤
5	Lively	①	②	③	④	⑤
6	Confused	①	②	③	④	⑤
7	Considerate	①	②	③	④	⑤
8	Sad	①	②	③	④	⑤
9	Active	①	②	③	④	⑤
10	Grouchy	①	②	③	④	⑤
11	Energetic	①	②	③	④	⑤
12	Panicky	①	②	③	④	⑤
13	Hopeless	①	②	③	④	⑤
14	Uneasy	①	②	③	④	⑤
15	Unable to concentrate	①	②	③	④	⑤
16	Fatigued	①	②	③	④	⑤
17	Helpful	①	②	③	④	⑤

	Item	Not at All	A Little	Quite a Bit	Moderately	Extremely
18	Nervous	①	②	③	④	⑤
19	Miserable	①	②	③	④	⑤
20	Muddled	①	②	③	④	⑤
21	Resentful	①	②	③	④	⑤
22	Exhausted	①	②	③	④	⑤
23	Anxious	①	②	③	④	⑤
24	Good natured	①	②	③	④	⑤
25	Gloomy	①	②	③	④	⑤
26	Weary	①	②	③	④	⑤
27	Desperate	①	②	③	④	⑤
28	Furious	①	②	③	④	⑤
29	Trusting	①	②	③	④	⑤
30	Bad-tempered	①	②	③	④	⑤
31	Worthless	①	②	③	④	⑤
32	Full of pep	①	②	③	④	⑤
33	Uncertain about things	①	②	③	④	⑤
34	Bushed	①	②	③	④	⑤
35	Vigorous	①	②	③	④	⑤

51

6.1.2 Method －State-Trait Anxiety Inventory (STAI)

	Item	Not at All	Some What	Moderate so	Very much so
1	I feel calm	①	②	③	④
2	I feel secure	①	②	③	④
3	I am tense	①	②	③	④
4	I feel strained	①	②	③	④
5	I feel at ease	①	②	③	④
6	I feel upset	①	②	③	④
7	I am presently worrying over possible misfortunes	①	②	③	④
8	I feel satisfied	①	②	③	④
9	I feel frightened	①	②	③	④
10	I feel comfortable	①	②	③	④
11	I feel self-confident	①	②	③	④
12	I feel nervous	①	②	③	④
13	I feel jittery	①	②	③	④
14	I feel indecisive	①	②	③	④
15	I am relaxed	①	②	③	④
16	I feel content	①	②	③	④
17	I'm worried	①	②	③	④
18	I feel confused	①	②	③	④
19	I feel steady	①	②	③	④
20	I feel pleasant	①	②	③	④

52

6.1.2 Method －Landscape Image Sketching Technique (LIST)

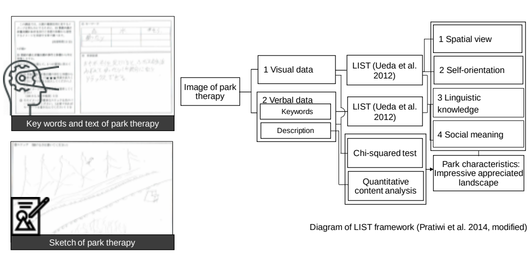
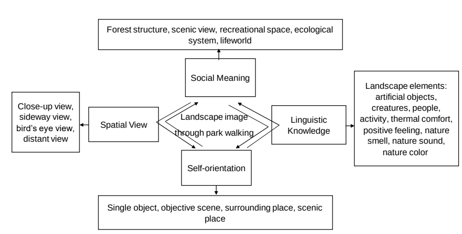


Diagram of LIST framework (Pratiwi et al. 2014, modified)

53

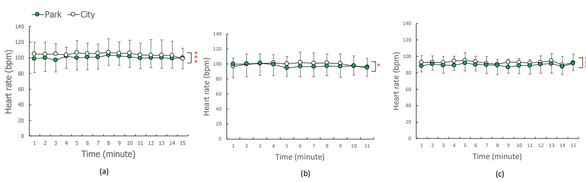
6.1.2 Method －Landscape Image Sketching Technique (LIST)



Source: Ueda et al (2012, modified)

54

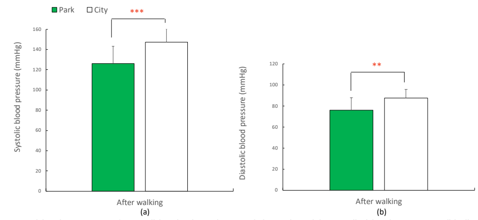
6.1.3 Results - Physiological Effects (Heart rate)



One-minute average heart rate during walking in the urban park in: (a) winter, (b) spring, and (c) early summer

55

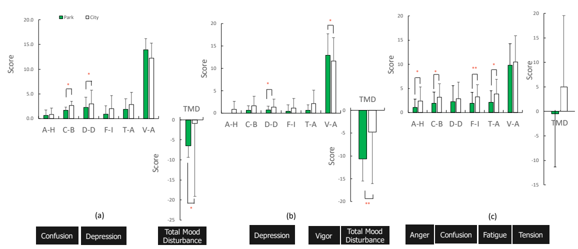
6.1.3 Results - Physiological effects (Blood pressure)



Average blood pressure after walking in the urban park in spring: (a) systolic blood pressure; (b) diastolic blood pressure

56

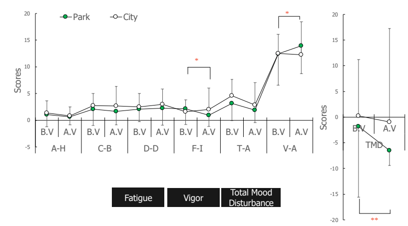
6.1.3 Results - Psychological Effects (Mood States)



The POMS score **after walking** in the urban park: (a) winter; (b) spring; (c) early summer

57

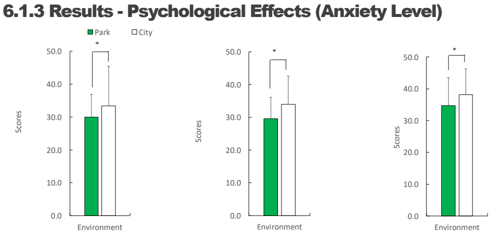
6.1.3 Results - Psychological Effects (Mood States)



Comparison of POMS score **pre- and post-walking** in the urban park in the winter

58

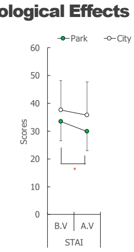
6.1.3 Results - Psychological Effects (Anxiety Level)



STAI score **after walking** in the urban park in: (a) winter; (b) spring; and (c) early summer

59

6.1.3 Results - Psychological Effects (Anxiety Level)



Comparison of STAI **score pre- and post-walking** in the urban park in winter

60

6.1.3 Results - Image of Park Therapy

Season	Linguistic Knowledge									Self-orientation	Social meaning
	Landscape Element (%)				Therapeutic Feeling (%)						
	Greenery	Trees	Water	Lawn	Activity	People	Comfortable	Relaxed	Broad	Surrounding place	Receational space
Winter	0	50	33.3	0	0	16.7	25	41.7	0	8.3	8.3
Spring	33.3	8.3	75	0	25	41.7	0	0	0	50	58.3
Summer	58.3	0	25	25	0	0	0	8.3	25	16.7	16.7
P - value	0.008**	0.004**	0.031*	0.038*	0.038*	0.034*	0.038*	0.015*	0.038*	0.045*	0.014*

61

6.1.3 Results – Correlation matrix of park therapy images and psycho-physiological responses

Physiological/ psychological responses \ Park Therapy Images		Linguistic Knowledge							Spatial View		Self-orientation
		Landscape elements						Therapeutic Feeling			
		Gr	Fl	Ac	Wa	Bi	Pe	Qu	Bv	Sv	Sp
Heart rate		-	-	o*	Δ*	□*	o**	-	-	-	-
Blood pressure	Systolic blood pressure	-	-	-	-	o*	-	-	-	-	-
	Diastolic blood pressure	-	Δ*	o*	-	-	-	-	-	-	-
Mood state	Confusion–bewilderment	-	-	-	-	-	-	-	Δ*	-	-
	Tension–anxiety	-	-	-	-	-	-	-	-	-	o*
	Vigor–activity	o*	-	-	-	o*	-	Δ**	o*	-	-
	Total Mood Disturbance	-	-	-	-	o*	-	-	o*	-	-
	State anxiety	-	-	-	-	o*	-	Δ**	-	Δ**	-

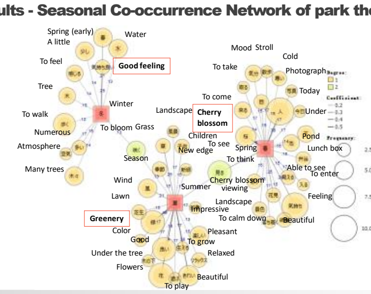
Gr: greenery, Fl: flower, Ac: activity, Wa: water, Bi: bird, Pe: people, Qu: quiet, Be: bird's eye view, Si: sideway view, Sp: surrounding place, □*: winter, o: spring, Δ: summer

62

6.1.3 Results - Park therapy sketches

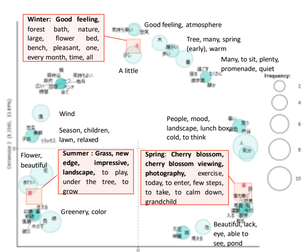
63

6.1.3 Results - Seasonal Co-occurrence Network of park therapy images



64

6.1.3 Results - Seasonal Correspondence Analysis of park therapy images

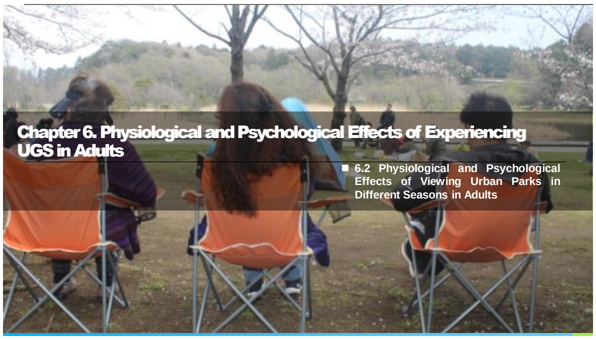


65

6.1.4 Conclusion

1. Walking in an urban park→**lower heart rates** and **blood pressure**.
   →**lower negative moods, TMD, and state anxiety**,
   →while the **higher positive mood**
2. Images in winter: **trees, relaxation, and comfort**; in spring: **water, activity, people, surrounding place, and recreational space**; and in early summer: **greenery, lawn, and broadness.**
3. The most correlated park therapy images: "**birds**" as indicator creatures in landscapes.
4. Evidence-based special features of park landscape→design considerations of park therapy road:
   - Accessible walking course through **tree stands or thinned forest**.
   - **Medium distance** as suitable views of distance zone.
   - Diversity of seasonal landscape changes (e.g., **greenery, flower, bird, water, lawn, physical activity**).

66



Chapter 6. Physiological and Psychological Effects of Experiencing UGS in Adults

- 6.2 Physiological and Psychological Effects of Viewing Urban Parks in Different Seasons in Adults

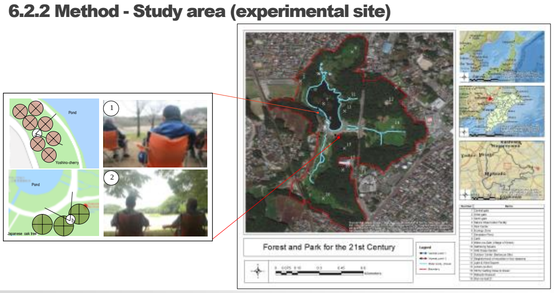
67

6.2.1 Objectives

To clarify the **physiological and the psychological relaxation effects** of remaining sedentary while viewing **cherry blossoms** in spring and **fresh greenery** in early summer.

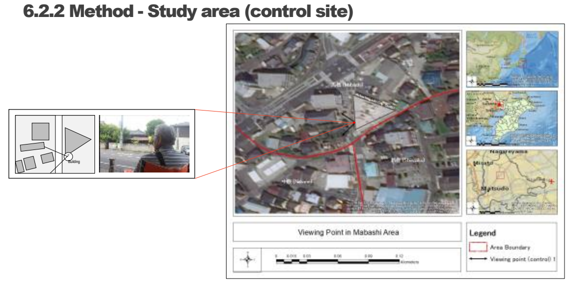
68

6.2.2 Method - Study area (experimental site)



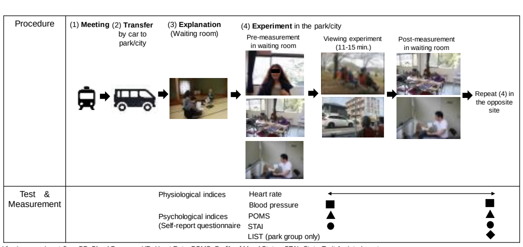
69

6.2.2 Method - Study area (control site)



70

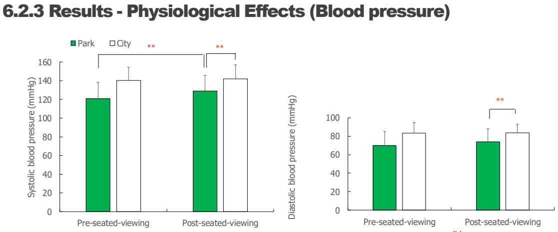
6.2.2 Method - Experimental Design



Viewing experiment flow. BP: Blood Pressure, HR: Heart Rate, POMS: Profile of Mood States, STAI: State-Trait Anxiety Inventory

71

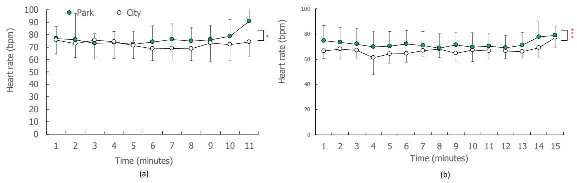
6.2.3 Results - Physiological Effects (Blood pressure)



The average of blood pressure **after urban park viewing** in spring: a) systolic blood pressure and b) diastolic blood pressure.

72

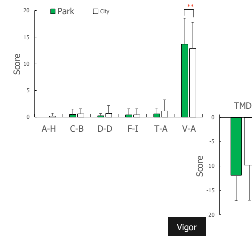
6.2.3 Results - Physiological Effects (Heart rate)



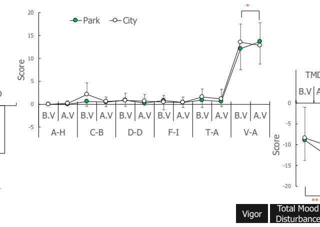
Average one-minute heart **rate during urban park viewing** in: (a) spring and (b) early summer

73

6.2.3 Results - Psychological Effects (Mood States)



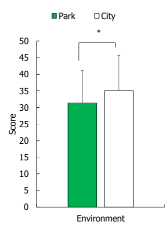
POMS scores **after viewing** in the urban park in spring



Comparison of POMS score **pre- and post-view** in the urban park in spring

74

6.2.3 Results - Psychological Effects (Anxiety level)



STAI score **after viewing** in an urban park in early summer

75

6.2.4 Conclusion

1. Viewing urban parks resulted in:
   - **Lower blood pressures in spring**.
   - **Increased vigor–activity in spring**.
   - **Decreased TMD in spring**, and
   - **Decreased anxiety levels in early summer**.
2. The composition of park therapy scenes→ input for therapeutic park design to provide higher value of relaxation benefits: considering the significant natural elements (e.g., **flowers, water bodies, and maintained greenery**).

76

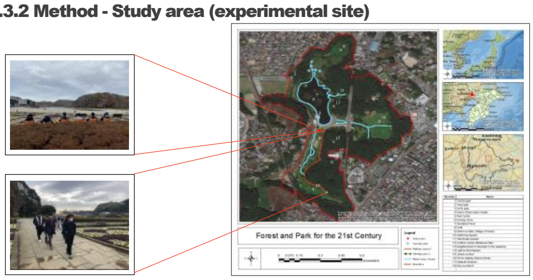
77

6.3.1 Objectives

1. To determine whether there were significant differences in **physiological and psychological responses** between Japanese and Indonesian young adults
2. To analyze the **attractiveness of specific elements** of the experienced park.
3. To analyze the **correlations between park images and psycho-physiological responses**.

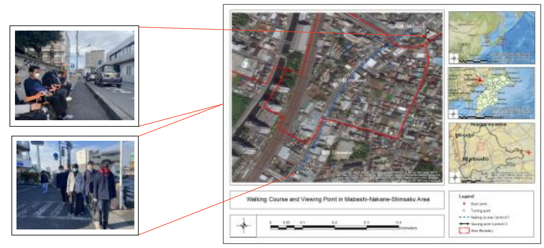
78

6.3.2 Method - Study area (experimental site)



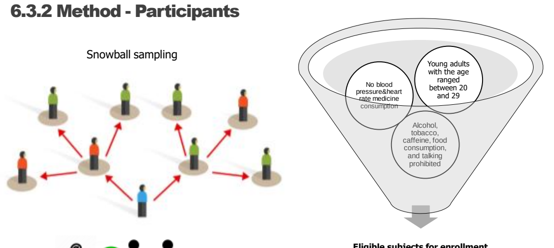
79

6.3.2 Method - Study area (control site)



80

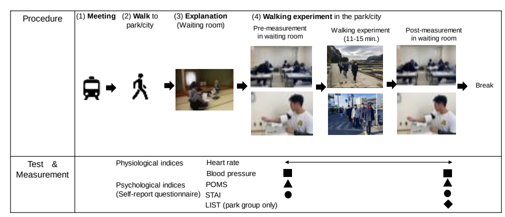
6.3.2 Method - Participants



Approved by: Ethics Committee of the Center for Environment, Health, and Field Sciences, Chiba University, Japan (no 19-04)

81

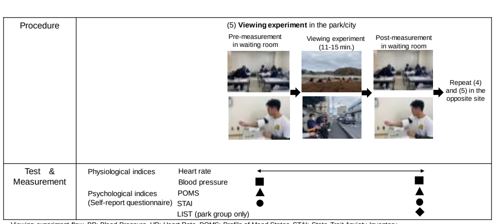
6.3.2 Method - Experimental Design



Walking experiment flow. BP: Blood Pressure, HR: Heart Rate, POMS: Profile of Mood States, STAI: State-Trait Anxiety Inventory

82

6.3.2 Method - Experimental Design



Viewing experiment flow. BP: Blood Pressure, HR: Heart Rate, POMS: Profile of Mood States, STAI: State-Trait Anxiety Inventory

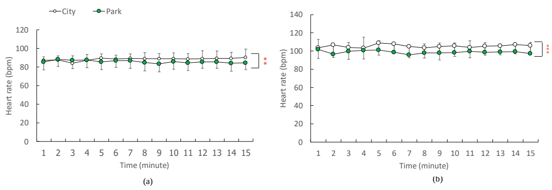
83

6.3.3 Results - Physiological Effects (Blood pressure)

Average blood pressure after **walking in the urban park** in autumn: (a) systolic blood pressure; (b) diastolic blood pressure

84

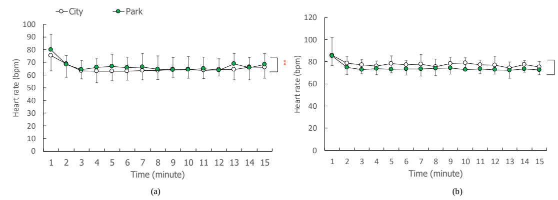
6.3.3 Results - Physiological Effects (Heart rate)



Average one-minute heart rate during urban **park walking** in autumn between: (a) Japanese and (b) Indonesian young adults

85

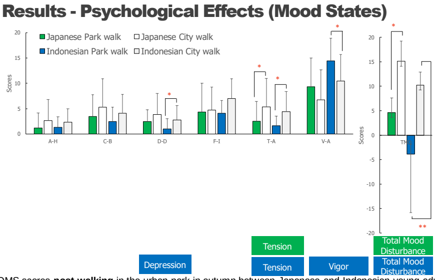
6.3.3 Results - Physiological Effects (Heart rate)



Average one-minute heart rate during urban **park viewing** in autumn between: (a) Japanese and (b) Indonesian young adults

86

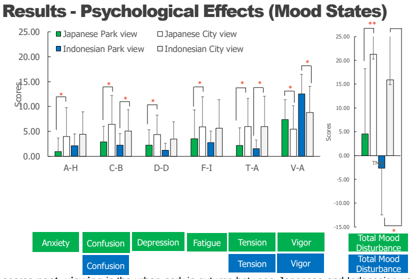
6.3.3 Results - Psychological Effects (Mood States)



POMS scores **post-walking** in the urban park in autumn between Japanese and Indonesian young adults

87

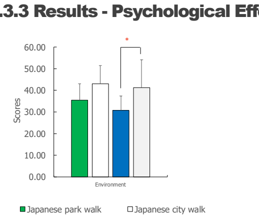
6.3.3 Results - Psychological Effects (Mood States)



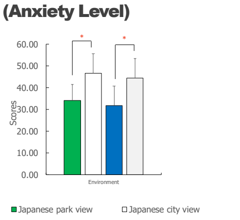
POMS scores **post- viewing** in the urban park in autumn between Japanese and Indonesian young adults

88

6.3.3 Results - Psychological Effects (Anxiety Level)



STAI score **post-walk** in an urban park and the city in autumn between Japanese and Indonesian young adults



STAI score **post-view** in an urban park and the city in autumn between Japanese and Indonesian young adults

89

6.3.3 Results - Interaction Terms of Environment, Activity, and Nationality

Parameter	Subparameter	*P*-Value		
		Environment x Activity	Environment x Nationality	Activity x Nationality
Heart rate		0.000***	0.000***	0.000***
Blood pressure	Systolic blood pressure	0.055	0.272	0.715
	Diastolic blood pressure	0.229	0.216	0.955
POMS	A-H	0.402	0.492	0.022*
	C-B	0.046*	0.357	0.659
	D-D	0.288	0.631	0.109
	F-I	0.104	0.874	0.044*
	T-A	0.005**	0.858	0.347
	V-A	0.067	0.282	0.976
	TMD	0.015**	0.969	0.100
STAI	State-anxiety	0.001***	0.609	0.174

90

Park therapy sketches

Park therapy image sketches of **Japanese**

Park therapy image sketches of **Indonesian**

91

6.3.3 Results - Correlation Matrix of park therapy images and psycho-physiological responses in Japanese

Physiological/ psychological responses \ Park Therapy Images		Linguistic Knowledge						Spatial View	Self-orientation	
		Landscape element								
		Tr	**Be**	**Th**	**Al**	**Hp**	**Fl**	**Sv**	**Os**	Sp
Heart rate		O**	Δ*	-	-	-	-	-	-	-
Blood pressure	Systolic blood pressure	-	-	Δ*	-	-	-	-	-	-
	Diastolic blood pressure	-	O* Δ*	-	-	-	-	-	-	-
Mood state	Anger-hostility	-	-	-	Δ*	-	-	-	-	-
	Confusion-bewilderment	-	-	-	-	-	-	-	O** Δ*	-
	Depression-dejection	-	O*	-	-	-	-	-	Δ*	-
	Tension-anxiety	-	-	-	-	-	-	O*	Δ*	-
	Fatigue-inertia	-	Δ*	-	Δ*	Δ*	-	-	-	-
	Vigor-activity	-	-	-	-	-	-	-	-	O*
	Anxiety level	-	-	-	-	-	Δ*	-	-	-

*p< 0.05, **p < 0.01, ***p < 0.01, Tr: trees, Be: bench, Th: traditional house, Al: autumn leaves, Hp: herbaceous plants, Fl: flowers, Bv: bird's eye view, Sv: sideway view, Os: Objective scene, Sp: surrounding place, o: walking, Δ: viewing.

92

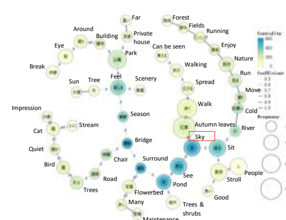
6.3.3 Results - Correlation Matrix of park therapy images and psycho-physiological responses in Indonesian

Physiological/ psychological responses \ Park Therapy Images		Linguistic Knowledge					
		Landscape element					
		Be	**Fe**	**Fl**	**Pa**	**Pl**	**Co**
Blood pressure	Systolic blood pressure	-	-	-	-	O* Δ*	-
Mood state	Anger-hostility	Δ*	-	-	-	-	-
	Vigor-activity	-	O* Δ*	Δ*	O* Δ*	-	-
	Total Mood Disturbance	-	O*	-	O*	-	Δ*
	Anxiety level	-	O* Δ*	-	O* Δ*	-	-

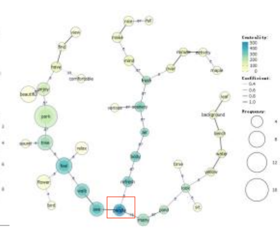
*p< 0.05, **p < 0.01, ***p < 0.01, Pl: plaza, Pa: Pavilion, Fe: fence, Be: bench, Fl: flowers, Co: comfortable, o: walking, Δ: viewing

93

6.3.3 Results - Co-occurrence Network of park therapy images



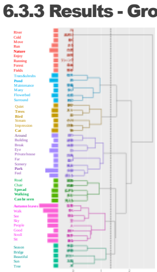
Co-occurrence Network of park therapy images of **Japanese**



Co-occurrence Network of park therapy images of **Indonesian**

94

6.3.3 Results - Groups of autumn appreciation among Japanese



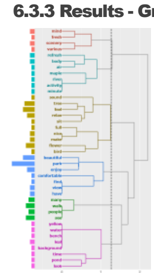
Dendrogram of Japanese young adults

Park therapy character among Japanese:

1. **Natural landscape** (e.g. forest, river, fields with some physical activities).
2. **Maintained landscape** (e.g. pond, trees, shrubs, flowerbed).
3. **Blue open space** with creature.
4. Park contained **elements with view.**
5. **Walking activity**.
6. **Autumn leaves** with sky view and activity.
7. **Beautiful season** by trees and sun.

95

6.3.3 Results - Groups of autumn appreciation among Indonesian



Dendrogram of Indonesian young adults

Park therapy character among Indonesian:

1. **Various sceneries**→refresh mind.
2. **Walking** through maple trees and a river→refresh body.
3. **Existence of elements** (e.g. trees, flowers, and bird sounds)→ can sit & feel relaxed.
4. Park with **beautiful view**→can enjoy & feel comfortable.
5. **People's activity** (e.g. walking & sightseeing).
6. Viewing **water body & yellowish leaves** as background.

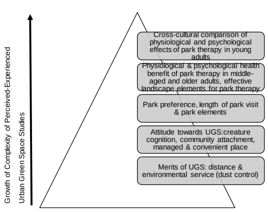
96

6.3.4 Conclusion

1. Walking in urban parks→**decrease systolic blood pressure** and **heart rate.**
2. Walking through autumn leaved forest →effective for **Japanese** young adults.
3. Viewing autumn leaved forest→effective for **Indonesian** young adults.
4. Difference in **heart rate** between Japanese and Indonesian.
5. **Japanese** experienced **greater psychological relaxation** after park viewing than Indonesian.
6. Experienced park images: **autumn-colored foliage** (54.5%) with the sky as by **Japanese**; **tranquility effect** (44.4%) by **Indonesian**.
7. **Familiar and exotic long tradition of hunting for autumn foliage** for Japanese and foreign adults: mingled into **park therapy programs** →to manage academic stress.
8. **Possibility of park therapy effect** in tropic young adults.

Chapter 7. Conclusion and Future research

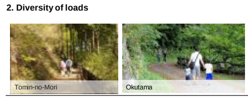
7.1 Novelty



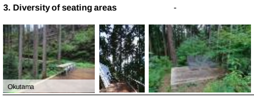
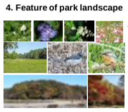
The Findings employing PE UGS framework as tools for evidence-based park planning and design:

1. Put some green spaces at least **250 m** from home and select **dust and pollutants-absorbent plants** in neighborhood green space.
2. Design and manage parks ecologically with good accessibility and security as well as clear orientation.
3. Provide adequacy of **seating areas and shade trees** for relaxation in parks.
4. Promote both walking in and viewing in urban parks every season to have physiological and psychological relaxation, especially **spring walking and viewing.**
5. Promote those activities in order to **have experience** of thermal comfort, positive feeling, sensing of nature color, smell, sound, texture that characterized by **park therapy images** using **LIST.**
6. Consider significant **seasonal landscape elements' composition**, **tree stands management**, and select **medium distance** for viewing the scenes.
7. Consider exotic and traditional landscape **elements** as well as **amenities** such as pavilion and local restaurant in the urban park to be taken into account to maintain academic stress in young adults.

7.2 Design Guidelines for Park Therapy

Requirement	Park Image Components			
	Linguistic knowledge	Spatial view	**Self-orientation**	Social Meaning
1. Load 	-	-	Easy to walk (1.5-2 m), sand, paved, wood path/wood chips	-
2. Diversity of loads 		-	• 1 km for middle-aged and older adults • 2 km for young adults	-

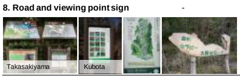
7.2 Design Guidelines for Park Therapy

Requirement	Park Image Components			
	Linguistic knowledge	**Spatial view**	**Self-orientation**	Social Meaning
3. Diversity of seating areas 	-	-	Plenty of choice in seating area based on scenic spots	-
4. Feature of park landscape 	Scenic spot: flowers, foliages, herbaceous plants, lawns, birds, activity, plaza, pavilion Landmark: trees, ponds	Bird's eye view, sideway view (medium distance, 100-200 m)	-	-

7.2 Design Guidelines for Park Therapy

Requirement	Park Image Components			
	Linguistic knowledge	Spatial view	**Self-orientation**	Social Meaning
5. Diversity of landscape changes 	Secondary forest with native species, a range of scented flowering plants that can be enjoyed throughout the year	-	Diverse sceneries	-
6. Comfortable space 	Comfortable, relaxed, tranquil, calm (subjective feeling), tea house and cafe (restaurants offering local specialties)	-	Surrounded by greenery but still allow borrowed view to have sense of belonging	-

7.2 Design Guidelines for Park Therapy

Requirement	Park Image Components			
	Linguistic knowledge	Spatial view	Self-orientation	Social Meaning
7. Management 	Maintain park facilities, such as wooden benches, signs, fences	-	Cutting and clearing about 20 m from walking course	-
8. Road and viewing point sign 	-	-	Maintain signs at junctions, entrance, exit with the contents: inclination, distance, calorie consumption, health effects of park therapy	Cooperation in management with NPOs, NGOs, etc.
9. Access 	-	-	Give access information of people with dissability and provide safety path (equipped by ramp)	-

Doctoral Thesis Review ***2020*** 103

103

7.3 Future Research

1. Wide range of **remote park therapy** research design due to pandemic situation using:
   - System for Observation Play and Recreation in Communities (**SOPARC**) method.
   - Impressive self- **geo-tagged** photographs of therapeutic park elements.
   - Integration with **Big data** analysis.
   - Qualitative research on park therapy **experience essays**.
   - Viewing UGS by watching video of nature stimuli with **VR technology**.
2. Country with established forest and park therapy research: **improvement of policies**→development of the forest therapy industry.
3. Country without the experience of forest and park therapy research→**basic research**
4. PE UGS framework: applicable in various contexts and at different scales→**home garden, urban or rural green spaces, and regional green spaces**.

Doctoral Thesis Review ***2020*** 104

104

References

1. Elsadek, M.; Sun, M.; Sugiyama, R.; Fujii, E. Cross-cultural comparison of physiological and psychological responses to different garden styles. *Urban Forest. Urban Green.* 2019, 38, 74–83.
2. Gao, T.; Zhang, T.; Zhu, L.; Gao, Y.; Qiu, L. Exploring psychophysiological restoration and individual preference in the different environments based on virtual reality. Int. J. Environ. Res. Public Health 2019, 16, 17, 3102.
3. Goto, S.; Gianfagia, T.J.; Munafo, J.P.; Fujii, E.; Shen, X.; Sun, M.; Shi, B.E.; Liu, C.; Hamano, H.; Herrup, K. The power of traditional design techniques: the effects of viewing a Japanese garden on individuals with cognitive impairment. Health Environ. Res. Des. J. 2016, 10, 74–86.
4. Hofmann, M.; Young, C.; Binz, T.M.; Baumgartner, M.R.; Bauer, N. Contact to Nature Benefits Health: Mixed Effectiveness of Different Mechanisms. Int. J. Environ. Res. Public Health 2018, 15, 31.
5. Igarashi, M.; Miwa, M.; Ikei, H.; Song, C.; Takagaki, M.; Miyazaki, Y. Physiological and psychological effects of viewing a kiwifruit (Actinidia deliciosa 'Hayward') orchard landscape in summer in Japan. Int. J. Environ. Res. Public Health 2015, 12, 6657–6668.
6. Kim, M., Rupprecht, C. D. D., Furuya, K., et al. (2018). Residents' Perception of Informal Green Space—A Case Study of Ichikawa City, Japan. Land, 7(102), 1-20.
7. Matsuba, N.; Lee, J.; Park, B.; Lee, M.; Song, C.; Miyazaki, Y. Physiological effects of walking in Shinjuku Gyouen, a large-scale urban green area. Japan Soc. Physio. Anthropol. 2011, 16, 133–139.
8. Matsunaga, K.; Park, B.; Kobayashi, H.; Miyazaki, Y. Physiologically relaxing effect of a hospital rooftop forest on older women requiring care. J. Am. Geriatr. Soc. 2011, 59, 2162–2163.
9. Morimoto K.; Miyazaki. Y.; Hirano H. Forest Medicine; Asakura Publishing Co., Ltd.: Tokyo, Japan 2006. (In Japanese)
10. Ng, K.S.T.; Sia, A.; Ng, M.K.W.; Tan, C.T.Y.; Chan, H.Y.; Tan, C.H.; Rawtaer, I.; Feng, L.; Mahendran, R.; Larbi, A.; et al. Effects of horticultural therapy on Asian older adults: a randomized controlled trial. Int. J. Environ. Res. Public Health 2018, 15, 1705.
11. Pratiwi PI, Furuya K, Sulistyantara B. 2014. The difference in people's response toward natural landscape between university students of Japan and Indonesia. Jurnal Manusia dan Lingkungan 21(2):247–253.

Doctoral Thesis Review ***2020*** 105

105

References

12. Pratiwi, P.I.; Sulistyantara, B.; Gunawan, A.; Furuya, K. A comparative study on the perception of forest landscape using LIST method between university students of Japan and Indonesia. J. Man. Hut. Trop. 2014, 20, 3, 167–178.
13. Song, C.; Joung, D.; Ikei, H.; Igarashi, M.; Aga, M.; Park, B.J.; Miwa, M.; Takagaki, M.; Miyazaki, Y. Physiological and psychological effects of walking on young males in urban parks in winter. J. Physiol. Anthro. 2013, 32, 18.
14. Song, C.; Ikei, H.; Igarashi, M.; Miwa, M.; Takagaki, M.; Miyazaki, Y. Physiological and psychological responses of young males during spring-time walks in urban parks. J. Physiol. Anthropol. 2014, 33, 8.Goto, S.; Gianfagia, T.J.; Munafo, J.P.; Fujii, E.; Shen, X.; Sun, M.; Shi, B.E.; Liu, C.; Hamano, H.; Herrup, K. The power of traditional design techniques: the effects of viewing a Japanese garden on individuals with cognitive impairment. Health Environ. Res. Des. J. 2016, 10, 74–86.
15. Song, C.; Ikei, H.; Igarashi, M.; Takagaki, M.; Miyazaki, Y. Physiological and psychological effects of a walk in urban parks in fall. Int. J. Environ. Res. Public Health 2015, 12, 14216–14228.
16. Ueda, H.; Nakajima, T.; Takayama, N.; Petrova, E.; Matsushima, H.; Furuya, K.; Aoki, Y. Landscape image sketches of forests in Japan and Russia. Forest Pol. Eco. 2012, 19, 20–30.
17. Uijtdewilligen, L.; Waters, C.N.H.; Aw, S.; Wong, M.L.; Sia, A.; Ramiah, A.; Wong, M.; Riemenschneider, F.M. The Park Prescription Study: Development of a community-based physical activity intervention for a multi-ethnic Asian population. PLoS ONE 2019, 14, 6, e0218247.
18. Ulrich, R.S. Aesthetic and affective response to natural environment. In: Altman I (eds). Behaviour and the National Environment. Boston, MA: Springer 1983, 85–125.
19. United Nations. World Urbanization Prospects: The 2018 Revision, Key Facts; United Nations: New York, NY, USA, 2018.
20. Morimoto K.; Miyazaki. Y.; Hirano H. Forest Medicine; Asakura Publishing Co., Ltd.: Tokyo, Japan 2006. (In Japanese)
21. World Health Organization (WHO). Global Recommendations on Physical Activity for Health; World Health Organization: Geneva, Switzerland 2010.
22. World Health Organization (WHO). Global Status Report on Noncommunicable Diseases: Geneva, Switzerland 2014.
23. World Health Organization (WHO). Noncommunicable Diseases (NCD) Country Profiles: Geneva, Switzerland 2018.

Doctoral Thesis Review ***2020*** 106

106

文部科学省 MEXT Scholarships 日本学術振興会 Japan Society for the Promotion of Science 科研費

Lab. of Landscape Planning in Fall 2017

Thank you

107