Alma Mater Studiorum - Università di Bologna

Dottorato di ricerca in
Salute, Sicurezza e Sistemi del verde
XXXV ciclo

Settore Concorsuale: 05/B1 ZOOLOGIA E ANTROPOLOGIA

Settore Scientifico Disciplinare: BIO/08 ANTROPOLOGIA

Influence of the natural environment on health: evaluation of different environmental contexts (urban, green spaces) and intervention proposals.

Presentato da: Alessia Grigoletto

Coordinatore Dottorato
Patrizia Tassinari

Supervisore
Stefania Toselli

Co-Supervisore
Daniele Torreggiani
Maria Pia Fantini

Esame finale anno 2023

Table of contents

Acronyms

BIA: Bioelectrical Impedance Analysis

BIVA: Bioelectrical Impedance Vectoral Analysis

BMI: Body Mass Index

CFA: Fat Area of the Calf

CMA: Muscle Area of the Calf

CG: control group

CT: control trial

EG: experimental group

FFM: Fat-Free Mass

FM: Fat Mass

%F: Percentual of Fat Mass

GUS: Green Urban Space

HRQL: Health-Related Quality of Life

MET: Metabolic Equivalent Task

MVPA: Moderato to Vigorous Physical Activity

NW: Nordic walking

OFE: Outdoor Fitness Equipment

PA: Physical Activity

Pha: Phase Angle

PI: Physical Inactivity

PGWB-S: Psychological General Well-Being Index Short Form Questionnaire

R: Resistance

RCT: Randomized Controlled Trial

ROS: restoration outcome score

SB: Sedentary behavior

TCA: Total Calf Area

TUA: Total Upper Arm Area

UFA: Upper Arm Fat Area

UMA: Upper Arm Fat Area

Xc: Reactance

WHO: World Health Organization

Abstract

Urbanization has grown during the last decades, with an increase in population concentrated in cities. The World Health Organization predicts that by 2030 three of every five people of the worldwide population will live in an urban area. This phenomenon creates the so-called “compact cities”, which are characterized by the opposition of buildings and roads with limited space to insert green and natural space. In this scenario, cities are usually relatively nature-poor, and the loss of green urban space likely leads to less contact with the natural world for urban dwellers. It is known that the natural environment could provide important advantages, and the loss of contact with this type of environment has potential negative impacts on the quality of life, well-being, and health status of the population. Several Authors found several improvements in health and well-being after the use of green urban space. In fact, the use of green urban space demonstrated stronger benefits for mental health and stress reduction, in comparison with other pathways. A study assessed that among people who regularly use green urban spaces, the decrease in self-reported symptoms of depression is influenced by the proximity of the natural environment from home. Another important benefit was related to the decrease in the risk of cardiovascular disease, and the number of hospitalization and self-reported heart diseases were lower in people who live in areas with the presence of green space.

In general, exposure to green urban space is linked to a reduction in mortality rates, due to the promotion of a healthy lifestyle. In fact, green urban space could be an optimal environment in which to perform physical activity. Undertaking regular physical activity is one of the major determinants of health. The benefits of exercise have been widely demonstrated through a wide range of studies. Benefits are linked to the treatment and prevention of most chronic and non-

communicable diseases, that are not contagious, but they are usually long-lasting, with slow progress, and are typically a result of environment, genetics, or poor lifestyle. Regular physical activity could reduce mental health problems, such as anxiety, or improve the executive functions of the brain, such as plan, or organizing. The World Health Organization proposed to improve physical activity programs through the implementation of interventions in green urban spaces. Green urban space provides a safe, accessible, and attractive place to perform physical activity.

In connection with this, the present thesis has had the objective of investigating these topics through three lines of research. The first part focuses on introducing the topic with an overall state of the art regarding the importance of green urban and physical activity in the natural environment. In addition, this topic was discussed also in light of the results of two systematic reviews that investigated the most popular type of activities performed in green urban spaces (study 1) and the benefits of physical activity done in the natural environment (study 2). In study 1 emerged that the most popular activities were walking and the use of fitness outdoor equipment, while study 2 confirms the positive effects of projects carried out in natural environments (both green and blue spaces).

The second part discusses the relationship between the use of green urban space and mental and physical health, through questionnaires (study 3, study 4, study 5, and study 6). In particular, study 3 analyzed the attitude toward green space in two Italian regions: Veneto and Emilia-Romagna, to understand what are the motivations that drive people to use this type of environment and highlight how the best attitude found in Emilia-Romagna can be attributed to the best territorial policies. In fact, in this region, there were more projects and initiatives to improve and sensibilize the importance of visiting and using green urban space. Study 4 focused on the effects of restoration after visiting green urban spaces. The questionnaire was administered in four European cities (Barcelona, Doetichem, Stoke-on-Trent, and Kaunas) to investigate the feelings after doing different

types of activities (such as practicing sports, walking, playing with children, or relaxing) in people with different levels of mental health. The study showed that the best benefits of practicing these activities were found in the subjects who had poorer mental health than those who had better mental health. Study 5 and study 6 were about the project "The moving park project" carried out by the Municipality of Bologna with the AUSL and the local sports societies. The project provided the administration of free supervised physical activity by qualified instructors to citizens within Bologna's Park during the spring-summer time. In particular, study 6 assessed the impact of COVID-19 on the project and participants' health and well-being. From the questionnaires emerged the importance of territorial and local policies in helping people to understand the importance of green urban space (study 3), the positive effects of restoration for people with poorer mental health (study 4), the benefits in terms of stress reduction and increased psychological well-being of project carried out in parks (study 5), and the importance of this type of project also after the COVID-19 pandemic situation (study 6).

The third part discusses the effectiveness of physical activity performed in green urban spaces on mental and physical health and compares these results with the effectiveness of PA done in an indoor space (study 7, study 8, study 9, and study 10). In study 7 the motivations for using Arcoveggio park (Bologna) were analyzed, together with the amount of physical activity done. From the results of this study emerged that usually, people who performed physical activity individually at the park did not achieve the goal of 150 minutes/week proposed by the World Health Organization, but if active commuting was added, more people achieved the goal. In study 8 the effectiveness of a period of Nordic walking training was observed. Nordic walking is usually proposed as a rehabilitative kind of physical activity but from this study emerged its positive effects also for the non-clinical population. While in study 9 the effects of the period of Nordic walking training were compared to a period of resistance training in indoor spaces. Nordic walking seemed

to be more effectiveness for men than indoor resistance training, highlighting the beneficial effects of outdoor activity. Finally, in study 10 the effectiveness of a period of the walking program was assessed, in women over 65 years.

From this study emerged that walking could be a good strategy for the elderly population, to remain active, and to help people to age healthily.

In conclusion, it seems that the territorial policies implemented to improve and increase the use of green urban space are very important, probably more than national policies. The projects carried out in Emilia-Romagna represent a good example to follow also in other regions in Italy, but they could also be improved and implemented. All the interventions aimed to promote the practice of physical activity and to reduce sedentary behavior are important. In fact, even if it is well known that physical activity has several positive effects, a great amount of the population remains inactive. A good strategy could be to show people how integrated physical activity into their all-day life, for example through the use of green urban space or active commuting. The results in the present thesis showed the effectiveness of performing physical activity in a natural environment and of active commuting in reaching the recommended goal of 150 minutes/week of moderate intensity of PA or 75 minutes/week to high intensity of PA. Several mental health and well-being benefits were also observed through the results of the questionnaires: reduction of anxiety and depression, increase in vitality, and quality of life. At the same time, physical benefits were found in the experimental trial. Physical activity has been confirmed to have beneficial effects also in terms of body composition parameters (such as the reduction in fat mass), and body strength (who showed a significant increase) of the participants of all ages.

Green urban spaces seem to be a multipurpose type of environment and represent an ideal context for improving both mental and physical health.

Keywords: green urban space, health, mental and physical health, park, physical activity

1. Introduction

1.1 The problem of urbanization

During the last decades, urbanization has grown, leading to significant changes in the landscape, with an increase in population concentrated in cities [1]. It is common knowledge that the natural environment could provide important advantages, such as an important increase in physical and psychological health, however, the loss and degradation of green space is a threat to the natural ecosystem, and also to human health. This is reflected in the loss of the possible beneficial effects that nature can provide to people, including those related to health and psychophysical well-being. The World Health Organization (WHO) predicts that by 2030, three out of five people of the worldwide population will live in an urban area [1]. The loss of the natural environment undoubtedly will have a strong impact on public health. Rapid urbanization could compromise environmental planning [2]. Each city may have unique and specific problems and limitations in increasing green urban space, however, at the same time the physiological limits of vegetation growth tend to be equal in all cities [3–5]. The constraints are increasing and causing pervasiveness in areas with condensed development, which can be called “compact cities” [2]. Compact urban areas are characterized by the opposition of buildings and roads with limited space to insert green areas, mixed land use, and a union of form and function [6]. Therefore, usually, cities are relatively nature-poor due to the great range of competing land use [2] as well as there are areas in which urban natural spaces face a great deal of development pressure [7]. The loss of green urban spaces can lead to less contact with the natural world for urban dwellers, which has potential negative impacts on the quality of life and well-being of the population [7–9].

1.2 The definition of “green urban space”

About the health and well-being impact, “green urban space” (GUS) has not a universal definition or it has not been accepted yet. This is why there are several definitions to describe GUS. In particular, the United States Environmental Protection Agency’s defines GUS as all vegetated land, including agriculture, lawns, forests, wetlands, and gardens [10]. Barren land and impervious surfaces such as concrete and asphalt are excluded. The European Union define the GUS as spaces including public green areas, which are predominately used for recreation such as gardens, zoo, park, and suburban natural area and forest, or green areas bordered by urban areas that are managed or used for leisure purpose [11]. GUS may include places with natural surfaces or natural settings, but also include specific types of urban greenery. Some examples contain streets or also “blue space”, which represent water elements ranging from ponds to coastal zone. In the last period, an interest in “blue spaces” has increased and the two types of environments are starting to be considered separately. Researchers usually consider GUS as public parks and gardens, but this definition, as stated above, can have a different significance depending on the context, and it may or may not include a range of other areas, such as other public open spaces, recreational facilities, or residential open spaces. For this reason, any place with a natural surface or with growing trees can be considered a GUS.

In policy terms, it is important to focus on GUS which are open to the public, particularly when considering universal green space accessible for all urban residents, regardless of socioeconomic circumstances.

1.3 Evidence of health benefits of GUS

Several health and well-being benefits in the use of GUS have been observed by various Authors [12–20]. A great part of the literature is concerned with the mental health effects of spending time

in a natural environment. The use of GUS demonstrated stronger benefits for mental health and stress reduction, in comparison with other pathways [12,13]. The results of the studies are partially in contrast to each other, depending on the considered variables. For example, Sugiyama et al. found a strong association between perceived greenness and mental health and with physical health [14]. On the contrary, Triguero-Mas et al. observed that exposure to GUS was associated with a significant increase both in physical and mental health for all socioeconomic status and genders [15]. In addition, people who live in urban areas with a great amount of green and GUS have been shown to have a reduction of stress levels and a significant improvement in well-being compared to people who live in areas with a poorer presence of GUS [16,17]. Another study assessed that, among people who regularly use GUS, the decrease in self-reported symptoms of depression is influenced by the proximity of UGS from home [18]. Van de Berg et al. found, in four different European cities, that a great amount of time spent in GUS is associated with a significant improvement in mental health and vitality, independently from cultural and climatic factors [19]. Another important benefit of GUS was related to the decrease in risk of cardiovascular diseases, such as coronary heart disease and stroke [20,21]. Walking in GUS could be recommended as a rehabilitation form for coronary artery disease since it reduces heart rate and diastolic blood pressure [22]. The numbers of hospitalization and self-reported heart diseases were lower in people who live in areas with different types of GUS in comparison with those who live in urban areas without GUS [23]. Also, type 2 diabetes mellitus seems to be affected by access to GUS, by promoting an active lifestyle, and improving the amount of PA with a consequent reduction of obesity [24]. Several studies, made in different countries observed an association between neighborhood GUS and the reduction of odds of having type 2 diabetes mellitus [25–28]. Thiering et al. (2016) concluded that the apparent protective effects could be due to the vegetation that reduces the exposure to traffic air pollutants [28]. In general, there are several pieces of evidence that exposure to GUS is linked to a reduction

in mortality rates [29]. For example, a Japanese study observed that the five-year survival rate in people over 70 years was positively associated with access to GUS for walking and with the nearness of the residence to tree-lined streets [30]. Similar results were found in England and Canada, in which the presence and the amount of GUS in neighborhoods influenced all causes of death rate, and the increase in residential GUS was positively associated with a reduction of mortality [20,31]. Partially in contrast, Gascon et al. (2016) in their systematic review and meta-analysis found that the presence of GUS reduces the risk of cardiovascular disease, while the evidence of a reduction of all causes of mortality is least evident [29]. It is important to consider that higher education and higher income are strong confounders, because they are strongly associated with better health outcomes.

1.4 Pathways linking GUS to improved health and well-being

Several pieces of evidence, that highlight the benefits of exposure to GUS, exist, however, there are no conclusive results about the mechanics that explain this link. Several mechanics were suggested, but the results are not conclusive. Health benefits could be provided through complex and different pathways, some of them may have a synergic effect [32]. Four principal mechanics were proposed to explain the relationship between GUS and health: stress reduction, improved biodiversity, enhanced physical activity, and greater social cohesion [32]. Different Authors investigated various mechanics [31–37]. For example, several authors highlighted strong evidence for restorative psychological effects from spending time in GUS, because of the intrinsic quality of the natural environment [32–34]. Villanueva et al. and Kuo emphasized the positive effects on respiratory health, immune functioning, resilience to heat-related illness, social capital, and cohesion, recognizing that there are probably several mechanics, some of which could interact with each other and offer both direct and indirect benefits [35,36]. Lachowycz & Jones proposed physical activity,

engagement with relaxation, nature, social activities, and interactions as major mechanisms linked to health [37].

1.4.1 Immune response, lowering temperature, air and noise pollution

GUS could have several positive effects in terms of a healthy environment, influences on the immune response, the lowering of the temperature, and lower air and noise pollution [33,38–44]. Some Authors suggested a primary role of GUS for enhanced immune functioning [36,43,45]. In particular, Li et al. found significant beneficial immune responses after visiting forests, such as the expression of anti-cancer proteins [45]. These results suggest benefits through contact with some physical or chemical factors in the use of GUS. According to those results, other Authors observed that the immunological pathway is through different microorganisms in the natural environments, which can play an important immunoregulatory role [43]. In addition, the children who were more exposed to GUS during the first years of life were least likely to have recurrent wheezing and allergic sensitization [46]. Noise pollution is one of the major problems linked to growing urbanization. In fact, noise pollution is one of the largest and increasing problems for human health. This is due to the traffic volumes, to activities linked to industries and it is also a consequence of the decreasing availability of GUS in cities [24]. GUS, if well-designed, could reduce the noise created by non-natural sources or reduce the negative perception and create relief from city sounds [47,48]. Several studies showed that a combination of landforms and vegetation was most effective in attenuating traffic noise [7,49–51]. Some Authors suggested that it could be also a psychological mechanism, which influences people in perceived noise reduction due to the presence of natural vegetation. In fact, Yang et al. found that a big amount of their participants overestimates the ability of the vegetation in the road site to attenuate noise [50]. Therefore, it could be possible that the presence of plants affects people's emotional processing. In addition, there is several evidence for the positive effects of GUS in mitigating the air pollutants in cities [24]. In fact, vegetation, through carbon storage,

could decrease levels of air pollutants and reduce atmospheric dioxide [52–57]. So, every type of vegetation improves air quality in urban areas, mitigating the impact of road traffic and industry, and providing positive effects on dwellers' health. Due to the replacement of the vegetation, the heat island can be a serious health hazard during heat extreme events [24]. Exposure to excessive heat is linked to increase morbidity and mortality, especially in a vulnerable subpopulation, such as the elderly [38,58]. Bowler et al. showed that urban parks had an average cooling effect of approximately 1°C [59,60]. Similar results were found also by other Authors [61,62]; Harlan et al. (2006) observed that in the densely populated areas, the decrease of vegetation and the little levels of open spaces in the neighborhood were linked to higher temperatures and the urban heat island [61]. The importance of trees is well established since they can provide shade and reduce the demand for air conditioning and in addition, they provide comfortable outdoor settings [63].

1.4.2 Enhancement of social interaction and improved social cohesion in the community

Social relationships could have a protective effect on health and well-being, while social isolation is a predictor of morbidity and mortality [64–66]. Kim and Kaplan observed that GUS could promote a sense of community in dwellers [67]. Other studies evaluate the sense of community, considered with a focus on trust, shared norms and values, positive and friendly relationships, and the feeling of being accepted and belonging [68]. The Authors found that several types of GUS have been associated to facilitate social cohesion and inclusion, even in children and adolescents [69]. At the same time, the relationship between social well-being and green spaces is complex and the mechanisms are not easy to explore, even if some researchers could find a positive association [32]. Some Authors observed that the presence of GUS in disadvantaged neighborhoods influenced the reduction of crime [70,71].

1.4.3 Relaxation and restoration

Contact with a natural environment could have a restorative effect and a positive effects on mental health [72,73]. Kaplan and Kaplan (1989) created the "attention restoration theory", which suggests that watching a GUS influences health perception and well-being, because of the intrinsic quality of the natural outdoor environment [33,74,75]. In addition, the rich stimulus in a natural setting helps to improve performance in cognitively demanding tasks [76–78]. Involuntary attention is restored from contact with the natural environment and for this reason, cognitive performance is improved. Another theory is the psycho-physiological stress reduction theory, which affirms how contact with nature can have a positive effect on people with high levels of stress, by moving them to a more positive emotional state [79,80]. People are predisposed to find beneficial effects from natural environments, so, exposure to these incitements increases the parasympathetic nervous system response, leading to feelings of enhanced well-being and relaxation.

Both theories postulate that humans have an innate need to affiliate with the natural environment and that the interaction with the natural environment serves a restorative function but through different mechanisms [81]. Several studies demonstrate restorative physiological responses associated with viewing or being in green spaces, including the reduction of blood pressure, heart rate, skin conductance, and muscle tension [79,82,83]. In addition, other studies found a lower concentration of cortisol, lower pulse rate, lower blood pressure, greater parasympathetic nerve activity, and lower sympathetic nerve activity when compared to city environments [84,85]. Walking in GUS has been associated with stronger short-term cognitive benefits than walking in an urban environment [86]. Cortisol was used as a biomarker to evaluate chronic stress, and several types of research demonstrated a connection between stress reduction and the presence of GUS in the neighborhood in which people live [87–91].

1.4.4 Opportunity to perform physical activity (PA)

Physical inactivity is considered one of the leading risk factors for global mortality, and it has increased in several countries due to the lack of GUS and footpaths [92]. GUS could be a viable alternative to indoor PA and exposure to a natural environment is linked to triggering a higher amount of PA among dwellers, and a lower mortality rate [21,93,94]. Some Authors have observed long-term adherence to PA initiatives if they were carried out in outdoor settings, such as GUS, and that the effects could be superior to those obtained from indoor exercise interventions [95–97]. With regards to what has just been mentioned, Harting et al. reported an association between GUS and levels of PA, highlighting how walking for leisure may be supported by green environments in a different way than walking to go to a place [32]. Recreational walking can increase PA and reduce sedentary behaviors [14,25,37,98–105]. Björk et al. and De Jong et al. found a positive association between the quality of green spaces in the neighborhood and the levels of PA, as well as self-rated health improvement [106,107].

Lachowycz, et al. in their studies, conducted in the United Kingdom, found that time spent in GUS represents one-third of all physical activity during the week [108]. Barton and Pretty defined "green exercise" as the practice of PA in GUS or in another natural environment and Marselle et al. observed that "green exercise" had more benefits than other types of activities [109,110]. The comparison between the effects of running in a park and in an urban environment is that the first type of PA showed an association with a higher restoration experience than the second type of PA [111]. In fact, there is a study that demonstrated the effectiveness of outdoor PA compared to indoor PA or PA undertaken in an urban setting [111]. Another article showed a significant association between PA in GUS and a reduction in the risk of poor mental health [112]. At the same time, PA done in other types of environments did not show the same health benefits [112]. A systematic review showed that a big number of articles observed an association between the

presence of GUS and the reduction of obesity [113]. PA in GUS has been shown to improve cardiovascular and mental health, neurocognitive development, general well-being, and to help prevent obesity, cancer, and osteoporosis [114]. Despite the evidence of the health benefits of GUS, people usually underutilized them, and dwellers are often engaged in low levels of PA during their visits [115,116]. Providing attractive GUS may encourage people to spend more time in this environment and could facilitate PA for some parts of the population, such as the elderly [117,118]. Some authors demonstrated a significant association between the quality of GUS in the neighborhoods and increased walking among older people [14].

Additional information about the importance of PA would be better explained in the next chapter, because it one of the main focus of the present thesis.

1.5 Potential pathogenic effects of green spaces

Despite the positive evidence of the importance of GUS, there are also some possible negative effects. For example, in certain cases, trees can trap and contain air pollution in traffic roads [119]. This means that, if GUS are located near a traffic road and people use the GUS to perform PA, they would be exposed to a heavy amount of pollution [120,121]. However, a Danish study demonstrated that exposure to high levels of traffic-related air pollution did not modify the association between PA levels and mortality, showing beneficial effects of PA even in the presence of air pollution [122]. Another possible negative effect is the risk of allergies and asthma, but the evidence is rather inconclusive [123,124]. Dadvand et al. observed no association between GUS in residential areas and asthma, but at the same time, they saw that proximity to GUS was linked with an elevated percentage of asthma [125]. A similar study was conducted in northern and southern Germany, and the results were different in the two areas [126]. In fact, in the south, GUS were positively associated with allergic asthma, but in the north, GUS appeared to have a protective effect [126]. The balance of risk and benefits are difficult to assess for various population [25]. The optimally designed of GUS

could also provide protection from excessive exposure to UV radiation [127,128]. In addition, negative effects can be avoided and mitigated using appropriate clothing, such as hats, and sun creams [24]. Finally, another negative aspect of GUS could be the perception of risks of crimes against the person. Usually, women felt more fearful to use the GUS because of their vulnerability or because of their past crime experiences, but this does not necessarily reflect recorded crime incidence [129].

In summary, although several studies have evaluated the importance of GUS on health and PA, the results are not yet conclusive, due to the multidisciplinary aspects involved in this topic. In addition, it remains unclear what drive people to use the GUS and in which way projects carried out in GUS could affect psychological well-being.

2. The role of physical activity

2.1 Definition of physical activity

Physical activity (PA) is one of the most important determinants of health[130,131]. It is well known that people who are engaged in an active and fit life live healthier and longer [131]. The World Health Organization (WHO) defined physical activity (PA) as bodily movement produced by skeletal muscle that requires energy expenditure [132]. So, any movement that people could perform in daily life, during their free time, also traveling from home to the workplace, can be considered PA. There are several ways to undertake PA, such as cycling, walking, and participating in recreational activities (e.g., yoga, dance, etc..) [133]. In addition, PA can also be undertaken as part of the work, and as a part of domestic tasks around the home (such as cleaning, carrying, and care duties). Some activities can provide enjoyment, for example, the ones people choose to do; other activities may be necessary or mandatory, such as domestic-related PA, and may not provide the same mental, and social health benefits compared with active recreation [134]. PA is different thing compared to exercise, which is planned, structured, and repetitive, and has as its objective the improvement or the maintenance of fitness [132]. In turn, physical fitness represents a set of attributes that are either health and skill related [132]. All manners of PA can provide important health benefits if practiced regularly, and with sufficient intensity and duration [134,135].

2.2 Health benefits of physical activity

Several types of studies have demonstrated and confirmed health benefits related to the practice of PA. In particular, benefits are linked to the treatment and prevention of most chronic and non-communicable diseases, such as cardiovascular disease, osteoporosis, metabolic disease, or neoplastic disease [131,136–139]. These kind of diseases are not contagious, but they are usually long-lasting, with slow progress, and are typically a result of environment, genetics, or poor lifestyle

[140]. In addition, non-communicable diseases are a major burden worldwide with an increasing prevalence in all age groups, ethnicities, and genders [122,141]. Performing PA is the most important activity people can do to improve and sustain their health. PA is important for mental health, delaying cognitive decline, and promoting general well-being [92,142]. The 2018 Physical Activity Guidelines Advisory Committee Scientific Report reported several important benefits of undertaking PA [143]. They observed that PA reduces the risk of all-cause mortality, of cardiovascular disease mortality, of cardiovascular disease (including heart disease and stroke), of type 2 diabetes, of adverse blood lipid profile, of some types of cancer, of dementia (including Alzheimer's disease), of falls, fall-related injuries (especially for older people), and of psychological diseases [143–145]. In addition, PA has an important role in the improvement of cognition, quality of life, sleep, bone health, and physical function [143]. Finally, the literature reported a slowed or reduced weight gain, an improvement in weight loss (particularly when combined with reduced caloric intake), and prevention of weight regain following initial weight loss [143]. Some health benefits could be immediate and others could be stronger if PA is practiced regularly for months or years [143]. For example, mental benefits, such as a decrease in anxiety, and an increase in sleep quality, occur immediately after a single session of PA [146]. Regular PA could improve permanently the reduction of anxiety, and the executive functions of the brain, such as plan, organizing, initiating a task, or controlling emotions [146]. Also, academic achievements, neuropsychological tests, and executive functioning are influenced by the performance of PA and contribute to lowering the risk of developing cognitive impairment, like dementia [146].

2.3 Physical activity recommendations

The WHO and the U.S. Department of Health and Human Services created guidelines to understand the amount of PA recommended categorized based on age [143,146,147]. For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) to 300 minutes (5 hours)

per week of moderate intensity, or 75 minutes (1 hour and 15 minutes) to 150 minutes (2 hours and 30 minutes) per week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate and vigorous-intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week [143,146,147]. Adults should also do muscle-strengthening activities of moderate or greater intensity that involve all major muscle groups, on 2 or more days a week, as these activities provide additional health benefits [146]. The intensity of the activity depends on the request for energy to do [147]. Energy expenditure is calculated using the metabolic equivalent of task (MET), and its multiples. One MET represents the rate of energy expenditure while sitting at rest. PA intensity is described as light (less than 3.0 METs), moderate (requires more than 3.0 METs and less than 6.0 METs), or vigorous (requires more than 6.0 METs) [143]. Regarding the amount of PA done, people could be classified into four categories which are related to how many health benefits a person can obtain at a given level and to how to become more active [146]. An inactive person means that he/she is not carrying out any moderate or vigorous intensity PA beyond basic movement from daily life activities. An insufficiently active person does some moderate or vigorous PA but for less time than recommended by the WHO (150 minutes of activity of moderate intensity, 75 minutes of intense activity, or an equivalent combination of the two). Active is who achieves the goal of 150 to 300 minutes of moderate-intensity PA a week. Finally, a highly active person performs the equivalent of more than 300 minutes of moderate-intensity PA a week. PA is usually divided into three categories: aerobic, muscle-strengthening, and bone-strengthening activities [148]. Aerobic activities involve a large group of muscles in dynamic movements, this leads to a significant increase in heart rate and energy expenditure. In addition, this type of activity improves cardiorespiratory fitness and strengthens of skeletal muscle [148]. Some examples could be running, swimming, or dancing. Muscle-strengthening activities provide a more intensive use of muscle during daily life activities. This type of activity could be structured, such as lifting weights or working with resistance

bands, or unstructured. Finally, bone-strengthening activities produce a force on the bones of the body, which provides bone growth and strength, and it is usually produced by the impact of the ground. This type of activity can also be aerobic, and muscle strengthening.

2.4 Sedentary behavior and physical inactivity

Life expectancy has risen in comparison to the previous centuries; however, current estimations support a potential decline for future generations, due to the consistent, and continuous increase of chronic diseases [149–151]. In 1990, more than 57% (at least 28 million) of people died worldwide caused to chronic disease [152]. Then, in 2008 the deaths from chronic diseases became 63% (at least 36 million people worldwide); and in 2016 they were 72% (at least 39 million people) [153,154]. As was said before, daily PA provides primary disease prevention, through the reduction of chronic disease and mortality [155]. In addition, the treatment for chronic disease is better managed when PA is part of the disease medical management plan [156]. Sedentary behavior is defined as any waking behavior characterized by an energy expenditure ≤1.5 METs, and it is linked to the increase of chronic diseases and is one of the five leading global risks for mortality in the world [157]. From 2002 to 2017 the European adult population showed an increased trend in sedentary behavior prevalence, for both males and females [136,158]. This has prompted to consider sedentary behavior, and physical inactivity a new type of pandemic [159,160]. This is because physical inactivity is an important risk factor for premature mortality, and several chronic diseases [146]. Katzmarky et al. analyzed the effects of sedentary behavior on chronic disease in countries with different income status [161]. The results showed that the proportion of chronic disease linked to physical inactivity ranged from 1.6% for hypertension to 8.1% for dementia [161]. Regarding income status, an increasing trend in the adjusted population-attributable risks was observed [161]. The countries which had the highest chronic disease burden associated with sedentary behavior were Caribbean and Latin American countries, together with countries from Western and Asia Pacific,

which has an high income, followed by countries in Central Asia, North and Middle East Africa [161]. Sedentary behavior and physical inactivity represent also a cost for the countries, due to health care. Globally, in 2013, sedentary behavior was estimated to cost INT$ 54 billion in direct health care, and INT$ 14 billion attributable to lose in production [162]. Even a low amount of moderate to vigorous PA could reduce the risk of all-cause mortality.

Sedentary behavior is linked to increasing industrialization, and urbanization, with the average adult who spends more than half of the day on sedentary life [163].

2.5 Improving PA

There are several strategies to improve the practice of PA and the reduction of sedentary behavior of the population. Two of them, which are connected to each other, could be active transport, such as walking or cycling from home to work, and the use of GUS. The WHO proposed, between the different strategies to reduce physical inactivity, to promote health, and well-being, the possibility of improving PA programs, and the implementation of interventions in GUS, and other natural environments [164]. The increase in PA may be most successful when integrated into daily life habits [165]. In this light, GUS provides a safe, accessible, and attractive place to perform PA, such as walking, running, or playing ball games [163]. The presence of GUS in the neighborhood has been linked to the possibility to achieve a higher amount of PA and to achieve the goal of 150 minutes per week [166]. In addition, the use of GUS to perform PA could provide a space with multiple health benefits, in which it is also possible to have social interaction, and contact with nature [95,115,167–169]. PA in GUS provides a reduction of stress, anxiety, an improvement of self-esteem, mood, and promotion of mental focus [109,170–173]. Outdoor exercise could be a suitable alternative to PA performed in an indoor setting [93]. Some studies observed that exposure to the natural environment significantly increases the amount of PA among the residents, and influences the

decrease in mortality rate [21,37]. At the same time, other studies showed that the achievement of the goal of 150 minutes of PA per week was more common in GUS rather than in other types of settings, such as school, or home, with significant differences [174–176]. Long-term adherence to outdoor PA initiatives is higher than that of indoor PA interventions [95–97]. In addition, the beneficial effects of PA in GUS were higher in reducing negative emotions, than in other types of environments [112,177].

3. Justification and aims

The importance of contact with nature and GUS is known, as well as the importance of performing PA and having an active lifestyle. However:

- Even if there is an increasing interest and literature on this topic, the results are still not conclusive, due to the multidisciplinary aim of the topic, which permits different approaches and types of investigations;
- It remains unclear what drives people to use GUS and in which way projects carried out in GUS could affect psychophysical well-being;
- Few studies investigate the practical effects of PA carried out in GUS on the nonclinical population, and few of them have been conducted in Italy.

For these reasons, one of the aspects addressed in the present thesis was to increase the knowledge of the relationship between GUS, physical and mental health, and the practical effects of performing PA in this type of environment.

The subsequent chapters are divided into three subtopics:

- Two systematic revisions of the literature, in order to have a frame of these topics and to better understand what was already known:
    - **Study 1**. Impact of Different Types of Physical Activity in Green Urban Space on Adult Health and Behaviors: A Systematic Review
    - **Study 2**. The Effect of Physical Activity Interventions Carried Out in Outdoor Natural Blue and Green Spaces on Health Outcomes: A Systematic Review
- The influence of GUS on physical well-being and mental health:
    - **Study 3**. Attitudes towards Green Urban Space: A Case Study of Two Italian Regions
    - **Study 4**. Restoration in mental health after visiting urban green spaces, who is most affected? Comparison between good/poor mental health in four European cities

- **Study 5**. The Effects of Park Based Interventions on Health: The Italian Project “Moving Parks”
- **Study 6**. Effect of a Park-Based Physical Activity Intervention on Psychological Wellbeing at the Time of COVID-19

- The analysis and assessment of PA attitude and PA programs carried out in GUS: evaluation of performance, anthropometric characteristics, and body composition parameters.
  - **Study 7**. Physical Activity Behavior, Motivation, and Active Commuting: Relationships with the Use of Green Spaces in Italy
  - **Study 8**. Effects of Nordic Walking Training on Anthropometric, Body Composition, and Functional Parameters in the Middle-Aged Population
  - **Study 9**. Evaluation of the effectiveness of Nordic walking and an indoor training program: Anthropometric, Body Composition and Functional Parameters in the Middle-aged Population
  - **Study 10**. Women Walking over 65: results of a pilot study.

4. Study 1: Impact of Different Types of Physical Activity in Green UrbanSpace on Adult Health and Behaviors: A Systematic Review

This article was published in European Journal of Investigation in Health, Psychology, and Education

Grigoletto, A.; Mauro, M.; Maietta Latessa, P.; Iannuzzi, V.; Gori, D.; Campa, F.; Greco, G.; Toselli, S. Impact of Different Types of Physical Activity in Green Urban Space on Adult Health and Behaviors: A Systematic Review. *Eur. J. Investig. Health Psychol. Educ.* **2021**, *11*, 263-275. https://doi.org/10.3390/ejihpe11010020

Keywords: exercise; health; natural environment; training

Overview

This systematic review aimed to investigate the type of PA carried out in green urban spaces by the adult population and to value its impact on the population's health. Searches of electronic databases, with no time restrictions and up to June 2020, resulted in 10 studies meeting the inclusion criteria. To Walk is the most popular type of training, due to its easy accessibility and as it does not require equipment or special skills. In addition, outdoor fitness equipment has been installed in an increasing number of parks and has become very popular, worldwide. Furthermore, outdoor fitness equipment provides free access to fitness training and seems to promote physical activity in healthy adults. People living near equipped areas are more likely to perform outdoor fitness than those who live further away. The most common training programs performed in green urban spaces include exercises with free and easy access, able to promote physical health and perception.

4.1 Introduction

One of the most important challenges for the future will be to create taylor made cities and safeguarding green spaces will be fundamental to achieve this goal, because the characteristics of the environment in which people live are linked to the quality of their health, both physical and mental [178]. There has been an increase in the literature focused on the importance of green urban spaces and several studies have highlighted a relationship between the exposure to the natural environment and a better health perception, but, as already reported in the introduction, the mechanisms that explain this relationship are not so clear [179,180]. The beneficial effects of a physically active lifestyle on various health outcomes are well established, with strong evidences of the reduction of risk for chronic diseases and cognitive functional decline and improvement in mental health [181,182]. Moderate physical activity intensity compared to a total sedentary behavior can reduce the relative risk of mortality [183]. Despite this, a significant proportion of the adult population remains inactive [184]. Green urban spaces could be a solution to this problem because the exposure to a natural environment is also linked with triggering a higher amount of PA carried out by residents, and with a lower mortality ratio [29,178,185,186]. Green urban space could reach a variety of people due to it being freely accessible, it could help PA levels in people who do not usually perform exercise [102,187,188]. Due to the urban growth, there has been a the necessity to upgrade open urban spaces or green spaces in built-up areas to promote PA [189–197]. Existing literature on PA performed in green urban spaces showed a high levels of heterogeneity in samples, intervention characteristics, and investigated outcomes. Specifically, there have been a lot of different types of PA intervention in green urban spaces, as: resistance training using outdoor gyms and aerobic physical activity (walking, running, biking), but it is still not known if they could have different effects on health [198].

This systematic review had the objective to outline a picture of the different types of physical

activity proposed in green urban spaces. Further, this review is focused on different outdoor trainings to understand their impact on the population's health. Finally, we wanted to clarify whether the presence of outdoor gyms in green urban spaces can promote participation in physical activity in adults.

4.2 Materials and Method

4.2.1. Search Strategy

The Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines were followed to conduct this systematic review [199]. Databases used included: Cochrane Library, Med-Line, SportDiscuss, GreenFile, Health Administration Database, The UK and Ireland Database, and Psycinfo. Search strategies were adapted to the different databases and these keywords and terms were used: "outdoor exercise (exercises)" OR "outdoor fitness" OR "outdoor physical activity" OR "green urban space exercise (exercises)" OR "green urban space physical activity" OR "outdoor training" OR "outdoor circuit training" OR "outdoor resistance training" OR "outdoorhigh-intensityy training" OR "park exercise" OR "park training" AND "adult". Terms were searched as titles and keywords.

4.2.2. Eligibility Criteria

Table 1 shows inclusion and exclusion criteria. Population, Interventions, Comparators, Outcomes, Study design, and Timing (PICOST) of interest were defined and different electronic databases were used to search the keywords with no time restrictions up to 10 June 2020 (T) [200].

The Population (P) was adults aged between eighteen and eighty years, and with no chronic diseases or health problems. Children and teenagers were excluded because they represent a specific sector of the population with specific needs.

Interventions (I) of interest were physical activity carried out in green urban spaces or parks to evaluate how PA could affect adult health; gym equipment installation to evaluate its impact on

adult behavior. Physical activity indoors or in different natural environments such as beaches or blue areas was excluded.

Comparators (C) were the control group (if presented); baseline observation; and park with no gym equipment. If participants in the studies received different treatments from PA, they were excluded.

Outcomes (O) were the impact of PA in green urban spaces and/or the PA level, the health indicators, and the behavior characteristics of park users.

Only observational or experimental studies, written in English, with original primary data, were selected (S). Papers with no study protocol or other papers without original data were analyzed.

Table 1**.** PICOST eligibility criteria.

Parameter	Inclusion criteria	Exclusion criteria
Population	Healthy adults (18≤age≤80)	People <18 or >80
		Unhealthy people
Intervention	PA in green urban spaces and gym equipment installation	PE indoors or in different natural environments as beaches or blue areas
Comparator	Control group (if presented); Baseline observation; Park with no gym equipment	Participants receiving different protocols from PA
Outcome	Impact of PE in green urban spaces and/or PA and Health indicators and behaviour characteristics of park users	No information about PA
Study design	Observational or Experimental with original primary data	Study protocols or other papers without original data
	English language	No English language
Timing	No time restrictions until 2020 June 10th	After 2020 June 10th

Abbreviations: OFE= Outdoor Fitness Equipment; PA= Physical Activity; PE= Physical Exercise; PSY=Psychological.

4.2.3. Article Information

After quality assessment, a double-blind extraction of data was performed. This included: authors, country, study design, population, type of interventions, intensity and frequency of the intervention, outcomes, number of experimental and/or control groups, results, and studies' stratification for the different types of interventions.

4.2.4. Effect Size and Treatment Effect

Two independent reviewers extracted data available in the studies (MM, AG). The statistical analysis was assessed to quantify the effect size (ES) or treatment effect (TE) for each study. The principal summary measures were expressed as standardized differences in means (Cohen's d) of CRF and p-values to quantify the statistical significance of the evidence. It is assumed that an effect size $d \geq 0.80$ represents a large effect, $0.50 \leq d < 0.80$ medium, and $d < 0.50$ small [201]. Further, Hedge's g estimator was used to calculate unbiased d values, using the J correction factor. When proportions, correlation coefficients, and odds ratios were found, we appropriately converted them among ES [202]. Finally, we calculated the statistical test value (Z or Student's t) where the p-value was not shown.

4.3 Results

One hundred and seventeen articles were retrieved from the browsed databases. Thirty studies were excluded because they were duplicated, and 60 articles were excluded following abstract and/or title review. Twenty-seven studies were classified as pertinent, but 17 were subsequently excluded after detailed full-text reading. In the end, the articles included in the systematic review totaled 10 which fully met the eligibility criteria (Figure 1).

PRISMA flowchart

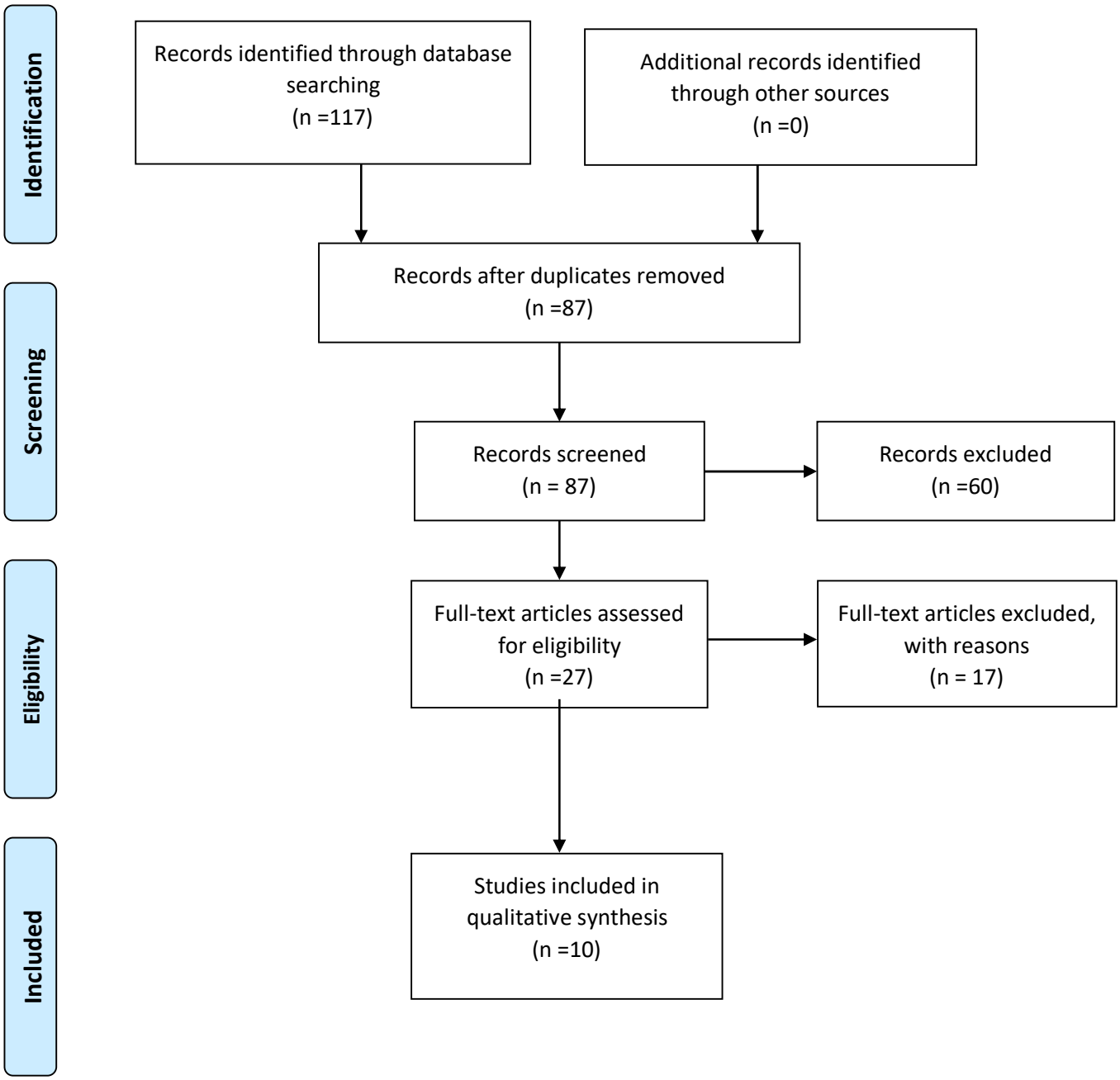


Figure 1. PRISMA flowchart

4.3.1. Study Characteristics

Table 2 shows the participants' characteristics. Their geographic origins were Australia (three articles, 30%), Taiwan and Korea (two articles, 20%), the USA (two articles, 20%), Ukraine, Sweden, and the UK (one article for each, for a total of three articles, 30%).

Table 2. Participants characteristics

Study	Country	Participants	Age (yrs.)	Gender
Veitch et al. (2012)	Australia	1309	≥18	M and F
Cohen et al. (2012)	USA	2636	40±12.5*	F=61%; M=39%
Wu et al. (2015)	Taiwan	86	31.28±4.93*	F=50%; M=50%
Johnson et al. (2019)	Sweden	6	41.2±6.5*	F=33%; M=67%
Apaychev et al. (2018)	Ukraine	60	40 - 50	M
Schoffman et al. (2015)	USA	295	49.4±13.3*	F=86%; M=14%
Marselle et al. (2015)	UK	127	55 - 74	F=55.5%; M=44.5%
Astell-Burt et al. (2013)	Australia	203883	61.5*	F=53.2%; M=46.8%
Cranney et al. (2015)	Australia	796	≥18	F=47.6%; M=52.4%
Kim et al. (2018)	Korea	35	73.2±4.95	F=91.5%; M=8.5%

**Weighted average of age ± SD (if explicated); M=Male; F=Female.*

The sample size varied from 6 participants to 203883 participants [110,203–211]. Two studies included different age classes of participants: 2–4, 5–18 or more than 18 years [207]; children, adults, and seniors [205]. Other studies explained the weighted average age of the samples. A different distribution of gender resulted from them; only one study reported a whole male sample [110].

4.3.2. Impact of Outdoor Fitness on Participants' Health

Table 3 reports the main characteristics and results of the studies which analyzed the outdoor fitness effect on participants' health. The articles presented a big heterogeneity in the study design, number of participants, time of the experiment, type of treatment, measurements performed, and statistical analysis. Nevertheless, they highlighted the efficacy of outdoor PA on participants' heath. The study designs were randomized control trials (RCTs) or control trials (CTs) with no randomization. Three studies of six reported one experimental group and one control group [208–210]; one of these reported two experimental groups [210]. One study reported a

cross-sectional analysis [206]. Two studies compared differences in time, between pre- and post-evaluation [110,203]. The duration of the studies varied from 6 weeks to 6 months [208,210]. Three studies had a walking program as the treatment [110,206,209], and three treated participants with different outdoor activities [203,208,210].

Table 3. Impact of Outdoor Fitness

Study	Design	EG	CG	Other Group	Treatment	Duration	Cohen's d	Hedge's g	p-value	Measurements	Analysis
Wu et al. (2015)	RCT	41	45	no	Walking program	8 weeks	1.325	1.313	0.0005	Overall fatigue	Stand. Mean diff.
Schoffman et al. (2015)	CT	Cross-Sectional 194		no	Walking program	6 months	1.036 6.08	1.02 5.99	0.007 >0.001	%Weekly MVPA Self-efficacy	Correlation coefficient
Marselle et al. (2015)	CT	Pre 127	Post 127	no	Walking program	13 weeks	2	1.99	>0.001	Walk happiness	Correlation coefficient
Apaychev et al. (2018)	CT	EC 20	CG 20	no	Outdoor activity	6 months	4.02	3.03	>0.001	Motor activity	Stand. Mean diff.
Johnson et al. (2019)	CT	Pre 6	Post 6	no	Outdoor activity	10 weeks	1.08 0.83	0.99 0.76	0.004 0.02	Number of steps Cardiovascular fitness	Stand. Mean diff.
Kim et al. (2018)	RCT	EG1 12	CG 10	EG2 13	Outdoor activity	6 weeks	0.4 0.41	0.385 0.395	0.017 0.0003	Number of push-up 6minutes walk	Stand. Mean diff.

Abbreviations: RCT= Randomized Control Trial; CT= Control Trial; EG= Experimental Group; CG= Control Group; MVPA= Moderate to Vigorous Physical Activity; Stand. Mean diff.= Standardized Mean difference

The randomized control trials (RCTs) evaluated two different treatments (walking program and outdoor activity) on several measurements (fatigue perception; upper body muscular strength/endurance and physical function) [209,210]. Both studies showed improvements in EGs compared to CG (with no PA intervention). Wu et al. reported a significant statistical difference in overall fatigue among the two groups ($p < 0.001$; $g = 1.313$) [209]. Further, the brisk walking

intervention had a positive effect on motivation for the EG ($p < 0.05$), improved concentration for EG ($p < 0.05$) and did not affect the reduction in activity. Kim et al. analyzed two experimental groups (resistance exercise, n = 12; combined resistance and aerobic exercise, n = 13) and one control with no exercise (n = 10) [210]. They used the American College of Sports Medicine (ACSM) guidelines for the elderly population to select the frequency, intensity, and duration of PA. Both experimental groups (EGs) showed significative improvements in upper body muscular strength/endurance, measured by a push-up test ($p = 0.017$; $g = 0.385$), and physical function, measured by a six-min walking test ($p = 0.003$; $g = 0.395$), compared with the control group. However, the small sample size was a research limitation.

Two control trials (CTs) analyzed the efficacy of a group-based walking program in an outdoor environment, in which PA intensity varied from light to moderate to vigorous (MVPA) [51,53]. The treatment proposed by Schoffman et al. improved participants' self-efficacy, increased the percentage of weekly MVPA, and showed a positive correlation between walking activity and perceived happiness [206]. In addition, Marselle et al. found that perceived restorativeness and perceived naturalness interacted to enhance the positive effect following an outdoor group walk (both $p < 0.001$) and that the intensity of the walking program could change the perceived well-being of participants ($p < 0.0001$) [110]. Two CTs evaluated how different outdoor activities (combined and resistance training) affected physiological measurements [203,208]. Both studies showed improvements in physical fitness after the treatments. Apaychev et al. compared the experimental group (EG, n = 20), who performed a combined outdoor training program (resistance and aerobic exercise), with the control group (CG, n = 20), who performed a combined indoor training program (resistance and aerobic exercise) [208]. They also reported significant changes ($p < 0.05$) in the indices of health state, activity, and mood of EG men. Differently, Johnson et al. analyzed six participants pre- and post-treatment (paired group) [203]. The researchers designed

a resistance training program in which participants could select one of two training sessions, either 20:10 s or 40:20 s (work: rest). The overall results showed an average increase from baseline to the post-measures in strength, time to exhaustion (cardiovascular fitness; $p < 0.05$; $g = 0.76$), and the number of steps ($p < 0.01$; $g = 0.02$). In addition, the small sample size was a big limitation.

4.3.3. Impact of Green Spaces on Physical Activity Behaviors

Table 4 shows the factors which can influence the use of green spaces. Four observational studies analyzed different sample sizes, from 358 to 203883 participants [204,205], which lasted differently (12 up to 16 months) [207,211].

Table 4. Impact of factors that can influence the use of green spaces.

Study	Design	Participants	Exercise type	Duration	Cohen's d	Hedge's g	p-value	Outcome	Measurements	Analysis
Astell-Burt et al. (2013)	OBS	203883	Walking and MVPA	not specified	1.98 1.97	1.98 1.97	>0.001 >0.001	Impact of distance on park usage	Walking the nearest green space	Odds Ratio difference
Cranney et al. (2015)	OBS	358	Outdoor gym	12 months	2.63	2.63	>0.03	Impact of gym installation on park usage	MVPA frequency pre-post	Proportion difference
Cohen et al. (2012)	OBS	958	Outdoor gym	16 months	0.61	0.61	>0.001	Exercise in gym park vs no gym park	Exercise frequency	Proportion difference
Veitch et al. (2012)	OBS	609	Outdoor gym	12 months	<7	<7	>0.001	Impact of gym installation on park usage	Usage frequency pre-post	Proportion difference

Abbreviations: OBS= Observation study; MVPA= Moderate to Vigorous Physical Activity

Three studies analyzed the impact of gym installations on park usage [205,207,211]. Two of these analyzed the differences in park user customs, before and after the outdoor gym equipment installation, and showed an increase in park usage [205,207]. Further, a higher MVPA frequency was found after OFE installation [205]. The other one assessed a comparison between parks with

equipment and parks with no equipment [211]. The Authors showed a significant difference in the proportion of PA practiced in the two different contexts. The presence of outdoor fitness equipment (OFE) positively affected the promotion of the physical activity.

Astell-Burt et al. studied the impact of distance from green spaces, to understand whether people who lived nearer green spaces performed more PA than people who lived further away [204]. They reported the time spent walking and doing moderate to vigorous physical activity. The researchers found significant differences between participants who lived with the availability of 0–20% and those who had +80% availability in the walking and MVPA. Greener neighborhood environments positively affected the frequency of participation in walking activity and MVPA. Figure 2 shows what green space means.

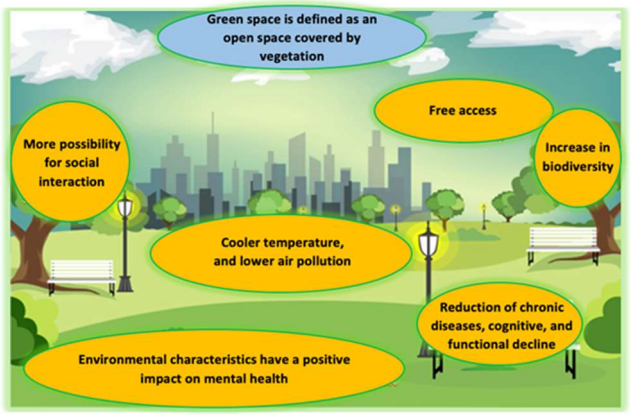


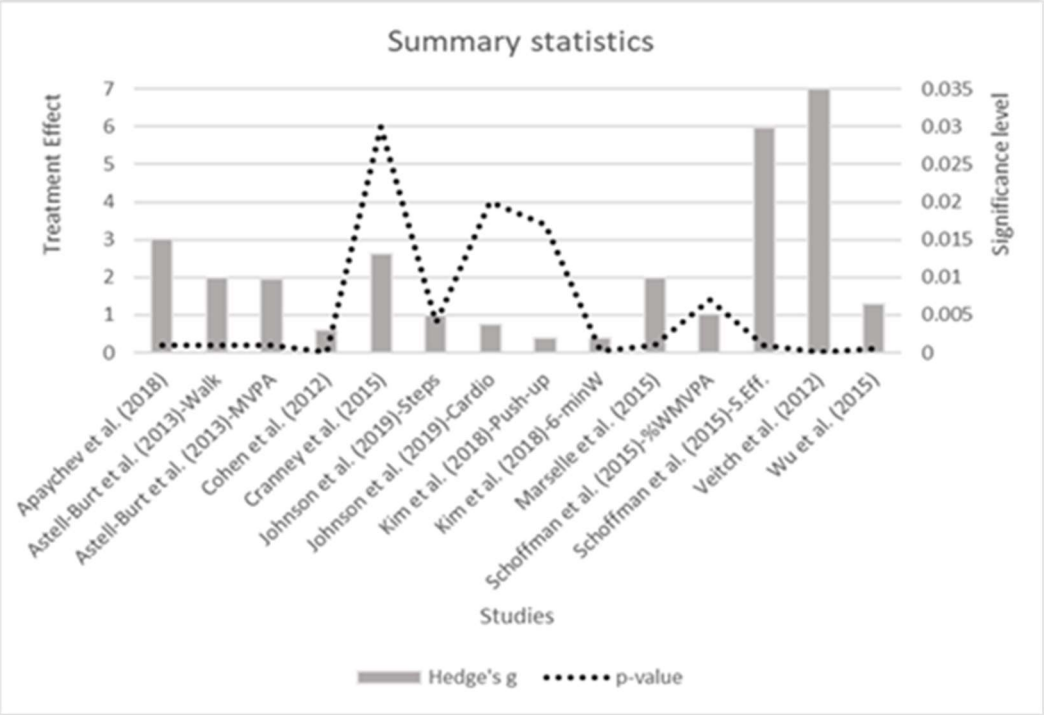
Figure 2. What is green space?

4.3.4. Summary Statistics

Figure 3 shows summary statistics with the treatment effect (g) and the p-value for each study analyzed. Four studies reported two different data: Astell-Burt et al. reported outcomes for a walk and MVPA [204], Johnson et al. reported outcomes for the number of steps and cardiovascular fitness [203], Kim et al. reported outcomes for the number of pushups and a 6-minute walk [210] and Schoffman et al. reported outcomes for the percentage of weekly MVPA and self-efficacy

[206]. Veitch et al. observed the highest treatment effect (difference in proportion, g > 7) [207]. Eight studies reported a large ES (d > 0.80); only Cohen et al. showed a moderate TE (0.50 < d < 0.80), and only Kim et al. showed a small ES (d < 0.50).

Figure 3. Summary Statistics



4.4 Discussion

This systematic review aimed to outline a picture of the different types of physical activity proposed in urban green spaces. Further, this review focused on different outdoor trainings to understand their impact on the population's health. Finally, we wanted to clarify whether the presence of outdoor gyms in green urban spaces could promote participation in physical activity in adults. Existing literature on PA performed in green urban spaces shows high levels of heterogeneity for samples, intervention characteristics, and investigated outcomes; specifically, there are a lot of different types of interventions proposed, but it is not clear if they have similar effects on health.

This review aims to fill this gap and so, unlike the previous systematic review, it is focused on how different types of interventions affected participants' health.

The systematic research of the literature found 10 studies, 6 of which analyzed the impact of different outdoor PA on participants' health and 4 of which observed the effect of green spaces on participants' behaviors. In this review, several types of training were reported, and among all those considered, walking training, resistance exercise, and combined exercise (resistance and aerobic) showed the best results on participants' health.

Many epidemiological studies highlighted the health benefits of walking. PA, including walking, has a substantial role in the management of coronary heart disease, hyper- tension, type 2 diabetes, obesity, elevated cholesterol, osteoporosis, osteoarthritis, obstructive pulmonary disease, and several other conditions, including depression and anxiety disorders, dementia, pain, congestive heart failure, syncope and stroke [212]. Walking as a healthy form of PA began to receive attention in the 1990s because of new recommendations by the American College of Sports Medicine that emphasized the importance of a healthy lifestyle and MVPA. Then, also the World Health Organization (WHO) created its guidelines on PA and sedentary behavior, in which the last update was in 2020. The WHO Guidelines highlighted the health benefits of a greater amount of PA, including light-intensity PA, and the importance of breaking up sedentary time with light-intensity activity [213]. Lee et al. observed an inverse relationship between overall walking and the risk of developing coronary heart disease, in women [214]. Walking is the easiest way to remain active and the most popular, so it is one of the major focuses of the PA initiative. It is the most reported activity in adults who meet physical recommendations [215]. It is probably because of its accessibility. Walking is a universal form of PA that is appropriate regardless of sex, ethnic group, age, education, or income level. Walking does not require expensive equipment, special skill, or special facilities. Walking is also important for older adults. Walking outdoors at least once a week has been

associated with achieving more time spent in MVPA than walking indoors and it also provides a means to participate in meaningful activities, such as shopping or leisure activities (e.g., visiting friends or pleasure walking) [212]. Also, limited walking is effective in preventing falls and falls injuries in older adults [216]. A meta-analysis of four studies that included walking reported a 44% reduction in fall injuries in the intervention group [216]. Therefore, the costs of medical care are substantially lower in physically active adults [217], and walking has the potential to reduce medical expenditure, particularly among older adults where the prevalence of chronic disease is higher [218]. Wu and et al. demonstrated that a walking program activity could improve perceived fatigue [219]. Further, a walking program reported an improvement in the happiness of the participants [211].

Some studies reported the beneficial effect of RE and CO outdoor PA on adult health. Improvements in cardiovascular fitness, strength, and endurance were shown [207,219]. However, many articles are needed to confirm the good impact of resistance and combined outdoor PA on adult wellness.

Our results show that the presence of green spaces could increase walking and MVPA [208]. Moreover, the presence of park equipment can favor walking activity [220].

Many studies reported that OFE has become very popular worldwide in numerous green spaces and built-up environments [221–225]. According to an investigation by Chow [225], OFE was installed in more than half of the parks in cities in Taipei and a growing number are being added to parks in the United States [212], South America [226], Australia [25] and some European countries, such as Spain and Portugal [38, 51-53]. OFE could be used by everyone because it provides free access to fitness training for the community and also enables a different kinds of training (e.g., resistance or circuit training) [212,224]. The installation of OFE in green urban spaces offers many benefits, including increasing engagement in PA, improving the perception of security, adding pleasant contributions

to the city's landscape and encouraging social interaction [225–227]. Some studies found different benefits directly associated with OFE, such as improved cardiorespiratory fitness, muscle strength, balance, and flexibility, but the studies also reported limited and mixed results, so the effects of OFE have not yet been fully explored [207,211]. The presence of OFE in green urban spaces could attract new visitors and increase the overall number of park visits [225]. Our review agrees with the above results.

However, this is in contrast with the results reported by Cranney et al. In their article, they reported a significant short-term increase in MVPA among the overall park users, especially after the OFE installation, but they also suggested that this could be due to a seasonal effect, since the installation occurred in summer, and at the post-installation control, in the autumn, there was not an increase in park use. The Authors suggested that the OFE may not attract new park users but may provide existing park users with more opportunities for active recreation [225]. According to this result, Chow et al. observed that most users interacted with fewer than three OFE stations (out of a total of six) available in the park and each OFE user operated one device for less than five minutes with a total time using all equipment of fewer than nine minutes [227]. This is coherent with an observational study, which reported that many users used OFE only for a very short period, which could be insufficient to produce substantial health benefits [228]. Earlier studies claimed that MVPA was achieved using OFE, but Chow et al. investigated the energy expenditure and level of intensity during OFE use and they reported that the use of OFE appeared to be less intense compared with the use of conventional resistance training machines in indoor gyms [227]. This result does not represent all kinds of OFE because there are different manufacturers that design and produce OFE, with differences in size, shape, materials, or smoothness of operation. The lack of energy expenditure could be compensated by the natural environment, which brings additional benefits in comparison with PA in an indoor environment and can improve people's health and well-being by

providing restoration from stress and mental fatigue [229,230]. People who constantly perform PA could also see more positive effects due to a different setting.

Heterogeneous studies have indicated that OFE could pose many safety problems because of a lack of surveillance and inadequate usage instructions, and they also reported many OFE accidents due to users operating equipment incorrectly [227]. A survey study indicated that many users mimic how others use the equipment since no information session was conducted after installing the OFE and many instructions were absent [226]. Therefore, an important development for the future and the increase in OFE use could be that manufacturers provide clear equipment operation guides (or demonstration videos) on the correct use of their equipment and warning messages regarding risky behaviors. Manufacturers should also design OFE with suitable angle ranges or fixed operating positions. The government or the local authorities that authorized the OFE installation may allow instructional sessions in which professional trainers can explain how to safely use the OFE to meet the individual's capability and fitness level.

4.4.1. Limitations

The biggest limitation of this study is linked to a lack of findings/definitive results and articles in the literature. It was possible to include in this systematic review only 10 articles. The literature about the general importance of green urban spaces is growing, but studies about constructing interventions in green urban spaces for the general population are not growing at the same speed. There are a lot of studies about the beneficial effects of natural environments for children, teenagers, and the elderly population to promote an active lifestyle or a healthy elderly age. However, the growing literature is not connecting green urban spaces and rehabilitation interventions. Instead, this can be of paramount importance to create specific protocols for people undergoing rehabilitation programs for different health problems, such as cardiovascular diseases.

Green urban spaces could also be a good support or an alternative for this kind of rehabilitation. In green urban spaces, there are also physical activity protocols for people with chronic diseases, such as diabetes. There is no doubt that these kinds of problems and protocols are very important to promote public health, but there is a lack of literature on physical activity for the general population, such as people between eighteen and seventy-five years old, without health problems. This is a big part of the population that is very little considered in the literature.

For these reasons, the sample of articles that met the inclusion criteria was very limited. It was not a problem of quantity, but rather of quality, because a major part of the articles retrieved provided an "intermediate"-quality evaluation, with different problems and lack of information. Furthermore, the articles were very heterogenous, and they had a different approach (i.e., the simple observational approach before/after, without randomization), so it was difficult to obtain strong and definitive evidence and conclusions.

5. Study 2: The Effect of Physical Activity Interventions Carried Out in Outdoor Natural Blue and Green Spaces on Health Outcomes:A Systematic Review

This article was published in the International Journal of Environmental Research and Public Health

Marini, S.; Mauro, M.; Grigoletto, A.; Toselli, S.; Maietta Latessa, P. The Effect of Physical Activity Interventions Carried Out in Outdoor Natural Blue and Green Spaces on Health Outcomes: A Systematic Review. Int. J. Environ. Res. Public Health 2022, 19, 12482. https://doi.org/10.3390/ijerph191912482

Keywords: blue exercise; green exercise; healthy adults; blue–green space setting; natural outdoor environment; physical activity intervention; outdoor exercise; health promotion

Overview

PA interventions carried out in blue and green environments are being investigated as a potential strategy to increase health outcomes in people with and without chronic conditions. Many recent studies reported positive results, but a high number of these studies were focused on people with mental or physical disorders. In this scenario, the present systematic review was aimed at investigating the existing evidence regarding the effects of physical activity interventions carried out in green–blue space settings, involving healthy people. No exhaustive conclusion can be drawn based on available evidence. However, this systematic review highlighted the need to extend this kind of intervention to reveal more robust evidence that green and blue exercises benefit health.

5.1 Introduction

There are an increasing number of studies with the aim of estimating the impact of access and exposure to neighborhood green and blue spaces on the risk of mental health conditions and the opportunity for promoting well-being [231,232]. Up-to-date research indicates that the benefits may be different due to the population groups, context, and health outcome [233,234]. Adequate PA levels are essential, given that PA is a fundamental aspect of human health, but a great part of the population remains inactive [164]. The use of green and blue spaces can facilitate PA, social interaction, and contact with nature, providing multiple health benefits [95,115,168,169,231,235].

Therefore, evidence of such health benefits might be of high relevance for healthcare professionals, urban planners, and policymakers, who can help translate available evidence into interventions and policies targeted to improve health. However, the knowledge base is limited to the green and blue spaces evaluation of exposures or nearness separately considering green or blue or involving a nonhealthy population. In such a scenario, the aim of the present systematic review was to investigate the existing evidence regarding the effects of PA interventions performed in a natural environment involving healthy people (aged ≥ 18 years).

5.2 Materials and Methods

5.2.1. Data Sources and Search Strategy

The present systematic review was prepared in accordance with PRISMA recommendations and guidelines [236]. The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO).

Table 5 summarizes the Patients, Interventions, Comparators, Outcomes, Time, and Setting (PICOTS) criteria drafted to address the primary search aim.

Table 5. PICOST criteria for eligibility

Parameter	Inclusion criteria	Exclusion criteria
Population	Healthy people	People with acute or chronic conditions
	Age range: Adult (+19; +45; +80)	People aged under 18
Intervention	Outdoor PA intervention is carried out in the natural environment and natural/mixed settings (specifically blue space and green space)	Absence of PA intervention; Indoor PA intervention
Comparator	Standard treatment	
	No PA intervention	
	Another type of PA intervention	
Outcome	Quality of Life or Life satisfaction or Intervention satisfaction evaluation	No information about PA effects
	The physical performance or other indices of physical performance	
	Anthropometric evaluation	
Timing	10-year publication date limit	Published before 2011
	English Language	Not in the English Language
	Full text available	No full text is available
Study design	Experimental or observational study with original primary data	Study Protocol or other papers without original data

Note: PA: Physical activity.

A systematic literature search of the main coherent databases according to the aim of this paper, MEDLINE (PubMed), Cochrane Central Register of Controlled Trials (Central), CINAHL (EBSCO), and PSYCHINFO (EBSCO), from April 2022 up to May 2022 was conducted to identify all published articles about PA interventions carried out in green and blue spaces and relative effects in terms of physical fitness, quality of life, physical performance, and anthropometric characteristics focusing on healthy adults.

Only randomized controlled trials (RCTs), case reports, observational studies, and clinical trials for which the full text was available were included. In addition, only human subjects were included, and

we decided to put a 10-year publication date limit. Search strategies (strings adapted when necessary in order to fit the specific search requirements of each database) used the following Boolean expression, keywords, and terms (terms mainly chosen from papers related to the topic and mesh database): ("Exercis*" OR "Physical Activity" OR "Activities, Physical" OR "Activity, Physical" OR "Physical Activi- ties" OR "Exercise, Physical" OR "Exercises, Physical" OR "Physical Exercise" OR "Physical Exercises" OR "Acute Exercise" OR "Acute Exercises" OR "Exercise, Acute" OR "Exercises, Acute" OR "Exercise, Isometric" OR "Exercises, Isometric" OR "Isometric Exercises" OR "Isometric Exercise" OR "Exercise, Aerobic" OR "Aerobic Exercise" OR "Aerobic Exercises" OR "Exercises, Aerobic" OR "Exercise Training" OR "Exercise Trainings" OR "Training, Exercise" OR "Trainings, Exercise") AND ("Outdoor Exercise*" OR "Outdoor Fitness" OR "Outdoor Physical Activity" OR "Natural Environment Exercise" OR "Blue Space Physical Activity" OR "Green Urban Space Exercise*" OR "Green Urban Space Physical Activity" OR "Outdoor Training" OR "Outdoor Circuit Training" OR "Outdoor Resistance Training" OR "Outdoor High Intensity Training" OR "Park Exercise" OR "Park Training") AND (Adult OR "Young Adult" OR "Healthy Adult" OR "Older Adult") AND ("Health Outcomes" OR "Anthropometric Outcomes" OR "Anthropometric characteristics" OR "Anthropometrical outcomes" OR "Anthropometrical characteristics" OR "Wellbeing" OR "psycho-social Wellbeing" OR "Quality of Life" OR "Physical Performance" OR "Physical Fitness").

Moreover, hand searches of key conference proceedings, journals, and professional organizations' websites were conducted by SM, AG, and PML, and, in accordance with the snowball technique, references cited in the primary papers were examined to discover possible additional papers.

5.2.2. Quality Assessment and Data Extraction

Screening and checking phases followed different steps. First of all, the reviewers (SM, AG, MM, and PML) independently and blindly screened eligible papers after the removal of duplicates, reading

titles, and abstracts to select pertinent papers. After the first screening, the reviewers (SM, AG, and PML) retrieved and read the full text of all potentially eligible studies. Disagreements about the eligibility of the studies for inclusion were resolved through discussion between all the researchers' groups, and if more information was necessary, the study Authors were contacted. Finally, the investigators, following the standardized rules for literature collection given by the Cochrane Reviewers handbook, independently obtained the information of the included studies focusing on the following characteristics: Author, country, study design, population, intervention, outcomes, and results [200].

The studies included in the final step were independently and separately evaluated for the risk of bias by researchers (AG and SM) using the "A revised Cochrane risk of bias tool for randomized trials" (RoB 2) [237] and "The Risk Of Bias In Non-randomized Studies—of Interventions (ROBINS-I) assessment tool" [238]. Any disagreement between the quality scores separately assigned by the blind reviewers was resolved through discussion, and, if necessary, two more blind reviewers belonging to the research team (MM and ST) were involved as tiebreakers. This methodological choice was supported by the PRISMA guidelines [236].

RoB-2 tool analyzes different biases in five domains: (1) bias resulting in the randomization process; (2) bias arising from deviations from intended interventions; (3) bias linked to missing outcome data; (4) bias in the measurement of the outcome; and (5) bias on the reported result. The response options for the reported questions in each domain are as follows: yes, probably yes (PY), probably no (PN), no, and no information (NI).

These categories provide the possibility to assess an overall risk-of-bias judgment for the specific study result being evaluated in low risk of bias, some concerns, and high risk of bias. The ROBINS-I scale uses seven different domains: (1) bias arising from confounding; (2) bias in the selection of the

study's participants; (3) bias in intervention classification; (4) bias linked to deviations from intended interventions; (5) bias resulting to missing data; (6) bias due to the measurement of outcomes; and (7) bias on the reported result. The response options for the domain level were the same as those of RoB-2, but the overall risk-of-bias judgment includes low risk, moderate risk, serious risk, and critical risk of bias.

5.3 Results

5.3.1 Study Selection and Characteristics

Through database browsing and hand-searching, a total of 239 articles were identified (Figure 4). Considering the articles identified from databases, three were excluded because they were duplicated, and 157 were excluded after reading the abstract. Then, the authors read the full text of the articles, and 69 were excluded because they matched the exclusion criteria; finally, only six were considered relevant. All the records identified from hand-searching were excluded after reading the full text.

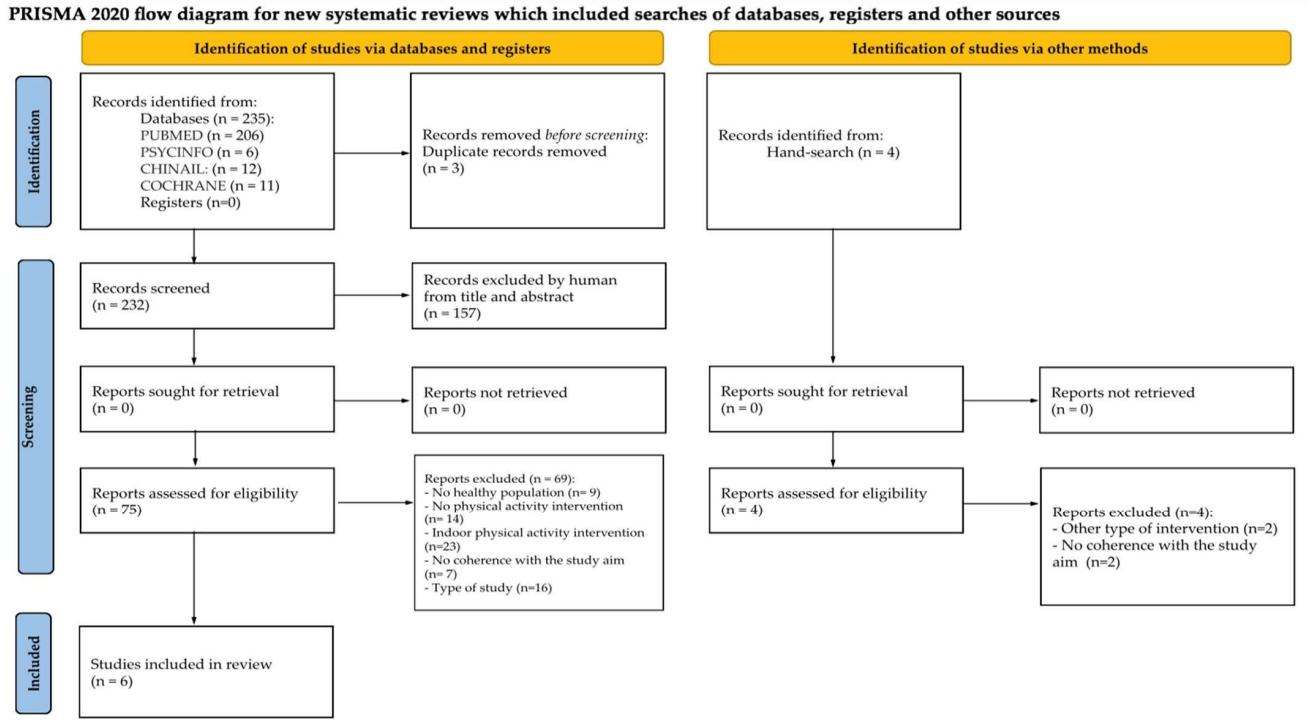


Figure 4. PRISMA 2020 flow diagram of studies selection [239].

The main reasons for exclusion in the first step (abstract reading) were as follows: no physical activity intervention was carried out in the study, and no healthy people were involved. After the full-text reading (considering both reports from databases and hand-searching), the main causes of exclusion were the implementation of physical activity intervention carried out indoors and the types of the study (without original primary data).

5.3.2 Risk of Bias Assessment

Each study was evaluated for quality assessment differentiating RCTs from quasi-experimental studies. The five studies categorized as RCTs scored a risk of bias from low to some concern, as shown in Table 6 showing studies that resulted in low risk [210,240–243] of bias and two with some concerns [210,242–244].

Table 6. Quality assessment of RCTs and quasi-experimental studies.

Authors	Study design	Tool for assessment	Quality
Song et al. 2015 [240]	Quasi-experimental	ROBINS	Moderate concerns
Sales et al. 2017 [241]	RCT	Cochrane ROB2 Tool	Low risk
Plotnikoff et al., 2017 [242]	RCT	Cochrane ROB2 Tool	Some concerns
Kim et al. 2018 [210]	RCT	Cochrane ROB2 Tool	Low risk
Muller-Riemenschneider et al. 2020 [243]	RCT	Cochrane ROB2 Tool	Low risk
Vert et al. 2020 [244]	RCT	Cochrane ROB2 Tool	Some concerns

RCT: randomized control trial; ROB2: Cochrane risk-of-bias tool for randomized trials. ROBBINS-I: the Risk Of Bias In Non-randomized Studies – of Interventions.

Considering the quasi-experimental study performed by Song et al., the response to the quality assessment was moderate concerns [210,240–244].

The major concerns were related to the second domain (risk of bias due to deviations from the intended interventions) mainly because there were no blinding of participants and people delivering the intervention given that it concerns physical activity practice (item #2.2–2.3).

5.3.3 Data Extraction of the Included Study

Table 7 summarizes the principal aspects and results of the included studies evaluating the effects of PA interventions on health outcomes in healthy people over 18. The geographic origin of the studies was as follows: Australia (n = 2), Korea (n = 1), Japan (n = 1), Spain (n = 1), and Singapore (n = 1). Study characteristics were heterogeneous. The sample size varied from 23 to 160 people. Ages ranged from 22 to 80 years.

Table 7. Characteristics of studies included.

Study	Study Design	Population	Intervention	Outcome	Results
Song et al. 2015, Japan [240]	NRCT	N: 23 men (aged 22.3±1.2, height 171.1±4.7 cm, weight 63.4±8.1 kg, BMI 21.5±2.1 kg/m2)	Type: 15 min of walking in two different environments—an urban park and a city area; after walking, the subject returned to the waiting room and completed the questionnaires. Participants rested for approximately 20 min and repeated the experiment in the other environment. There were no significant differences in the average speed between the two environments. Frequency: twice a day Time: 3 days	For physiological relaxation, three different questionnaires were used to investigate the psychological responses after walking in each site. The questionnaires were the SD scores, POMS, and STAI scores. Heart rate and its variability were measured to investigate automatic nerve activity	The participants showed statistically significant differences in their physiological and psychological responses to walking in different environments. The natural logarithm of the HF component, which is an estimate of the parasympathetic nerve activity, was higher when subjects walked in the urban park than when they walked in the city area. The mean ln(HF) was significantly higher in the urban-park walking than city-area walking (p≤0.01). Then, the estimation of the sympathetic nerve activity was lower during the urban-park walking than city-area walking. The mean heart rate was significantly lower in the urban-park walking than city-area walking (p≤0.01). A significantly higher SD score was observed following the urban-park walking than those following the city-area walking for the three adjectives: comfortable, natural, and relaxed. The negative subscale of tension–anxiety, anger–hostility, fatigue, and confusion was significantly lower after walking in the urban park than walking in the city area (p≤0.05). On the contrary, the positive mood state vigor was significantly higher for walking in the urban park (p≤0.001). The total STAI score was 19.3% significantly lower after walking in the urban park than after walking in the city area (p≤0.01)
Sales et al. 2017, Australia [241]	RCT	N: 48 CG: 21 (age 70.2±8.2, 77% women, BMI 28.1±5.0, 6% current smoker, 29% ex-smoker, 52% daily alcohol assumption, 61.9% had previous falls history, 47.6% had fallen over 12 months) EG: 27 (age 75.1±7.9, 64% women,	Type: different kinds of outdoor exercises with different exercise stations: push-ups, modified pull-ups, balance stool, sit to stand, ramp + net + climb through, balance beam, steps, step-ups or taps on platform, gangway, calf raises + finger steps, round snake pipe, sharp snake pipe, hip extension, screws and turners, and hip abduction. Exercisers were paired in stations, and an exercise session could include up to eight stations. Frequency: two times a week, approximately 1–15 h, with	BOOMER test, to assess the effectiveness of the exercise park to improve balance; handgrip strength, to measure physical strength; single leg test standing, to measure the ic balance; 2 min walk test, to assess physical tolerance, functionand al mobility; 30 min sit-to-stand test, to evaluate the strength of the knee extender muscle; feasibility, defined as the number of participants recruited and retained over	No significant improvement in the BOOMER test (CG, 13.5±1.7 pre, 13.9±1.4 post, p = 0.6 EG 13.6±1.4 pre, 13.7±1.3 post, p = 0.6, p between groups = 0.4) and the improvement in quality of life (CG 49.1±7.91 pre, 48.9±7.6 post, p = 0.2, for the physical component, 51.4±6.1 pre, 51.6±7.9 post, p = 0.6, for the mental component; EG 46.9±7.6 pre, 49.6±8.3 post, p = 0.4, for the physical component, 53.1±9.8 pre, 54.5±7.0 post, p = 0.6, for the mental component) and falls efficacy (CG 11.3±4.0 pre, 10.9±3.7 post, p = 0.4, EG 10.3±3.4 pre, 9.3±2.5, post, p = 0.4, p between groups = 0.1). EG showed significant improvements in knee strength (84.2±36.5 pre, 96.4±44.4 post, p = 0.01), balance (single leg stance, 15.6±11.0 pre, 17.3±11.3 post, p = 0.01), 2 min walk test (140.6±30.5 pre,

		BMI 28.9±5.3, 3% current smoker, 42% ex-smoker, 41% daily alcohol assumption, 62.9% had previous falls history, 40.7% had falls over 12 months)	5–10 min of warm-up, followed by 45–75 min on the equipment station and 5–10 min of cool-down exercises. Time: 18 weeks of interventions	the recruitment period; physical composite scores, shortfalls efficacy scale international, numbers of falls over 12 months	152.1±28.7 post, p = 0.01), and sit to stand (10.5±3.0 pre, 12.1±2.7 post, p = 0.01). Regarding feasibility, 87% of EG completed the 18-week intervention with mean attendance to the session of 79.6% and 14% of the CG attended the social meeting offered.
Plotnikoff et al. 2017, Australia [242]	RCT	N:84 (aged 44.7±14.0, BMI 33.3±5.7 kg/m2) CG: 42, aged 45.1±14.7, BMI 31.7±5.1 kg/m2, EG: 42, aged 44.2±13.5, BMI 35.0±5.9 kg/m2	Type: EG—five face-to-face group intervention, each intervention lasted for 90 min and consisted of 30 min of cognitive group and 60 min of small group outdoor training and outdoor PA with the eCoFit smartphone app that included workout circuits, and a description of where and how to use an outdoor physical environment to be more physically active. CG: no interventions Frequency: once a week Time: 20 weeks of interventions; phase 1: 1–10 weeks of face-to-face group intervention; phase 2: 11–20 weeks eCoFit smartphone app	Aerobic fitness to assess aerobic fitness; lower body muscular fitness using the chair stand test; steps/day measured using pedometers; functional mobility using the Timed Up and Go test; waist circumferences, BMI, and systolic and diastolic blood pressure	After 10 weeks, EG improved aerobic fitness (4.50 mL/kg/min), the strength of the lower body, number of steps (1330 steps), mobility (-1.8 s), and systolic blood pressure, and there was a decrease in waist circumference (-2.8 cm). After 20 weeks, EG showed effects on upper and lower body strength, blood pressure, and functional mobility. Survey conducted at the end of the intervention showed positive feedback for group cognitive sesssessionstdoor training, and use of the eCoFit app.
Kim et al. 2018, South Korea [210]	RCT	N: 35 (aged 73.20±4.90, women characteristics (32): BMI 25.48±2.41, kg/m2 height 151.98±5.90 cm, weight 58.73±8.19 kg, lean mass 19.64±2.50 kg, body fat 36.84±3.36%; men characteristics (3): BMI 24.70±2.87 kg/m2, weight 69.40±8.39 kg, 168.20±4.75 cm, lean mass 27.00±3.72 kg, body fat 28.66±3.95%) RC: 12, CoG: 13	Type: RC—outdoor resistance training using leg extension, pull weight, chair pull, for a total of 50 min of training; CoG: outdoor aerobic and resistance training using leg extension, pull weight, chair pull, sky-walker, cross-country, for a total of 70 min; CG: no interventions Time: 6 weeks of interventions at different intensity evaluated with the Borg scale	Fitness was evaluated with five fitness tests designed for the elderly (30 s chair stand, 30 s arm curl, 244 cm up and go, one-leg stand, and 2 min step), as well as the number of pushups and 6 min walking	Improvement in upper-body strength in both groups (RC 19.16±11.40 pre, 30.16±13.13 post; CoG 11.07±9.62 pre, 22.23±12.95 post); lower-body endurance was higher in the CoG (561.84±67.22 m) than the CG (486.44±96.14 m).

		CG: 10			
Muller-Riemnschneider et al. 2020, Singapore [243]	RCT	N: 160 (aged 51.1±6.3, 127 women, total MVPA 442.7±534.7 min/week) EG: 80 (aged 52.1±6.5, 65 women) CG: 80 (aged 50.0±6.0, 62 women)	Type: EG—face-to-face counseling on PA; they completed a park the prescription sheet where they committed to a goal that specified the frequency, intensity, time, and location of exercise parks. Participants received two brochures developed for the trial: one provided information on the main parks and their different features, including walking trails and the location of fitness corners. The second was generally about the Singapore National Park s Board. + invitationa to weekly exercise sessions in parks; in addition, participants received half-way through the trial a brief counseling a phone call to assess progress and included modification of the goal if necessary. CG: continued their daily routine; they received standard PA materials. Time: 6-week intervention.	Time spent on MVPA measured by an accelerometer and by the questionnaithe re, total volume of PA, time spent on light and sedentary activity, time spent at the park, physical activity at the park, recreational MVPA, mental well-being (measured by SF-12, K-10, WHO5, and WHOQOL-BREF).	No differences between EG and CG were observed with regard to physiological distress and overall quality of life. The only difference was found for the psychological quality of life, which was higher in EG than in CG ($p = 0.047$). The difference was not statistically significant regarding the mean differences in MVPA among participants. EG showed a significant increase in the time of recreational PA (EG 142±155.4 min/week, CG 93.6±131.0 min/week, $p = 0.044$), time spent in parks (EG 333.9±506.2 min/month, CG 186.4±85.4 min/month, $p = 0.047$), and PA in parks (EG 333.0±499.3 min/month, CG 140.5±270.7 min/month, $p = 0.005$).
Vert et al. 2020, Spain [244]	RCT	N: 49 (aged 29, min 19, max 49, 69.5% women, BMI 22.6±3.5 kg/m2, 88.1% saw blue space at work, 89.9% met the PA of WHO guidelines)	Type: for each study week, each participant was assigned to a different environment (blue, urban, or control site). All participants were exposed to all environments upon completion of the study. They walked 20 min in a blue, urban, or contrositeste. Participants were distributed in two turns: the first started at 10.00 a.m. and the second at 11.30 a.m. Frequency: 4 days a week Time: 3 weeks intervention	Participants completed a set of questionnaires (SWB, WHO-5, TMD, 4SDQ, and SF-36) to assesses their well-being, mood, and psychological responses, before and after each walking. In addition, sleep characteristics and general health were assessed. Blood pressure, pulse rate, and heart rate variabilities were continuously measured before and after the walking.	Better well-being and mood responses after walking in a blue space versus an urban space or control site ($p \leq 0.05$). For SWB, no significant differences were found. For WHO-5, the "total well-being score" was increased when participants were exposed to a blue environment ($p \leq 0.05$). TMD was significantly lower for the negative subscales after walking along the blue route compared with urban space and the control site ($p \leq 0.05$). 4SDQ did not show significant differences between the environments. Statistically significant increase was found in systolic blood pressure and pulse rate in the blue and urban environments compared with the control site. Increase in SNS activity during and after walking in blue and urban spaces.

RCT: randomized control trial; NRCT: nonrandomized control trial; N: numbers of participants; CG: control group; EG: experimental group; RC: resistance group; CoG: combined group; PA: physical activity; BOOMER: balance Outcome Measure for Elder Rehabilitation; min: minutes; SD: semantic differential; POMS: profile of mood state; STAI: state–trait anxiety inventory, MVPA: moderato-to-vigorous physical activity; PA: physical activity; SWB: subjective well-being; TMD: total mood disturbance; 4SDQ: four-dimensional symptom questionnaire.

We extracted the intervention characteristic by adopting the "F.I.T.T." classification (frequency, intensity, time, type) mainly used in exercise prescription [245].

The duration of the experimental design varied from 3 days to 20 weeks and the frequency from two to seven times a week. The "type" of the intervention included two studies involving walking intervention [243,244], two studies involving a combination of resistance training and aerobic were used [210,241], and two studies involved resistance training [240,242]. According to this, the outcomes were heterogeneous, varying from performance tests such as balance test and handgrip test to well-being and quality of life assessed through a questionnaire. Table 7 describes the details of the included studies.

5.4 Discussion

The present systematic review was aimed at investigating the existing evidence regarding the effects of PA interventions carried out in GBS involving healthy people (aged 18 years). While research has previously assessed how GBS affects health and physical well-being, the relationship between exposure and health effects for healthy people is not well-known. For this reason, the aim of the present systematic review was to investigate the existing evidence regarding the effects of PA interventions performed in a natural environment involving healthy people (aged 18 years).

The systematic research of the literature found six studies, with different kinds of interventions and outcomes. The six eligible studies were scored as of medium quality and showed several improvements in health outcomes, which will be investigated in the present section.

Among the PA interventions adopted in the included studies, walking is a cost-effective one, which might appeal to most of the population [246]. In connection with this, walking in a blue space and in urban park showed better well-being and mood responses compared with walking in an urban space or resting in a control site [240,243,244]. Song et al. reported significant differences in the

questionnaires administered during the study [240]. In fact, the SD score was higher after walking in an urban park for three adjectives: comfortable, natural, and relaxed ($p \leq 0.05$), and lower for the negative subscales tension–anxiety, anger–hostility, fatigue, and confusion ($p \leq 0.05$). Finally, the positive mood state vigor was significantly higher for walking in the urban park than for the city-center ($p \leq 0.05$). Song et al. did not report the effect size, but they used the Wilcoxon signed-rank test to analyze differences in psychological indices detected after walking in the two environments. Vert et al. found similar results for the blue space. In fact, participants showed better well-being and mood response after walking in a blue space versus an urban space or a control site ($p \leq 0.05$). The WHO-5 total well-being score increased when participants were exposed to a blue environment ($p \leq 0.05$). In addition, Vert et al. did not report the effect size, and they used mixed-effects regression models to evaluate the difference linked to the environment. One of the easiest ways to be and remain active is walking, and it is also the most popular [215]. A study found that adults who achieved the right amount of PA observed that walking was the most reported activity [215]. This could be due to its accessibility. Walking is a universal form of PA that a large part of the population can practice without differences in age, sex, education, income level, or ethnic group. Expensive equipment, special skills, or special facilities are not required in walking. There is an inverse association between the risk of developing coronary heart disease and overall walking in women [214]. In addition, walking is an important activity for older people. In fact, walking outdoors at least once a week has been associated with achieving more time spent in moderate to vigorous PA than walking indoors, and it also provides a way to take part in relevant activities, such as shopping or leisure activities (e.g., visiting friends or pleasure walking) [212]. Being physically active is linked to substantially lower costs of medical care, and, in particular, for older adults where the risk of chronic disease is higher, walking has the potential to reduce medical expenditure [217,218]. In this review, two studies used walking as an intervention; they had similar objectives even if they used different

questionnaires to evaluate the psychological answers to walking in a different kind of environment [240,243,244]. In particular, the first article aimed to value the psychological and cardiovascular responses of the exposure to blue space, urban space, and a control site and to value whether well-being and mood effects were constant for (at least) four hours after exposure [243,244]. The second article intended to clarify the physiological effects of walking in urban parks during fall (autumn) [240,244]. Both articles found positive effects after the period of interventions, so they seem to suggest that walking in a natural environment had multiple positive effects. However, more studies are needed to improve the knowledge about this topic.

Concerning performance outcomes, resistance training induced more significant improvements in body muscular strength, aerobic fitness, number of steps, functional mobility, systolic blood pressure, and waist circumference in the experimental group than in the control group [210,241,242]. In two studies, outdoor fitness equipment was used [210,240,241]. Several studies showed that outdoor fitness equipment has become a very popular worldwide in numerous green and blue spaces and built-up environments [221,222,224,226,247]. Outdoor fitness equipment (OFE) can be used by a large part of the population (there is also OFE adapted for people in wheelchairs) because it provides free access to fitness training for the community and also enables different kinds of training (e.g., resistance training or circuit training)[212,224,226]. The results of the use of outdoor fitness equipment are mixed. Sales et al. found significant improvements in knee strength, balance, 2 min walk test, and sit-to-stand [241]. Meanwhile, Kim et al.'s study showed significant improvement in the upper- body strength. These differences in the results are linked to the different kinds of outdoor fitness equipment used. In fact, there are different manufacturers that design and produce outdoor fitness equipment, with differences in shape, materials, size, or smoothness of operation [133].

Plotnikoff et al. and Muller-Riemenshneider et al. evaluated the effects of PA in green and blue spaces and the effectiveness of face-to-face counseling [242,243]. In both studies, the participants received information about the parks in their city or in their neighborhood to promote the use of this kind of environment. Plotnikoff et al. used a smartphone application, called eCoFit, in which the participants of the experimental group could find workout circuits suited for several geographical locations in the city. Indeed, in the study of Muller- Riemenshneider et al., the participants received an information brochure and a sheet where they filled in the types of activities they aimed to do each week over the trial period [242,243]. Even if the study design is similar between the two studies, the results are not comparable because they used different types of exercises and different questionnaires, and the time of the study was different. However, both studies found positive effects of the interventions. The experimental group in Muller-Riemenshneider et al.'s study was asked to join one hour of an outdoor structured and supervised PA program every week in a park. The control group received only standard PA promotion materials. At the end of six months, the experimental group had a significant increase in recreational PA, time spent in parks, and PA in parks. Additionally, they achieved improvements in chosen measures of quality of life and well-being, especially the psychological quality of life. Plontikoff et al.'s study divided into two parts the experimental design for the intervention group: for 10 weeks, the participants performed personal sessions and used the app for smartphones; then, for the other 10 weeks, they used only the smartphone app. Most of the improvement related to health outcomes at 10 weeks was also confirmed at 20 weeks. This suggests that the participants continued the PA during phase 2. One of the key objectives was to promote the use of local green spaces, and eliminating many of the common barriers to participating can be interesting to verify if, after a longer period (a year), the participants of the intervention group continued to use the green spaces as a place to do PA. Despite several pieces of evidence on the health benefits of green and blue spaces, they are generally

underused [115,116], so it can be important to sensitize the population more about the potential of this kind of environment.

From a public health perspective, these results can represent a strategy to be implemented to make the most of the natural setting to amplify the benefits of physical activity practice with a view to preventing health risks and saving resources. In connection with this, a recent systematic review recommends for future policies and research take a more integrated multisystem approach and be inclusive of local and spatial authority planning and meet the needs of transport and natural resources [232]. The concept of “blue space” has not been widely used compared with green space, even if some studies demonstrated the potentially higher effects of blue space on people’s health. For this reason, it would be important that future studies propose physical activity programs in blue spaces to more consistently verify the benefits of this type of environment.

6. Study 3: Attitudes towards Green Urban Space: A Case Study of Two Italian Regions

This article was published in the International Journal of Environmental Research and Public Health

Grigoletto A, Mauro M, Campa F, Loi A, Zambon MC, Bettocchi M, Nieuwenhuijsen M, Bragonzoni L, Maietta Latessa P, Toselli S. Attitudes towards Green Urban Space: A Case Study of Two Italian Regions. *Int J Environ Res Public Health*. **2021** Jun 14;18(12):6442. doi: 10.3390/ijerph18126442.

Keywords: attitude; green space; health promotion; park

Overview

Understanding what drives people to use green urban space is fundamental to create appropriate campaigns to develop the use of such spaces and improve the citizens' quality of life. For this purpose, a questionnaire on the attitude towards green space was developed and submitted to people from two Italian regions: Emilia-Romagna and Veneto. Significant differences were observed between the two regions, among the considered age groups, and in relation to the type of job. People from Emilia-Romagna have higher scores of attitudes toward green space than people from Veneto, underlining the importance of territorial policies. Moreover, younger participants (18–30 years) seem to be less attracted to green urban space.

6.1 Introduction

Even though there has been a growing literature focused on the importance of green urban spaces and several studies have highlighted a relationship between exposure to the natural environment and better health perception [178], the mechanism that brings people to use green space is still unclear [179,180]. In particular, some concerns regard the optimal distance of the house from the park to ensure frequent use of green spaces. The currently recommended distance between a residence and the nearest open public space is 300 m [37]; however, other studies have suggested that people are willing to walk for even longer distances in order to have access to a green urban space if parks have some attractive features [21,59]. Other factors that may influence access to parks are socioeconomic status, sex, and age. Previous studies have shown that the use of natural environments may differ according to socio-economic status and sex [178,248–250]: women between 18 and 30 and those over 65 generally showed a higher frequency of use in comparison with men or people belonging to other age groups [251]. In addition, women are disproportionately affected by common mental health issues and they are more sensitive to the neighborhood environment [13]. Women are therefore a group for which the effects of urban parks can be especially important [252]. With regard to age, young people generally underutilize parks and green urban spaces because they prefer to spend their free time by doing other kind of activities rather than outdoor experiences [253].

Some studies suggest that people's perception of the environment could influence the willingness and intention to use the surrounding environment [254,255]. Relatively few studies have assessed the effects of the perception of green space and the use of parks in terms of health promotion and such studies are lacking in Italy. Encouraging Park visitation could promote the physical and mental health of residents. Even if there is an increasing literature about the importance of green spaces, the results are contrasting because of the different measurements, statistical analysis, and

covariate sets used. Thus, the relationships change based on the individual characteristics considered, and the enquire of what drives people to use green urban spaces is still open.

Therefore, the first aim of this exploratory research was to develop a questionnaire to evaluate the attitude toward green spaces and understand what drives citizens to use them. In Italy, different policies regarding green spaces are adopted among regions [256,257]. Thus, a second aim was to assess whether there are any differences in attitudes toward parks between the inhabitants of two Italian regions: Emilia-Romagna and Veneto. These are two bordering regions in the north of Italy, similar in population characteristics and socio-economic status. Emilia-Romagna has an area of 22,444 km^2 with a population of 4,459,477 people, mostly living in the provincial capitals and a pro capita income of 22 500 euros. The area of Emilia-Romagna is mainly covered by plains and mountains with rainfall ranging from 600 mm per year in the plain to 1500 mm per year in the mountainous area. In this region, there are two national parks covering an area of 36 000 hectares. Veneto is further north than Emilia-Romagna and has an area of 18,390 km^2 mainly covered by plains and mountains. There are 4,905,854 people who live in Veneto and most of them live in the provincial capitals, with a pro capita income of 21,994 euros. The rainfall range is very similar to Emilia-Romagna. Veneto has only one national park, but it covers an area of 32,000 hectares [258–260].

However, as regards physical activity programs in green spaces for the population, the two regions show marked differences. In Emilia-Romagna, a project to increase green areas in cities by 20% was approved in 2020, while in Veneto there are no similar projects, yet. In March 2021, the Emilia-Romagna region allocated 4.5 million euros for parks and biodiversity agencies to promote sustainable development and combat climate change, and 3.6 million euros for projects that protect and enhance the natural environment and the environmental heritage throughout the whole region [261]. At the same time, eight areas of Emilia-Romagna were chosen by the Europarc

Federation to participate in the “European charter for sustainable tourism” with the goal of developing environmental tourism [262]. Since 2005, the municipality of Bologna (the regional capital) has celebrated “Arbor Day”, where trees are planted in different parts of the city [263]. In Bologna, there have been other initiatives to improve the use of green urban spaces. In fact, since 2010 Bologna citizens have had the possibility to experience different kind of outdoor physical activity in parks in the summertime through the project “The Moving Park project” [264]. Moreover, from 2011 onwards, senior citizens in Bologna have had the opportunity to be physically active while also improving their socialization thanks to the city’s project “Badabene alla salute”, which envisages twice weekly physical activity group sessions and walking groups in public parks and other urban outdoor spaces located in the six districts of Bologna. Similar projects were carried out in other provinces of Emilia-Romagna. Veneto has had only a few projects regarding green spaces and these are linked to local municipalities (such as Padua or Verona); there were no similar regional projects or events [265,266]. Higher scores in attitude towards green urban spaces could be a demonstration of the efficacy of the territorial policies in Emilia-Romagna.

Therefore, the first objective of the present study was to propose a questionnaire that could be effective in understanding attitudes toward green space. Many factors (demographic, proximity of the park, and park use) may affect attitudes, and in literature, these were often considered individually. Therefore, the second goal was to gain a better understanding of the influence of these factors and assess the differences in the attitude towards green spaces, not only at a territorial level but also considering sexes, age groups, level of education, distances between home and green space and among people who use parks for physical activity or not. In particular, in Italy, there is a lack of studies about attitudes toward green urban space, and this preliminary study has the potential to provide helpful, if not generalizable, information on this matter. The understanding of what components influence the determination of an attitude, could be very

useful for managers and decision-makers engaged in public health, as this could help guide management strategies.

6.2 Materials and Methods

6.2.1. Participants

Three hundred and fifty subjects completed the questionnaires, but some were excluded from the analysis as they lacked important information. Ultimately, 310 surveys contained all the information and were considered in the present study: 167 from Emilia- Romagna and 143 from Veneto. The survey was approved by the Bioethics Committee of the University of Bologna (prot. N. 022254) and was administered in the two regions both on paper (distributed in parks) and in an online version with Google Moduli. Distribution of the survey began in May 2020 and the online version was closed in September 2020.

In addition, before administering the questionnaire a pre-test was carried out using a small sample of respondents to assess its reliability. For this purpose, we recruited 60 subjects via convenience-based sampling to validate the survey. This group consisted of 30 participants from Emilia-Romagna and 30 from Veneto, divided equally between men and women, and age groups. The questionnaire was administered in the paper version to people who were randomly recruited in both regions using a social network, such as Facebook.

6.2.2. Procedures

A new questionnaire was developed to investigate the attitude that drives people to use urban parks. Attitude represents a synthetic assessment of a psychological object evaluated in positive or negative dimensions [252,253]. The survey was divided into two sub-sections: (1) demographic information, and (2) attitude toward green space components. The first section collected demographic information, including sex, date, place of birth, region and city of living, level of education, marital status, occupation, and the distance from their home to the nearest urban park.

Information regarding the use of parks for physical activity was also gathered. The second part included questions designed to assess participants' attitudes toward green urban spaces [64]. The statements were evaluated using the Likert scale.

The questionnaire included fifteen items, divided into three components: cognitive, behavioral, and affective. Questions one to five belonged to the cognitive component, which can be measured through the belief types of value orientations, objective knowledge, and perceived outcomes. The second component covered the behavioral aspect, and investigated park use and participation in outdoor nature recreation. The items included in this section were from number six to number ten. Finally, questions from eleven to fifteen examined the affective component, based on basic emotions differentials. All three components were evaluated with the Likert scale, from 1 to 5, in which 1 meant "strongly disagree" and 5 "strongly agree". The data used for this statistical study will be available from the corresponding author upon request.

6.2.3. Statistical Analysis

In order to assess the questionnaire's validity, its internal consistency was evaluated by Cronbach's alpha coefficient on the answers of the recruited pre-test sample; a confirmatory analysis (CFA) for the convergent validity of the constructs was then performed. Cronbach's alpha was considered reliable for values between 0.5 and 0.9.

Subsequently, to better achieve the objectives of the study, the suitability of the sample size was assessed using the G-Power software 3.1.9.2. An a priori power analysis was conducted to ensure that the number of participants was representative of the purposes of this study. To identify the sample size for the study, we assessed an a priori: computer required sample size given α, power, and Effect Size by G*Power (version 3.1.9.2, Universitat Kiel, Kiel, Germany). When ANOVA was selected ($\alpha = 0.05$; $1 - \beta = 0.90$; effect size f= 0.25) a sample size of 270 participants was detected.

When multiple regression was selected, the calculated outcomes parameters detected a sample size of 130 participants. Additional subjects were involved to ensure the availability of data in case of problems with data collection.

The variables' normality was verified with the Shapiro–Wilk test. Descriptive statistics (means and SD) and frequencies were calculated. Since the variables were not normally distributed, a non-parametric ANOVA was used to assess differences between regions, sex, age groups, marital status, education level, distance from the park, and use of the park. When a significant F ratio was obtained, the Tukey post hoc test was used to evaluate the differences among the groups. As regards demographic factors of proximity and park use, the differences in the frequencies between the two regions were assessed by the Chi- square test.

Finally, to further understand the influence of demographic characteristics on green space perception, a set of multiple regression models was built. A backward multiple regression analysis was carried out to assess possible predictors of the total score obtained in the three different components. Some demographic and personal characteristics were used as independent variables. In particular, age groups, sex, marital status, region of living, educational level, profession, distance from the park, and use of the park were included in the model. Predictors inputted into the model were those found to have significant associations with the total score obtained in the three different components (i.e., $p < 0.05$), while those with $p > 0.05$ were removed from the model. After performing the model, all the hypotheses were verified.

Data analysis was performed using Statistica for Windows, version 8.0 (Stat Soft Italia srl, Vigonza, Padua, Italy).

6.3. Results

6.3.1. Validation of the Questionnaire

The Cronbach's α value was 0.888, and the Cronbach's alpha values of the different components of attitude were all above the threshold of 0.7, which can be regarded as reliable. Loading values, used to assess the relationship between variables, ranged from 0.583 to 0.965 among the different items in this study. Since the alpha was 0.929 for the cognitive component, 0.704 for the behavioral component, and 0.761 for the affective component, the questionnaire could be considered valid. The model derived from the confirmatory factor analysis showed a fit with the data (Minimum discrepancy per degree of freedom, CMIN= 70.08; df = 51, CMIN/df = 1.06; Comparative Fit Index, CFI = 0.961; Root mean square residual, RMR = 0.03). According to conventional criteria, the Chi-squared/df < 2, CFI >0.9, and RMR < 0.05 indicated a good fit [65–67]. Table 8 shows the results of Cronbach's α for the sample of sixty people.

Table 8. Reliability analysis

Attitude components	Items	Loading Value	Cronbach's α
Cognitive component	I prefer to do outdoor physical activity	0.965	0.929
	Green space in cities is important	0.898	
	Nature parks improve quality of life	0.897	
	Contact with nature is important for well-being	0.893	
	It is important to have convenient nature parks in cities	0.910	
Behavioral component	Nature parks are boring	0.793	0.704
	Humans have the right to modify nature to suit our needs	0.623	
	The time spent in an urban nature park relaxes you	0.592	
	Tax dollars should be spent on nature parks	0.637	

	Nature parks in the cities provide valuable contact with nature	0.583	
Affective components	I expect to feel refreshed after visiting a nature park	0.750	0.761
	I enjoy talking with neighbors at the local nature park	0.748	
	I learn about the local environmental issues from friends/family	0.787	
	I like the structure of the park you use	0.657	
	I can count on family and friends for help	0.710	

6.3.2 Assessment of the Attitude toward Green Space

6.3.3.1 Demographic and Socio-economic Characteristics

Table 9 summarizes the demographic and socio-economic characteristics of the subjects that participated in the study: 167 subjects (54%) come from Emilia-Romagna and 143 (46%) from Veneto. Most of the respondents were female (n=194, 62%). To consider the representation of subjects according to age, people were divided into 10-year age class groups: the class most represented was the 51–60 years group (n = 81, 27%), followed by the 18–30 years (n = 66, 21%), 41–50 (n = 51, 16%), 31–40 (n = 49, 16%), 61–70 (n = 46, 15%) and the over 70 (n =14, 5%). Most of the participants had gained a high school diploma (n= 106, 35%) or a master's degree (n = 108, 35%). A large part of the sample lived at a distance of less than 300 m from a park (n = 213, 69%). Park users numbered 206 (67%) and non-users 104 (33%).

Table 9. Demographic characteristics of participants (n=310) and Chi-squared test between the frequencies of the two regions

	Emilia-Romagna		Veneto			
Characteristics	Male	Female	Male	Female	X^2	p
Age	N (%)	N (%)	N (%)	N (%)	32.59	<0.001
18-30	13 (22.4%)	18 (16.5%)	13 (22.0%)	23 (27.4%)		
31-40	9 (15.5%)	17 (15.6%)	14 (23.7%)	11 (13.1%)		
41-50	6 (10.3%)	10 (9.2%)	12 (20.3%)	21 (25.0%)		
51-60	12 (20.7%)	30 (27.5%)	14 (23.7%)	24 (28.6%)		
61-70	12 (20.7%)	25 (22.9%)	5 (8.5%)	5 (6.0%)		
Over 70	6 (10.3%)	9 (8.3%)	1 (1.7%)	-		
Education Level					32.32	<0.001
Below high school	6 (10.3%)	15 (13.8%)	3 (5.1%)	3 (3.6%)		
High school	9 (15.5%)	35 (32.1%)	27 (45.8%)	41 (48.8%)		
Bachelor's degree	6 (10.3%)	8 (7.3%)	9 (15.3%)	14 (16.7%)		
Master's degree	24 (41.4%)	41 (37.6%)	19 (32.2%)	23 (27.4%)		
Doctorate	13 (22.4%)	10(9.2%)	1 (1.7%)	3 (3.6%)		
Marital status					10.16	<0.05
Single	18 (31.0%)	34 (31.2%)	11 (18.6%)	24 (28.6%)		
Engaged	3 (5.2%)	7 (6.4%)	6 (10.2%)	12 (14.3%)		
Cohabiting	6 (10.3%)	9 (8.3%)	6 (10.2%)	12 (14.3%)		
Married	29 (50.0%)	56 (51.4%)	36 (61.0%)	36 (42.9%)		
Widower	1 (1.7%)	4 (3.7%)				
Distance from park					8.26	<0.05
Less than 300 m	44 (17.2%)	81 (29.4%)	40 (32.2%)	48 (42.9%)		
More than 300 m	10 (82.8%)	32 (70.6%)	19 (67.8%)	36 (57.1%)		
Use of the park					0.07	0.70
Users	41 (74.1%)	71 (63.3%)	39 (66.1%)	55 (65.5%)		
Non-users	13 (25.9%)	42 (36.7%)	20 (33.9%)	29 (34.5%)		

Note. Some demographic characteristics were no present in all the sample (female over 70 years in Veneto, widower in Veneto).

Significant differences between the participants of the two regions were observed for certain demographic characteristics, such as age groups, education levels, marital status, and distance from the park ($p < 0.05$). In Emilia-Romagna, most participants were in the age group 18–31 years for men (22.4%) and 51–60 years (27.5%) for women. In Veneto, the situation was similar for women (28.51% in the age group 51–60) but different for men, where the highest percentage of participants was observed in the age groups of 31–40 years and 51–60 years (23.7%). Significant differences were also observed in the education level: a generally higher level was observed in Emilia-Romagna compared to Veneto. Married people were more represented than those with the other statuses

(50.0% for men and 51.4% for women in Emilia-Romagna, and 61.0% for men and 42.9% for women in Veneto). Even though in both regions the people who lived at a distance of less than 300 m from the park were higher than those who lived farther (82.8% for men and 70.6% for women in Emilia-Romagna, and 67.8% for men and 57.1% for women in Veneto), the difference between the two regions was significant. No significant differences were observed between regions in users for physical activity and non-users: users were more numerous than non-users, with the highest percentage of men in Emilia-Romagna (74.1%).

Participants were asked if they regularly used the park since this information could influence their attitude toward green spaces: 67% of the participants regularly used the parks (n = 206), while 33% (n = 104) did not. Of this percentage, 47% (n = 96) of users lived in Veneto and 53% (n = 110) in Emilia-Romagna; 60% (n = 123) of users were female and 40% (n = 83) were male. In Veneto, the percentage of women that used the park was 65% (n = 55) and the percentage of men users was 66% (n = 39). Regarding non-users, women represented 35% (n = 29) and men 34% (n = 20). In Emilia-Romagna, women users were 62% (n = 68) and men users 77% (n = 42). Non-users were respectively 38% for women (n= 41) and 24% for men (n = 13).

A non-parametric two-way ANOVA was performed to evaluate sex and age group differences in the total sample (Table 3). Regarding the sexes, significant differences were found in two items: “I prefer to do outdoor physical activity” and “I learn about the local environmental issues from family/friends”. For the first item, men had higher scores than women, but for the second item, women had higher scores than men.

Regarding age groups, significant differences were found in the items “I prefer to do outdoor physical activity”, “Green space is important”, “Nature parks are boring”, “I learn about the local environmental issues from family/friends”, and in the total score of the cognitive component and

the total score of the affective components. Such differences were mostly found between the youngest age group (18–30 years) and the oldest groups (61–70 years and over 70). The participants of the age group 18–30 years generally showed lower values than the participants of the other age groups for many items. Significant interactions were observed between sexes and age groups in thirteen items. Women of all age groups generally presented higher scores than men; women aged 41–50 years showed lower scores than women aged 31–40 years.

When the distance of the dwelling from the park was considered, 69% of the participants indicated a distance of less than 300 m from their residence to the nearest park and only 31% indicated a greater distance. No significant differences were found in attitudes between the two groups.

Since one of the aims of the present study was to highlight any differences in the attitude towards green space between the participants of the two regions, we carried out a non-parametric ANOVA considering regions, sexes, and age groups. In Table 10, the mean values and standard deviations of the considered items for regions, sexes, and age groups are reported, while the ANOVA results are shown in Table 11.

Table 10. Descriptive statics and ANOVA for sexes and age groups.

	18-30		31-40		41-50		51-60		61-70		Over 70							
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Sexes		Age		Sexes*age	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	F	p	F	p	F	p
I prefer to do outdoor physical activity	3.84 (1.21)	3.56 (1.36)	3.70 (1.33)	3.82 (1.42)	4.56 (0.78)	3.39 (1.45)	4.31 (0.97)	3.89 (1.25)	4.35 (1.00)	4.11 (1.40)	4.86 (0.38)	4.50 (0.53)	6.30	<0.05	2.45	<0.05	2.38	<0.05
Green space in cities is important	4.44 (0.82)	4.29 (0.96)	3.87 (1.25)	4.64 (0.78)	4.72 (0.57)	3.68 (1.30)	4.58 (0.81)	4.38 (0.84)	4.65 (0.61)	4.44 (0.89)	5.00 (0.00)	4.75 (0.46)	1.81	0.18	2.39	<0.05	3.54	<0.05
Nature parks improve quality of life	4.16 (0.99)	4.10 (0.97)	4.09 (1.28)	4.82 (0.55)	4.89 (0.32)	3.74 (1.15)	4.42 (0.86)	4.32 (0.92)	4.76 (0.56)	4.48 (0.89)	5.00 (0.00)	4.88 (0.35)	1.86	0.17	3.32	0.06	4.20	<0.05
Contact with nature is important for well-being	4.40 (0.76)	4.37 (0.89)	4.00 (1.24)	4.79 (0.57)	4.78 (0.55)	4.00 (1.06)	4.50 (0.86)	4.39 (0.93)	4.76 (0.56)	4.44 (0.89)	4.86 (0.38)	4.75 (0.46)	0.43	0.51	1.20	0.31	2.47	<0.05
It is important to have convenient nature parks in cities	4.32 (0.85)	4.29 (0.87)	4.13 (1.25)	4.80 (0.57)	4.83 (0.71)	4.00 (1.07)	4.35 (0.89)	4.41 (0.91)	4.76 (0.56)	4.48 (0.89)	4.71 (0.49)	4.88 (0.35)	0.25	0.61	1.33	0.25	2.33	<0.05
Nature parks are boring	1.96 (0.98)	1.71 (1.25)	1.26 (0.45)	1.14 (0.45)	1.28 (0.46)	1.48 (0.96)	1.38 (0.57)	1.55 (1.06)	1.35 (0.70)	1.11 (0.42)	1.86 (1.57)	1.75 (1.49)	0.11	0.74	4.12	<0.05	2.18	<0.05
Humans have the right to modify nature to suit our needs	2.12 (0.88)	1.95 (1.05)	1.70 (0.76)	1.68 (0.82)	1.83 (1.10)	1.71 (0.78)	1.85 (1.05)	1.66 (1.05)	2.00 (1.32)	1.70 (0.91)	2.14 (1.46)	2.50 (1.69)	1.43	0.23	1.66	0.15	0.99	0.45
The time spent in an urban nature park relaxes you	4.00 (1.08)	3.88 (1.05)	3.65 (1.23)	4.50 (0.92)	4.33 (0.77)	3.77 (1.09)	3.62 (1.30)	4.20 (1.02)	4.24 (0.75)	4.19 (1.11)	4.29 (0.76)	4.75 (0.46)	0.55	0.46	1.20	0.31	2.22	<0.05
Tax dollars should be spent on nature parks	4.32 (3.76)	4.39 (0.83)	4.09 (1.24)	4.79 (0.57)	4.94 (0.24)	4.00 (1.13)	4.38 (0.85)	4.39 (0.85)	4.76 (0.56)	4.33 (1.11)	4.86 (0.38)	4.88 (0.35)	1.79	0.18	1.01	0.41	2.64	<0.05
Nature parks in the cities provide valuable contact with nature	3.76 (1.09)	3.80 (1.12)	3.61 (1.20)	4.25 (1.00)	4.22 (1.11)	3.74 (1.09)	4.04 (0.96)	4.18 (1.05)	4.12 (0.93)	4.33 (0.92)	3.86 (1.07)	4.63 (0.52)	2.25	0.13	1.70	0.13	1.71	0.07
I expect to feel refreshed after visiting a nature park	3.76 (1.09)	3.73 (1.03)	3.35 (1.15)	4.18 (1.09)	4.22 (1.11)	3.58 (1.09)	3.58 (1.24)	4.20 (1.05)	4.18 (0.81)	4.11 (1.05)	4.14 (1.07)	4.63 (0.52)	2.70	0.10	1.19	0.09	2.24	<0.05
I enjoy talking with neighbors at the local nature park	2.28 (1.14)	2.29 (1.23)	3.61 (1.22)	4.25 (1.00)	4.11 (1.08)	3.76 (1.09)	4.04 (0.96)	4.09 (1.03)	4.14 (0.81)	4.35 (0.94)	3.86 (1.05)	4.75 (0.46)	0.84	0.36	2.24	0.06	2.36	<0.05
I learn about local environmental issues from friends/family	2.36 (1.25)	3.80 (1.12)	2.35 (1.19)	2.57 (1.23)	3.11 (1.13)	2.74 (1.32)	2.38 (1.24)	2.70 (1.43)	2.59 (0.80)	2.85 (1.46)	2.86 (1.68)	3.50 (1.07)	7.83	<0.05	2.25	<0.05	1.37	0.18
I like the structure of the park I use	3.16 (0.90)	2.61 (1.38)	2.74 (1.05)	3.25 (1.08)	3.11 (1.23)	2.90 (1.14)	3.31 (1.19)	3.50 (1.21)	3.76 (1.25)	3.56 (1.37)	3.86 (1.21)	3.88 (1.55)	0.02	0.88	4.83	<0.05	2.41	<0.05
I can count on family and friends for help	2.28 (1.14)	1.73 (1.05)	2.30 (1.49)	2.14 (1.51)	2.44 (1.10)	1.58 (0.81)	2.54 (1.17)	1.95 (1.21)	2.35 (1.00)	2.56 (1.45)	2.57 (1.72)	3.25 (1.58)	2.69	0.37	1.38	0.10	1.21	0.28
Total score of cognitive	21.16 (4.10)	20.61 (4.29)	19.78 (5.83)	22.86 (3.23)	23.78 (1.96)	18.81 (5.44)	22.15 (3.78)	21.39 (4.50)	23.29 (2.69)	21.96 (4.85)	24.43 (1.13)	23.75 (1.67)	2.34	0.13	2.30	<0.05	3.28	<0.05
Total score of behavioral	16.16 (2.91)	15.73 (3.35)	14.30 (3.71)	16.36 (2.53)	16.61 (2.03)	14.71 (3.40)	15.27 (3.38)	15.98 (3.25)	16.47 (2.55)	15.67 (2.94)	17.00 (3.87)	18.50 (2.33)	0.07	0.80	1.57	0.16	1.85	<0.05
Total score of affective	15.32 (3.65)	14.17 (3.88)	14.35 (4.84)	16.39 (3.45)	17.00 (3.99)	14.55 (4.13)	15.85 (4.51)	16.41 (4.61)	17.00 (2.35)	17.41 (5.15)	17.29 (5.28)	20.00 (2.73)	0.20	0.66	3.52	<0.05	2.72	<0.05

Table 11. Descriptive statistics in Emilia-Romagna and Veneto for age groups and sexes

	Emilia-Romagna												Veneto									
	18-30		31-40		41-50		51-60		61-70		Over 70		18-30		31-40		41-50		51-60		61-70	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
I prefer to do outdoor physical activity	3.25 (1.66)	3.21 (1.55)	4.10 (1.60)	3.56 (1.54)	3.86 (1.86)	2.82 (1.94)	3.92 (1.44)	3.76 (1.41)	4.00 (1.58)	4.50 (1.21)	4.83 (0.41)	4.44 (1.49)	3.79 (1.53)	3.54 (1.53)	2.93 (1.53)	3.69 (1.93)	4.29 (1.51)	3.43 (1.47)	4.07 (0.53)	3.76 (1.45)	3.67 (1.97)	2.00 (2.00)
Green space in cities is important	3.67 (1.50)	4.16 (1.34)	4.10 (1.66)	4.28 (1.41)	4.00 (1.83)	3.27 (1.90)	4.15 (1.52)	4.36 (1.08)	4.23 (1.42)	4.65 (1.16)	5.00 (0.00)	4.67 (1.55)	4.43 (1.34)	4.04 (1.30)	3.20 (1.52)	4.46 (1.44)	4.43 (1.49)	3.61 (1.37)	4.33 (1.40)	4.04 (1.24)	4.00 (1.00)	3.17 (1.83)
Nature parks improve quality of life	3.42 (1.56)	4.05 (1.22)	4.20 (1.62)	4.50 (1.29)	4.00 (1.83)	3.64 (1.57)	3.85 (1.46)	4.33 (1.14)	4.38 (1.45)	4.69 (1.16)	5.00 (0.00)	4.78 (1.57)	4.14 (1.35)	3.79 (1.35)	3.47 (1.68)	4.54 (1.45)	4.64 (1.46)	3.52 (1.41)	4.13 (0.41)	3.96 (1.27)	4.00 (1.00)	3.17 (1.83)
Contact with nature is important for well-being	3.75 (1.48)	4.26 (1.28)	4.20 (1.62)	4.44 (1.29)	3.86 (1.86)	4.18 (1.60)	4.00 (1.53)	4.33 (1.22)	4.38 (1.45)	4.69 (1.16)	4.83 (0.41)	4.67 (1.55)	4.29 (1.33)	4.08 (1.28)	3.33 (1.59)	4.54 (1.45)	4.57 (0.36)	3.61 (1.30)	4.33 (0.40)	4.12 (1.24)	4.00 (1.00)	3.15 (1.83)
It is important to have convenient nature parks in cities	3.75 (1.48)	4.21 (1.27)	4.40 (1.58)	4.44 (1.29)	3.86 (2.04)	4.18 (1.60)	3.92 (1.50)	4.33 (1.19)	1.08 (0.49)	4.65 (1.16)	4.83 (0.41)	4.78 (1.57)	4.14 (1.41)	4.00 (1.25)	3.40 (1.64)	4.54 (1.45)	4.64 (0.26)	3.60 (1.31)	1.27 (0.59)	4.16 (1.25)	3.67 (1.95)	3.17 (1.80)
Nature parks are boring	1.75 (1.22)	1.68 (1.42)	1.20 (0.63)	1.00 (0.34)	1.00 (0.58)	1.45 (1.04)	1.31 (0.75)	1.64 (1.14)	1.69 (1.25)	1.12 (0.47)	1.67 (1.63)	1.67 (1.43)	1.93 (1.00)	1.58 (1.18)	1.13 (0.52)	1.15 (0.72)	1.21 (0.59)	1.35 (1.00)	1.47 (0.74)	1.32 (0.99)	1.50 (1.22)	0.83 (0.41)
Humans have the right to modify nature to suit our needs	2.08 (1.08)	2.05 (1.35)	1.50 (0.97)	1.50 (0.86)	1.86 (1.68)	1.55 (0.69)	2.00 (1.41)	1.55 (1.03)	4.00 (1.35)	1.77 (0.95)	2.33 (1.51)	2.78 (1.90)	1.86 (1.03)	1.71 (0.86)	1.60 (0.83)	1.62 (0.98)	1.50 (0.83)	1.61 (0.95)	3.40 (1.80)	1.68 (1.14)	2.00 (1.79)	1.00 (0.63)
The time spent in an urban nature park relaxes you	3.75 (1.42)	3.74 (1.37)	3.80 (1.62)	4.11 (1.45)	3.43 (1.72)	3.91 (1.51)	3.31 (1.32)	4.06 (1.27)	4.38 (1.45)	4.38 (1.34)	4.50 (0.55)	4.67 (1.55)	3.57 (1.60)	3.67 (1.31)	3.07 (1.49)	4.23 (1.50)	4.21 (1.36)	3.43 (1.33)	4.27 (0.39)	4.04 (1.27)	3.33 (1.86)	3.17 (1.83)
Tax dollars should be spent on nature parks	3.75 (1.42)	4.16 (1.26)	4.40 (1.58)	4.50 (1.29)	4.14 (1.86)	4.18 (1.60)	3.85 (1.46)	4.39 (1.09)	4.00 (1.35)	4.54 (1.33)	5.00 (0.00)	4.78 (1.57)	4.21 (1.37)	4.21 (1.25)	3.33 (1.59)	4.46 (1.44)	4.64 (0.46)	3.61 (1.37)	3.80 (1.42)	4.04 (1.24)	4.00 (1.00)	3.17 (1.83)
Nature parks in the cities provide valuable contact with nature	3.67 (1.56)	3.84 (1.46)	3.70 (1.64)	3.83 (1.38)	3.57 (2.15)	4.00 (1.55)	3.69 (1.44)	4.03 (1.36)	4.38 (1.45)	4.54 (1.18)	4.17 (0.75)	4.56 (1.52)	3.43 (1.45)	3.46 (1.28)	3.07 (1.44)	4.23 (1.59)	4.00 (1.00)	3.30 (1.28)	3.80 (1.50)	4.04 (1.21)	3.00 (1.90)	3.17 (1.83)
I expect to feel refreshed after visiting a nature park	3.42 (1.51)	4.05 (1.39)	3.50 (1.51)	4.06 (1.30)	3.43 (2.07)	3.73 (1.62)	3.69 (1.44)	4.03 (1.36)	4.00 (1.35)	4.54 (1.11)	3.17 (1.47)	4.44 (1.56)	3.43 (1.45)	3.67 (1.31)	2.80 (1.37)	4.23 (1.59)	4.14 (0.31)	3.30 (1.28)	3.33 (1.72)	4.00 (1.00)	3.00 (1.85)	3.00 (1.67)
I enjoy talking with neighbors at the local nature park	3.92 (1.44)	3.95 (1.31)	3.40 (1.43)	3.67 (1.24)	2.00 (1.41)	3.82 (1.47)	3.31 (1.32)	4.06 (1.27)	3.54 (1.51)	4.46 (1.17)	3.33 (1.21)	4.44 (1.56)	3.36 (1.50)	3.46 (1.28)	2.00 (1.31)	4.00 (1.51)	4.00 (1.00)	3.30 (1.30)	2.40 (1.30)	2.56 (1.45)	3.17 (1.83)	3.17 (1.83)
I learn about local environmental issues from friends/family	3.75 (1.42)	3.11 (1.37)	1.90 (0.99)	2.22 (1.22)	2.14 (1.35)	1.91 (1.51)	3.31 (1.32)	3.91 (1.23)	3.38 (1.61)	3.54 (1.42)	1.83 (1.17)	3.44 (1.60)	1.79 (1.12)	2.00 (1.06)	3.07 (1.44)	2.54 (1.61)	2.86 (1.25)	2.57 (1.41)	2.47 (1.36)	1.56 (1.46)	2.17 (1.33)	1.50 (1.38)
I like the structure of the park I use	2.58 (1.44)	2.58 (1.84)	1.90 (1.20)	1.61 (1.42)	3.14 (1.95)	2.18 (1.54)	3.23 (1.36)	3.58 (1.41)	2.38 (1.45)	3.42 (1.51)	2.17 (1.17)	3.33 (1.83)	2.79 (1.31)	1.79 (0.88)	2.20 (1.08)	2.38 (1.70)	2.29 (1.25)	1.70 (0.90)	2.93 (1.53)	3.12 (1.24)	2.50 (1.64)	1.17 (0.75)
I can count on family and friends for help	3.33 (1.72)	3.21 (1.40)	2.90 (1.20)	3.17 (1.42)	3.71 (1.80)	3.55 (1.57)	2.00 (1.41)	2.12 (1.41)	1.69 (1.25)	3.12 (1.57)	3.67 (1.51)	2.11 (1.29)	1.79 (1.12)	2.21 (1.22)	1.87 (1.25)	3.15 (1.47)	3.00 (1.52)	2.52 (1.18)	3.80 (1.42)	2.57 (1.60)	2.67 (1.97)	1.50 (1.22)
Total score of cognitive	17.83 (7.49)	19.89 (6.24)	21.00 (7.76)	21.22 (1.54)	19.57 (9.09)	18.09 (7.78)	19.85 (7.12)	21.12 (5.73)	21.38 (7.02)	23.19 (5.76)	24.50 (1.22)	23.33 (7.62)	20.79 (6.44)	19.46 (6.06)	16.33 (7.54)	21.77 (7.18)	22.57 (6.88)	17.78 (6.70)	21.20 (6.81)	20.04 (6.21)	19.67 (9.83)	14.67 (9.14)
Total score of behavioral	14.67	15.47	14.60	14.94	14.00	15.09	14.15	15.67	15.15	16.35	17.67	18.44	15.00	14.63	12.20	15.69	15.57	13.30	14.20	15.12	13.83	11.33

	(5.14)	(5.44)	(5.38)	(4.53)	(6.88)	(5.52)	(5.40)	(4.20)	(5.06)	(3.98)	(3.78)	(6.19)	(5.45)	(4.07)	(5.24)	(5.38)	(4.64)	(4.48)	(5.13)	(4.59)	(7.41)	(6.41)
Total score of affective	19.25	20.74	17.00	17.28	18.00	19.18	17.77	20.33	17.62	21.23	18.00	18.78	13.14	13.13	11.93	16.31	16.29	13.39	14.93	15.28	13.50	10.33
	(7.61)	(7.55)	(6.80)	(6.32)	(9.80)	(7.92)	(6.85)	(7.03)	(7.68)	(8.62)	(5.25)	(9.86)	(5.02)	(4.05)	(5.35)	(6.10)	(5.54)	(5.14)	(6.51)	(4.86)	(7.01)	(6.62)

Table 12. Results of the interaction of regions, sexes, and age groups of non-parametric ANOVA.

	Regions		**Age*Regions**		**Sexes*Regions**		**Age*Sexes*Regions**	
	F	p	F	p	F	p	F	p
I prefer to do outdoor physical activity	1.65	0.20	2.06	<0.05	2.84	<0.05	2.26	<0.05
Green space in cities is important	3.85	0.05	1.57	0.10	2.36	0.07	2.67	<0.05
Nature parks improve quality of life	6.43	<0.05	1.98	<0.05	4.85	<0.05	3.12	<0.05
Contact with nature is important for well-being	6.70	<0.05	1.33	0.20	3.42	<0.05	2.51	<0.05
It is important to have convenient nature parks in cities	8.50	<0.05	1.47	0.14	3.53	<0.05	2.50	<0.05
Nature parks are boring	0.01	0.91	2.25	<0.05	0.20	0.89	1.39	0.12
Humans have the right to modify nature to suit our needs	1.55	0.21	1.15	0.32	1.29	0.28	0.94	0.55
The time spent in an urban nature park relaxes you	6.36	<0.05	1.16	0.31	2.71	<0.05	1.77	<0.05
Tax dollars should be spent on nature parks	7.29	<0.05	1.73	0.06	3.24	<0.05	2.78	<0.05
Nature parks in the cities provide valuable contact with nature	9.88	<0.05	2.16	<0.05	3.73	<0.05	1.83	<0.05
I expect to feel refreshed after visiting a nature park	6.36	<0.05	1.16	0.31	2.72	<0.05	1.77	<0.05
I enjoy talking with neighbors at the local nature park	4.29	<0.05	1.74	0.06	2.31	0.07	2.10	<0.05
I learn about local environmental issue from friends/family	6.10	<0.05	2.01	<0.05	2.41	0.06	1.31	<0.05
I like the structure of the park I use	27.04	<0.05	4.57	<0.05	9.27	<0.05	3.22	<0.05
I can count on family and friends for help	3.65	0.06	1.45	0.15	4.23	<0.05	2.12	<0.05
Total score of cognitive	5.98	<0.05	1.75	0.06	3.60	<0.05	2.80	<0.05
Total score of behavioral	9.25	<0.05	1.56	0.11	3.10	<0.05	1.83	<0.05
Total score of affective	15.82	<0.05	3.28	<0.05	5.30	<0.05	2.73	<0.05

Note. * = interaction between the variables, F = test F, *p* = *p*-value.

With regard to the differences between regions, significant differences were found in 13 items (Table 12). Participants from Emilia-Romagna generally presented higher scores than those from Veneto. Numerous significant interactions were observed between regions and sexes: in

general, men from Veneto had the lowest values while women from Emilia-Romagna had the highest. Considering regions and age groups, the highest values of the scores were observed in the oldest participants from Emilia-Romagna (61–70 years and over 70 years); the lowest scores were observed in the youngest participants from Veneto (18–30 years and 31–40 years). Regarding the interaction between the three factors (sexes, age groups, and regions), the men from Veneto aged 31–40 years generally showed the lowest scores in nearly all the considered items. In particular, men from Veneto aged 31–40 showed significant differences in comparison with their peers in the items "Contact with nature is important to well-being" and "Tax dollars should be spent on nature parks". In addition, they presented significant differences with the older women from Emilia-Romagna (61–70 years and over 70 years) in the items "Green space in cities is important", "I expect to feel refreshed after visiting a nature park", "I like the structure of the park I use" and the total score of the cognitive and affective components.

Multiple regression models were carried out to quantify the relationship between the dependent variable (the total score of the three components) and the explanatory variables (demographic characteristics). The results of the multiple regressions divided for the three different components are shown in Tables 12–14. The analysis was carried out first on the entire sample and then separately for Emilia-Romagna and Veneto.

Table 13 shows the results for the cognitive component. The total model explained 27% of the variance. The results revealed that age group 18–30 years (regression coefficient, $\beta = -0.20$, $p < 0.05$), profession (employee $\beta = -0.20$, $p < 0.005$, managing director $\beta = -0.20$, $p < 0.05$, health care professional $\beta = -0.21$, $p < 0.05$) and do not use the park ($\beta = -0.22$, $p < 0.05$) were negative predictors of the total score of the cognitive component. For Emilia-Romagna, the model explained 44% of the variance and the results were similar to the total model. Age

group 18–30 years (β = −0.43, p < 0.05), profession (employee β = −0.35, p < 0.05, managing director β = −0.25, p < 0.05) and do not use the park (β =−0.23, p < 0.05) demonstrated a negative relationship with the total score of the cognitive component.

Instead, a bachelor's degree (β = 2.67, p < 0.05) and the profession of engineer (β = 0.18, p < 0.05) were positive predictors of this component. For Veneto, the model explained 45% of the variance. The results revealed that profession (health care profession β = −0.33, p < 0.05) and do not use the park (β = −0.35, p < 0.05) were negative predictors of the cognitive component.

6.3.2.2. Multiple Regression

Table 14 shows the result of the multiple regression for the behavioral component. The total model explained 23% of the variance. The results showed that a bachelor's degree (β = 0.23, p < 0.05) was a positive predictor of the behavioral component, while professions (employee β = −0.08, p < 0.05, health care profession β = −0.14, p < 0.05) was a negative predictor. For Emilia-Romagna, the model explained 38% of the variance. The results revealed that a bachelor's degree (β = 0.44, p < 0.05), the profession of lawyer (β = 0.24, p < 0.05), and living more than 300 m from the park (β = 0.21, p < 0.05) were positive predictors of the behavioral component. Moreover, the profession of employee (β = −0.35, p < 0.05) was a negative predictor of the behavioral component. For Veneto, the model explained 48% of the variance: being a healthcare professional (β = −0.44, p < 0.05) and not using the park (β = −0.36, p < 0.05) demonstrated a negative relationship with the behavioral component.

Table 14**.** Multiple regression model for the cognitive component.

	Total model			Emilia-Romagna			Veneto		
	β	T	P	β	T	p	β	T	p
Age									
18-30	-0.24	-2.11	<0.05	-0.43	-3.20	<0.05	0.00	0.00	0.99
31-40	-0.08	-1.01	0.31	0.25	0.20	0.84	-0.28	-1.52	0.13
41-50	0.00	-0.81	0.42	-0.04	-0.49	0.63	-0.03	-0.12	0.91
51-60	-0.02	-0.04	0.97	-0.14	-1.43	0.16	-0.07	-0.34	0.73
61-70	0.10	1.11	0.27	0.14	1.23	0.22	0.02	-0.10	0.91
Over 70	0.15	1.90	0.06	0.14	1.17	0.09			
Sexes									
Male	-0.04	-0.56	0.58	-1.29	-1.49	0.14	-0.09	-0.61	0.54
Marital status									
Single	-0.09	-1.04	0.30	-0.10	-1.14	0.26	-0.11	-0.80	0.43
Engaged	0.14	1.50	0.14	0.05	0.43	0.66	-0.03	-0.17	0.86
Cohabiting	0.01	0.09	0.93	-0.05	-0.52	0.61	0.15	1.06	0.30
Married	0.07	0.74	0.46	0.11	1.12	0.26	0.22	1.25	0.22
Education level									
Below high school	-0.04	-0.46	0.64	-0.14	-0.89	0.38	0.10	0.44	0.66
High school	-0.03	-0.30	0.77	0.06	0.56	0.57	-0.32	-1.49	0.14
Bachelor's degree	0.15	1.53	0.13	0.31	2.67	<0.05	0.03	0.13	0.90
Master's degree	-0.05	-0.60	0.55	-0.06	-0.77	0.44	-0.25	-1.30	0.20
Doctorate	0.00	-0.04	0.97	-0.05	-0.34	0.73			
Profession									
Freelance	0.02	0.34	0.74	-0.04	-0.38	0.70	0.15	1.16	0.25
Sport employee	0.01	0.12	0.90	-0.02	-0.17	0.86	0.09	0.67	0.50
Employee	-0.20	-2.46	<0.05	-0.35	-3.50	<0.05	-0.03	-0.25	0.80
Engineer	0.08	1.08	0.28	0.18	2.07	<0.05	0.02	0.09	0.92
Managing director	-0.20	-2.23	<0.05	-0.25	-2.20	<0.05	-0.15	-0.89	0.38
Teacher	0.02	0.20	0.84	0.02	0.26	0.80	0.05	0.31	0.76
Doctor	-0.01	-0.18	0.86	0.02	0.30	0.76	-0.25	1.38	0.17
Retired	0.11	-0.93	0.35	-0.20	-1.37	0.17	-0.14	-0.47	0.63
Consultant	-0.04	-0.53	0.60	0.10	0.85	0.40	-0.02	0.53	0.60
Business owner	-0.09	-1.18	0.24	0.11	1.29	0.20	-0.20	-1.41	0.16
Unemployed	-0.04	-0.51	0.61	0.06	0.63	0.53	-0.22	-1.43	0.16
Worker	-0.01	-0.11	0.91	-0.13	-1.37	0.17	0.12	0.70	0.48
Lawyer	0.09	1.22	0.23	0.07	0.73	0.46	0.07	0.38	0.70
Health care professional	-0.21	-2.63	<0.05				-0.33	-2.02	<0.05
Park distance									
Less than 300m	-0.03	-0.45	0.65	0.10	1.19	0.24	-0.69	-0.47	0.63
Park use									
No	-0.22	-2.98	<0.05	-0.23	-2.43	<0.05	-0.36	-2.36	<0.05
R^2	0.27			0.44			0.45		
Adjusted R^2	0.05			0.22			0.02		
p	0.16			<0.05			0.43		

Note. β = regression coefficient, T = t-student, p = p-value, R2 = proportion of variance explained

Table 15 shows the results of the multiple regression for the affective component. The total model explained 32% of the variance. Belonging to the age group 18–31 years ($\beta = -0.37$, $p < 0.05$) and being an employee ($\beta = -0.28$, $p < 0.05$) showed a negative relation with the affective component. For Emilia-Romagna, the model explained 35% of the variance. Similar to the

general model, the results showed that age group 18–31 years (β = −0.44, p< 0.05), and the profession of employee (β = −0.33, p < 0.05) were negative predictors of the affective component. However, having a bachelor's degree (β = 0.20, p < 0.05), being a consultant (β = 0.18, p < 0.05) and living nearer than 300 m to a park (β = 0.05, p < 0.05) showed a positive relation with this component. In Veneto, the model explained 46% of the variance, and the profession of health care professionals (β = −0.39, p < 0.05) showed a negative relationship with the affective component.

Table 15**.** Multiple regression for the behavioral component.

	Total model			Emilia-Romagna			Veneto		
	β	T	p	B	T	p	β	T	p
Age									
18-30	-0.13	-1.79	0.07	-0.25	-1.78	0.08	-0.18	-0.83	0.41
31-40	-0.15	-1.47	0.14	-0.11	-0.99	0.32	-0.27	-1.50	0.14
41-50	-0.10	0.15	0.88	0.13	1.25	0.22	-0.13	-0.66	0.51
51-60	-0.03	0.17	0.87	-0.12	-1.02	0.31	-0.05	-0.25	0.80
61-70	-0.03	-0.07	0.94	-0.04	-0.37	0.71	0.05	0.33	0.73
Over 70	0.11	1.13	0.26	0.18	1.80	0.08			
Sexes									
Male	-0.02	-0.73	0.47	-0.02	-0.32	0.74	-0.13	-0.90	0.38
Marital status									
Single	-0.10	-1.50	0.14	0.10	-1.90	0.06	-0.12	-0.86	0.40
Engaged	0.02	0.66	0.51	0.13	1.14	0.26	-0.11	-0.65	0.52
Cohabiting	-0.10	-0.38	0.70	-0.10	-0.90	0.37	0.01	0.07	0.94
Married	0.09	0.67	0.50	0.10	0.94	0.34	0.13	0.76	0.45
Education level									
Below high school	-0.03	-1.18	0.24	-0.16	-1.34	0.18	0.14	0.65	0.52
High school	0.07	0.53	0.59	0.18	1.68	0.10	-0.12	-0.59	0.56
Bachelor's degree	0.23	2.87	<0.05	0.44	3.37	<0.05	0.25	1.17	0.24
Master's degree	0.01	-0.22	0.82	-0.19	-1.62	0.11	-0.08	-0.44	0.66
Doctorate	-0.05	-0.56	0.58	-0.14	-0.90	0.37			
Profession									
Freelance	-0.04	-0.48	0.63	-0.18	-1.77	0.08	0.12	0.91	0.37
Sport employee	0.11	1.07	0.29	0.60	0.58	0.57	0.17	1.22	0.23
Employee	-0.08	-2.05	<0.05	-0.23	-2.37	<0.05	-0.09	-0.71	0.48
Engineer	0.02	1.05	0.29	0.08	0.88	0.38	0.12	0.71	0.48
Managing director	-0.15	-1.90	0.06	-0.13	-1.12	0.27	-0.23	-1.35	0.18
Teacher	0.07	0.71	0.48	0.05	0.50	0.62	0.09	0.67	0.51
Doctor	-0.01	-0.23	0.82	0.03	0.43	0.67	-0.03	-0.16	0.87
Retired	0.03	-0.27	0.82	0.00	-0.01	0.99	-0.37	-1.24	0.22
Consultant	-0.10	-1.00	0.32	0.06	0.50	0.62	-0.12	1.05	0.30
Business owner	-0.02	-0.95	0.34	0.08	0.92	0.36	-0.16	-1.18	0.24
Unemployed	-0.03	-0.27	0.78	0.06	0.60	0.55	-0.22	-1.48	0.15
Worker	-0.06	-0.77	0.44	-0.13	-1.39	0.17	-0.05	-0.30	0.77
Lawyer	0.14	1.76	0.08	0.24	2.32	<0.05	0.08	0.48	0.63
Health care professional	-0.14	-2.38	<0.05				-0.44	-2.70	<0.05
Park distance									
Less than 300m	0.03	0.46	0.65	0.21	2.31	<0.05	-0.16	-1.09	0.28
Park use									
No	-0.07	-1.41	0.16	0.04	0.21	0.83	-0.36	-2.41	<0.05

R^2	0.23	0.38	0.48
Adjusted R^2	0.03	0.13	0.06
p	0.25	<0.05	0.33

Note. β = regression coefficient, T = t-student, p = p-value, R2 = proportion of variance explained

6.4 Discussion

The goals of this exploratory study were to develop a questionnaire to evaluate the attitude towards green space and to assess any differences between participants from two Italian regions: Emilia-Romagna and Veneto. To accomplish this goal, additional factors were considered. The questionnaire was developed to better understand what drives people to use green urban spaces and parks through the assessment of the attitude toward such spaces. The questionnaire consisted of fifteen items that investigated three components (cognitive, behavioral, and affective) to gain a clear idea of what mostly influenced the attitude. The questionnaire was validated and seems to be an interesting tool to use in further investigation.

The two considered regions (Emilia-Romagna and Veneto) are both in the north of Italy and they are bordering each other and are similar in population characteristics and socio-economic status; however, they have different territorial policies. In fact, in Emilia- Romagna, a project was approved in 2020 to increase green areas in cities by 20%, while in Veneto there are no such projects [267]. In 2021, Emilia-Romagna allocated several million for parks and biodiversity agencies and for projects protecting and enhancing the natural environment across the whole regional territory[260], eight areas of Emilia-Romagna were chosen by the Europarc Federation to participate in the “European charter for sustainable tourism” with the goal of developing environmental tourism [260,262]. In Bologna, there are different projects and events to promote green space. In fact, since 2005 the municipality has celebrated “Arbor Day”, where trees are planted in different parts of the city and since 2010 they created the project “The Moving Park project”, where citizens had the possibility to experience various

kinds of outdoor physical activity [263]. From 2011 onwards, senior citizens have had the possibility to participate in Bologna at the project “Badabene alla salute”, to be physically active towards walking groups in public parks. Similar projects were carried out in the other provinces of Emilia-Romagna, while Veneto has had only projects linked to the local municipalities (such as Padua or Verona) [265,266]. Higher scores in attitude towards green urban spaces could be a demonstration of the efficacy of the territorial policies in Emilia-Romagna.

We considered two other important demographic factors: sex and age. In the present study, women joined the project in a greater number than men. This is in accordance with the study by Smith et al. in which it was observed that women are more likely to have a greater willingness to participate in online surveys than me, and with the studies by Gascon et al. as well as van Praag et al. and Pattyn et al. which found that women have a greater sensibility toward the neighborhood environment [13,268–270]. The results showed a different trend for women in Emilia-Romagna and Veneto. In fact, females from Emilia-Romagna had higher scores than females in Veneto. These differences could be interpreted considering the different territorial policies implemented in the two regions.

Age was found to be one of the main factors influencing attitude. In fact, the subjects of the age group 18–31 years had the lowest score in many items and showed significant differences with the participants of older age groups; in addition, belonging to this age group was a negative predictor in the multiple regression analysis. This is in line with previous studies that showed that parks were generally underutilized by young people [271,272]. Young people tend to spend most of their leisure time on the Internet, rather than engaging in outdoor activities [253]. According to other studies, residents aged 20–30 are less likely to visit parks in their daily life because they prefer to pursue more active and exciting activities, or because

they have less leisure time due to work and study commitments [273–275]. Moreover, according to Chen et al., it is possible that young people could think that green urban spaces are occupied/frequented by older people and children and for this reason, they may not be attracted to using the park [276]. A nationwide study in Denmark suggested that 91.5% of the adult population used green spaces at least once a week [264]. In Northern Europe, there are many green spaces containing more physically challenging facilities that could encourage young people to use them and to have a better attitude towards green spaces [277].

Several studies have highlighted the importance of the distance between home and the nearest park in influencing the attitude toward green spaces [21,184,278–280]. In this study, however, this aspect does not appear to be such an important factor in influencing attitudes. In fact, the difference in the item scores between participants who lived nearer than 300 m to the park and those who lived farther than 300 m was not significant. Moreover, no significant correlation was found between the use of the park and the creation of an attitude; therefore, it seems that although people may understand the importance of green urban spaces, this may not be enough to drive them to use the park. Several studies have suggested that urbanization entails a lower level of attitude towards green spaces, resulting from a decrease in the level of interaction with nature and lower expectations of the quality of nature [281–283].

The cognitive component had a higher score than the other components, while the affective component demonstrated a weaker relationship with park attitude. This is in accordance with Wright et al. and Baur et al. who reported that the cognitive factor had a large statistically significant path coefficient to the creation of attitudes [284,285]. It is possible, therefore, to affirm that in the present study, the cognitive component had a greater influence on the creation of an attitude toward green space. This leads one to suppose that attitude has a

positive association with the logical, reasoned, conscious, and purpose full evaluation of parks and their characteristics and utilization. The multiple regression analysis highlighted an important relationship between the different components and the professions. In particular, being an employee proved negatively related to the three components of the questionnaire, both in the total model and in the Emilia-Romagna model; this could be due to the high number of hours spent at work or less leisure time available compared to other professions. To our knowledge, no other studies have included the profession of participants, and this could be an important factor to consider in future research.

Limits and Strengths

The questionnaire was administered throughout the whole of the regional territory, without taking into account the possible differences between the various provinces and places of living, for example, urban or more rural areas, and this could represent a limitation to the study. In addition, as an exploratory survey, the number of people involved was limited. Moreover, only two regions were included in the research, as a pilot study. Both regions are in the north of Italy and have similar socio-demographic characteristics. Given the lack of adequate instruments to assess people's attitude toward green space, the proposed questionnaire could represent an important new tool to better understand the factors that influence the person's decision to use green urban spaces or parks. This could help local governments and organizations plan strategies to improve the population's health. To the best of our knowledge, there are no similar surveys or research in Italy, and the present study could be an important starting point for future research. The evaluation and comparison among citizens from regions other than those considered here could provide a more complete framework of the territorial differences, linked to geographic position or territorial policy.

7. Study 4: Restoration in mental health after visiting urban green spaces, who is most affected? Comparison between good/poor mental health in four European cities

The present study has been accepted in Environmental Research

Grigoletto A., Toselli S., Zijlema W., Marquez S., Triguero-Mas M., Gidlow C., Grazuleviciene R., Van de Berg M., Kruize H., Maas J., Nieuwenhuijsen M.J.

Keywords: activity, green space, mental health, restoration theory

Overview

The aims of the present study were to understand what activities are most related to restoration and if these are the same for people with poorer and better mental health. A questionnaire was administered in four European cities and data about restoration outcomes, type of activity carried out in green spaces and mental health was collected and analyzed. The cities showed a similar trend in the association between restoration and the type of activity performed a in green environment. People with poorer mental health seem to be more sensitive to the positive effect of visiting the green environment and restoration was more evident in these people than in those with better mental health. At the same time, the type of activity was less evident in people with better mental health, and they seemed to be less influenced by the visiting of green space.

7.1 Introduction

There is increasing interest in the use of green spaces and in their connection with human health. In this study, we decided to focus on restoration theory. Attention Restoration Theory has been proposed to explain the mental health benefits of exposure to the natural environment. This theory is based on the idea that it is possible to improve mental health by counteracting stress and increasing the ability to focus and concentrate. Emerging evidence around improvements in the cardiovascular and respiratory systems is promising and provides some basis for observations linking better health with time spent in nature. The type and quality of the environment has been linked to the degree of connection with nature and the psychological effects on individuals [286]. The restoration outcomes score (ROS) was developed based on Attention Restoration Theory by Korpela & Ylén to measure restoration outcome in adults after exposure to nature [287–289]. ROS is based on the theory that the exposure to nature helps individuals relax, increases physical activity, eliminates unwanted thoughts, and improves attention and vitality [286]. The ROS comprises items that cover relaxation and calmness, attention restoration, clearing one's thoughts, subjective vitality, and self-confidence.

The aims of the present study were to answer the following questions:

a) Which activities carried out in green space are most related to restoration?

b) Are these activities the same for people with poor and good mental health?

Since different activities may have direct effects on emotional states, it is possible that one or more of them will have a greater impact on restoration. Data analysis was gathered as part of the Positive Health Effects of the Natural Outdoor Environment in Typical Populations in different Regions in Europe (PHENOTYPE) project that aimed to investigate the influence of

the natural outdoor environment on human health and well-being [290]. The questionnaire, to calculate the restoration, was collected from a large sample of adults in four European cities using a large comparable approach.

7.2 Methods

7.2.1 Study design

A cross-sectional design was used. An extensive description of the study design can be found in Nieuwenhuijsen et al. This study was based on adults who participated in the PHENOTYPE project. Data were collected in four European cities: Barcelona (Spain), Doetinchem (the Netherlands), Kaunas (Lithuania), and Stoke-on-Trent (the United Kingdom) [290]. The four cities offer diverse study areas in terms of size, population density, climate, and land cover [291]. Barcelona, the largest city (1.6 million inhabitants) is a densely built city (population density 16000 inhabitants/km^2) and has a Mediterranean climate. Doetinchem, the smallest city, (56000 inhabitants) has a much lower population density (706 inhabitants/km^2) and has a moderate maritime climate. Kaunas (319000 inhabitants) has a humid continental climate and a population density of 2046 inhabitants/km^2. Stoke-on-Trent (363000 inhabitants) has a population density of 1194 inhabitants/km^2 and a moderate maritime climate. Greenness and access to the natural environment vary per city. In general, Doetinchem is the greenest city with the best natural environment access, and Barcelona is the least green city with poorest natural environment access [290]. Survey data were collected from residents of 30 neighborhoods per city. These neighborhoods were selected based on their variability in socioeconomic status and their access to the natural environment. A random sample of 30-35 adults (age range 18-75 years) in each neighborhood was invited to participate in the survey. Response rates were 46.9% in Barcelona, 8.4% in Doetinchem, 21.3% in Kaunas, and 36.9% in

Stoke-on-Trent. The final sample contained approximately 1000 respondents per city. Data were collected by means of a face-to-face questionnaire administered at respondents' residences during May-November 2013. In Kaunas (Lithuania), data were collected using a postal questionnaire. The study was conducted in accordance with the Declaration of Helsinki. Ethical approvals were obtained from the relevant bodies of each institution and all respondents provided written informed consent before taking part.

7.2.2 Collection of study population data

A face-to-face questionnaire survey was used to collect the study population data. Most questions were derived from existing and validated indices and others were tailored to the specific objectives of the PHENOTYPE study. The survey was developed in English and then translated into Dutch, Spanish, and Lithuanian. The questionnaire was developed as an oral interview of 30-60 minutes. All the questions used in the present analysis referred to the green space most used and visited by the participants, identified by asking participants to "please list the name, location and approximate distance from your home of the green/blue environment that you visit or use most often".

7.2.3 Restorative outcomes score

Restorative experiences were measured with ROS [287]. The scale includes nine items. According to previous measures and findings on restorative outcomes [288,289], three items reflect attention restoration ('I feel calmer', 'I feel restored and relaxed', 'I get new enthusiasm and energy for my everyday routines'), one item reflects attention restoration ('My concentration and alertness clearly increase'), two items reflect clearing one's thoughts ('I forget everyday worries', 'My thoughts are cleared and clarified'), other two items reflect subjective vitality ('I gain vitality', 'I get trust for each new day') and the last one item reflected

self-confidence ('My self-confidence improves'). The response scale included not at all, a little, somewhat, much, and very much.

7.2.4 Type of activity

The type of activities and the frequency with which they were carried out were used as independent variables. The question, which referred to the most often visited green space, was: "How often do you use the natural environment you visit most often for the following activities?" The activities proposed were: "walking, cycling or doing sport", "picnic", "meeting family or friends", "walk or play with children", "experiencing tranquility" and "personal relaxation". For every activity, the frequency indicators included never, seldom, sometimes, often, and very often.

7.2.5 Mental health

Mental health was used as a possible modifier in the relationship between restoration and the type of activity. This variable was assessed with the Medical Outcome Study Short Form (SF-36) mental health subscale [292,293]. The SF-36 mental health subscale is a validated and widely used questionnaire to assess mental well-being. In the present study, we used the subscale of mental health, which is composed of five questions about how the respondent felt in the last four weeks. The questions are: Have you been a very nervous person? Have you felt so down in the dumps nothing could cheer you up? Have you felt calm and peaceful? Have you felt downhearted and blue? Have you been a happy person? The possible answers were six: all of the time, most of the time, a good part of the time, some of the time, a little of the time, and none of the time. A sum score was calculated by summing all items together. If two out of five items were missing, these missing values were replaced by the average of other items. If more than two items were missing, no sum score was calculated. Then, summed

scores were transformed into a scale from 0 to 100, according to guidelines [294,295]. Higher scores reflect better mental health. The subscale has been shown to be a reliable and valid measure of mental health [294]. Finally, the median of the combined sample was considered as a discriminant for dividing people of the entire sample with poorer and better mental health.

7.2.6 Covariates

Based on previous literature, some a priori covariates were selected: gender [296–298], age [296–298], education completed [296–298], marital status, living with children [292], and neighborhood socioeconomic status (SES). In addition, the appeal of the place, the length of stay, and the frequency of the visits to the environment that participants visit or use most often (the frequency indicators were seldom or never, once per month, 2/3 time a month, once per week, 2/3 time per week, every day) were also considered as covariates.

7.2.7 Statistical analysis

Descriptive statistics were used to characterize the study population and are shown for the pooled sample and by city. Depending on the type of variables, the one-way ANOVA, chi-squared test, and the Kruskall-Wallis test were performed to see the difference in variance by the city of residence. The aims of the present study were double: understand which activities carried out in green space are most related to restoration and understand if these activities are the same for people with 'poorer and better mental health'. So, to investigate these associations a multiple regression analysis was performed. The multiple regression was performed twice. The first time the entire population was considered together, then, the model was adjusted for the covariates described previously, and finally, the population was stratified by mental health. As the PHENOTYPE study was designed to include cities with

regional, social, and cultural differences, also the city-specific multilevel was analyzed. Analyses were based on a part of the complete cases. The total sample was 3599, but our sample was 3134 because we chose to exclude people that did not answer all the questions about the kind of activity done in the green urban space or they did not indicate if they had a most visited place. All the analyses were performed in STATA 14.2 (StataCorp, 2015).

7.3 Results

7.3.1 Population characteristics

Table 16 shows the sociodemographic characteristics of the combined sample and each city. The sample consisted of 3134 respondents from the four cities (Barcelona n=848, Doetinchem n=833, Kaunas n=739, Stoke-on-Trent n=714). Respondents had a mean age of 51.67 (SD 15.81), but it differed among the cities. In all the cities, the percentage of women was higher than the percentage of men. Stoke-on-Trent represented an exception because women and men were equally represented (357 women and 357 men).

Table 16. Description of the sociodemographic characteristics of the participants in a cross-sectional sample of 3134 adults in four European cities and divided by the four cities.

	Combined sample	Barcelona	Doetinchem	Kaunas	Stoke-on-Trent	P value
N	3134	848	833	739	714	
Age (years: mean±DS)	51.67±15.81	44.44±15.61	56.21±12.15	60.93±12.89	45.18±15.76	<0.001
Gender						<0.001
Male N (%)	1406(44.86)	399(47.05)	360(43.22)	290(39.24)	357 (50.00)	
Female N (%)	1728(55.14)	449(52.95)	473(56.78)	449(60.76)	357 (50.00)	
Missing N	*0*	*0*	*0*	*0*	*0*	
Education level						<0.001
Low N (%)	174(5.58)	118(13.96)	8(0.96)	12(1.62)	36 (5.14)	
Medium N (%)	1354(43.44)	327(38.70)	394(47.36	195(26.39)	438(62.48)	
High N (%)	1589(50.98)	400(47.34)	430(51.68)	532(71.99)	227(32.38)	
Missing N	*17*	*3*	*1*	*0*	*13*	

Income						<0.001
Low N (%)	959(30.60)	300(35.38)	262(31.45)	180(24.36)	217(30.39)	
Medium N (%)	1192(38.03)	277(32.67)	326(39.14)	348(47.09)	241(33.75)	
High N (%)	983(31.37)	271(31.96)	245(29.41)	211(28.55)	256(35.85)	
Missing N	*0*	*0*	*0*	*0*	*0*	
Money situation						<0.001
Cannot make ends meet N (%)	306(10.39)	100(12.30)	141(17.11)	31(4.69)	34(5.26)	
Have enough to get along N (%)	1431(48.59)	417(51.29)	254(30.83)	478(72.31)	282(43.59)	
Comfortable N (%)	1208(41.02)	296(36.41)	429(52.06)	152(23.00)	331(51.16)	
Missing N	*189*	*35*	*9*	*78*	*67*	
Family composition						<0.001
Alone N (%)	507(16.24)	58(6.87)	189(22.69)	131(17.77)	129(18.22)	
With partner without children N (%)	1081(34.63)	202(23.93)	379(45.50)	291(39.48)	209(29.52)	
With children younger than 12 years N (%)	507(16.24)	172(20.38)	125(15.01)	37(5.02)	173(24.44)	
With children older than 12 years N (%)	515(16.50)	109(12.91)	126(15.13)	161(21.85)	119(16.81)	
Other N (%)	512(16.40)	303(35.90)	14(1.68)	117(15.88)	78(11.02)	
Missing N	*12*	*4*	*0*	*2*	*6*	
Marital status						<0.001
Married/registered together N (%)	2022(64.93)	536(63.81)	544(65.38)	497(67.25)	445(63.30)	
Living apart together N (%)	151(4.85)	18(2.14)	71(8.53)	25(3.38)	37(5.26)	
Divorced/separated N (%)	941(30.22)	286(34.05)	217(26.08)	217(29.36)	221(31.44)	
Missing N	*20*	*8*	*1*	*0*	*11*	

P-value refers to one-way ANOVA for the age variable and refers to the chi-squared test for the other variables.

The participants of the different cities showed remarkable differences in each socio-demographic characteristics considered (p-value <0.001). The majority of the participants had a high education level (50.98% in the combined sample) and the results were similar among the cities, except for Stoke-on-Trent, in which 62.48% of participants had a medium education level. People from Doetinchem and Stoke-on-Trent had the better financial situation: 52.78% in Doetinchem and 51.16% in Stoke-on-Trent said that they were “comfortable”. Instead, in Kaunas, only 23% were “comfortable”, but at the same time Kaunas showed the lowest percentage of people that “cannot make ends meet” (4.69%). Due to these differences, subsequent analyses were always carried out for the combined sample and then separately

for each city.

7.3.2 Covariates and type of activity

Table 17 shows the descriptive characteristics of the covariates and of the type of activities. The Chi-squared test showed statistically significant differences between the cities in all the covariates and type of activities.

Table 17. Descriptive characteristics in a cross-sectional sample of 3134 adults in four European cities and divided by the four cities for the functionality of the place, the length of stay, the frequency of the visits, and the kind of activity. People were asked to think and answer questions about the green space they most used and visited.

	Combined sample	Barcelona	Doetinchem	Kaunas	Stoke-on-Trent	P value
N	3134	848	833	739	714	
Quality of the place	32.02±4.92	30.79±5.46	33.91±4.01	30.90±4.97	32.50±4.35	<0.001
Missing N	*46*	*7*	*25*	*0*	*14*	
Functionality of the place	12.07±2.04	11.91±2.26	12.55±1.82	11.84±2.04	11.99±1.94	<0.001
Missing N	*45*	*8*	*20*	*0*	*17*	
Length of stay						<0.001
Less than 10 minutes N (%)	83(2.65)	29(3.42)	28(3.36)	9(1.22)	17(2.39)	
11 to 30 minutes N (%)	356(11.37)	83(9.80)	136(16.33)	58(7.85)	79(11.10)	
30 minutes to 1 hour N (%)	816(26.06)	194(22.90)	267(32.05)	173(23.41)	182(25.56)	
1 to 2 hours N (%)	1216(38.84)	372(43.92)	294(35.29)	232(31.39)	318(44.66)	
2 hours or more N (%)	660(21.08)	169(19.95)	108(12.97)	267(36.13)	116(16.29)	
Missing N	*3*	*1*	*0*	*0*	*2*	
Frequency of visits						<0.001
Seldom or never N (%)	19(0.61)	-	-	19(2.57)	-	
Once per month N (%)	334(10.68)	82(9.70)	89(10.68)	73(9.88)	90(12.68)	
2-3 time a month N (%)	611(19.54)	148(17.51)	172(20.65)	149(20.16)	142(20.00)	
Once per week N (%)	569(18.20)	156(18.46)	145(17.41)	150(20.30)	118(16.62)	
2-3 time per week N (%)	900(28.78)	239(28.28)	242(29.05)	200(27.06)	219(30.85)	

Every day N (%)	694(22.19)	220(26.04)	185(22.21)	148(20.03)	141(19.86)	
Missing N (%)	7	3	0	0	4	
Sport						<0.001
Never N (%)	252(8.04)	120(14.15)	11(1.32)	39(5.28)	82(11.48)	
Seldom N (%)	183(5.84)	51(6.01)	15(1.80)	73(9.88)	44(6.16)	
Sometimes N (%)	604(19.27)	143(16.86)	57(6.84)	212(28.69)	192(26.89)	
Often N (%)	1203(38.39)	283(33.37)	394(47.30)	292(39.51)	234(32.77)	
Very often N (%)	892(28.46)	251(29.60)	356(42.74)	123(16.64)	162(22.69)	
Missing N	*0*	*0*	*0*	*0*	*0*	
Picnic						<0.001
Never N (%)	2002(63.88)	660(77.83)	653(78.39)	196(26.52)	493(69.05)	
Seldom N (%)	443(14.14)	89(10.50)	94(11.28)	176(23.82)	84(11.76)	
Sometimes N (%)	451(14.39)	67(7.90)	56(6.73)	231(31.26)	84(11.76)	
Often N (%)	165(5.23)	18(2.12)	19(2.28)	95(12.86)	33(4.62)	
Very often N (%)	73(2.33)	14(1.65)	11(1.32)	41(5.55)	7(0.98)	
Missing N	*0*	*0*	*0*	*0*	*0*	
Meet family/friends						<0.001
Never N (%)	1059(33.79)	230(27.12)	435(52.22)	81(10.96)	313(43.84)	
Seldom N (%)	474(15.12)	89(10.50)	128(15.37)	160(21.65)	97(13.59)	
Sometimes N (%)	870(27.76)	219(25.83)	148(17.77)	301(40.73)	202(28.29)	
Often N (%)	520(16.59)	210(24.76)	94(11.28)	137(18.54)	79(11.06)	
Very often N (%)	211(6.73)	100(11.79)	28(3.36)	60(8.12)	23(3.22)	
Missing N	*0*	*0*	*0*	*0*	*0*	
Walk or play with children						<0.001
Never N (%)	987(31.49)	292(34.43)	307(36.85)	140(18.94)	248(34.73)	
Seldom N (%)	343(10.94)	84(9.91)	93(11.16)	118(15.97)	48(6.72)	
Sometimes N (%)	729(23.26)	145(17.10)	162(19.45)	243(32.88)	179(25.07)	
Often N (%)	687(21.92)	190(22.41)	167(20.05)	171(23.14)	159(22.27)	
Very often N (%)	388(12.38)	137(16.16)	104(12.48)	67(9.07)	80(11.20)	
Missing N	*0*	*0*	*0*	*0*	*0*	
Tranquillity						<0.001
Never N (%)	365(11.65)	103(12.15)	52(6.24)	28(3.79)	182(25.49)	
Seldom N (%)	266(8.49)	104(12.26)	48(5.76)	50(6.77)	64(8.96)	

Sometimes N (%)	798(25.46)	207(24.41)	137(16.45)	253(34.24)	201(28.15)	
Often N (%)	1102(35.16)	279(32.90)	345(41.42)	280(37.89)	198(27.73)	
Very often N (%)	603(19.24)	155(18.28)	251(30.13)	128(17.32)	69(9.66)	
Missing N	*0*	*0*	*0*	*0*	*0*	
Personal relaxing						<0.001
Never N (%)	844(26.93)	121(14.27)	333(39.98)	81(10.96)	309(43.28)	
Seldom N (%)	442(14.10)	109(12.85)	143(17.17)	105(14.21)	85(11.90)	
Sometimes N (%)	760(24.25)	217(25.59)	132(15.85)	254(34.37)	157(21.99)	
Often N (%)	740(23.61)	246(29.01)	134(16.09)	226(30.58)	134(18.77)	
Very often N (%)	348(11.10)	155(18.28)	91(10.92)	73(9.88)	29(4.06)	
Missing N	*0*	*0*	*0*	*0*	*0*	

P-value refers to the chi-squared test.

The largest part of the participants visited the green space for one or two hours (38.84%) and two/three times per week (28.78%). It is possible to notice that no one from Barcelona, Doetinchem and Stoke-on-Trent said to visit the green urban space “seldom or never” and a very small percentage (2.65%) reported to stay in the natural environment for less than 10 minutes. The participation in the activities differed across cities.

“Sport” had the highest percentage of the answer “often” in the combined sample, and for the same answer, it achieved the 47.30% in Doetinchem. “Picnic” was the least practiced activity (63.88 % of the answer ‘never’ in the frequency indicators), in particular, this happened in Doetinchem (78.39% of the answer ‘never’ in the frequency indicators); the lowest percentage of never was (26.52) in Kaunas. Participants from Doetinchem and Stoke-on-Trent showed the lowest percentage for the answer “never” (52.22 and 43.84% respectively) for the activity “Meet family/friends”, while people from Kaunas presented the highest percentage. In the combined sample “Walk and play with children” the answer ‘never’ had the highest percentage. And regards “Tranquility”, it had a higher percentage of answers

"sometimes" for the combined sample (35.16%) than "personal relaxing" (24.25%). People from Stoke-on-Trent had a higher percentage of answers to "never" (39.98%) or the item "personal relaxing" than people from Kaunas (10.96%).

7.3.3 Restoration and mental health

Table 18 shows the median score of restoration and the median score of mental health, for the combined sample and each city separately. The Kruskall-Wallis test was performed and statistically significant differences were found both for the restoration and the mental score among the results of the cities. People from Doetinchem showed the higher statistically significant score of mental health while people from Barcelona and Kaunas had the lowest. On the contrary, respondents from Doetinchem had the lowest score of restoration (11), and those from Stoke-on-Trent had the highest (21).

Table 18. The restoration outcome score (5 lowest score, 45 highest score), calculated using the nine items included in the scale proposed by Korpela & Ylén, 2009, and the mental health score, calculate with the Medical Outcome Study Short Form (SF-36) mental health subscale (0 lowest score, 100 highest score), in a cross-sectional sample of 3134 adults in four European cities and, divided by the four cities

	Combined sample	Barcelona	Doetinchem	Kaunas	Stoke-on-Trent	P value
N	3134	848	833	739	714	
Restoration score (median, IQR)	17 [13]	18 [14]	11 [9]	18 [10]	21 [13]	<0.001
Missing N (%)	*74*	*9*	*0*	*0*	*64*	
Mental health (median, IQR)	76 [20]	72 [24]	84 [12]	72 [24]	76 [24]	<0.001
Missing N (%)	*0*	*0*	*0*	*0*	*0*	

P-value refers to the Kruskall-Wallis test

7.3.4 Relationship between restoration and the type of activity

The combined sample and city-specific samples showed different associations between the restoration and the type of activity (Table 4). In the combined sample, the activities linked to social cohesion ("picnic" and "meeting family/friends") and the reduction of stress ("tranquility" and "personal relaxing") were associated with higher restoration. In particular, "Picnic" and "meet family or friends" presented a high level of significance ($p<0.001$) for all the frequency indicators. Considering the results of the cities individually, several differences emerged.

In the Barcelona sample no statistically significant association was observed between restoration and "sport", "meet family or friends" or "walk and play with children". Indeed, significant differences were observed with "picnic" (with seldom and often), "tranquility" (from sometimes to very often), and "personal relaxing" (for all the frequency indicators).

In Doetinchem sample significant differences were observed with "sport" (for often and very often), "picnic" (for seldom and very often), "tranquility" (from sometimes to very often) and "personal relaxing" (for often and very often).

In the Kaunas sample the highest number of statistically significant associations were observed. In fact, a significance level of $p<0.05$ were observed for all the type of activities. "Picnic" showed a statistically significant association for all the frequency indicators, while "sport", "meet family or friends" and "personal relaxing" presented statistically significant associations for the three frequency indicators sometimes, often, and very often. Finally, "walk and play with children" recorded a statically significant association for two frequency indicators (sometimes and very often) and "tranquility" for only one frequency indicator (very often).

In the Stoke-on-Trent sample no statistically significant association was shown with the activity "sport" but a $p<0.05$ was observed from seldom to very often for "meet family or friends". Instead,

“tranquility” and “personal relaxing” presented statistically significant associations only for three frequency indicators (sometimes, often, and very often).

Table 19 showed the results of the multiple regression. “Never” was the comparison group.

Table 19. Association between activities in green spaces and restoration outcome score in a cross-sectional sample of 3134 adults in four European cities.

	Combined sample		Barcelona		Doetinchem		Kaunas		Stoke-on-Trent	
Type of Activity	β (95%CI)	p	β (95%CI)	p	β (95%CI)	p	β (95%CI)	p	β (95%CI)	p
Sport										
Never										
Seldom	-0.29 (-2.00, 1.42)	0.737	-1.93 (-4.89, 1.03)	0.202	3.03 (-1.17, 7.22)	0.157	1.50 (-1.76, 4.74)	0.367	0.51 (-3.22, 4.25)	0.788
Sometimes	0.60 (-0.74, 1.93)	0.380	0.93 (-1.22, 3.09)	0.395	1.25 (-1.97, 4.47)	0.445	2.99 (0.45, 5.53)	0.021	-1.29 (-3.55, 0.98)	0.265
Often	1.19 (-0.10, 2.48)	0.071	1.66 (-0.19, 3.51)	0.079	3.78 (1.03, 6.54)	0.007	3.48 (0.41, 6.56)	0.026	-0.51 (-3.09, 2.07)	0.697
Very often	2.29 (0.84, 3.74)	0.002	2.27 (-0.23,4.76)	0.079	5.09 (2.30, 7.87)	<0.001	5.77 (0.41, 6.56)	0.002	0.35 (-2.25, 2.95)	0.792
Picnic										
Never										
Seldom	1.74 (1.06, 2.41)	<0.001	1.92 (0.52, 3.01)	0.007	1.80 (0.62, 2.97)	0.003	2.06 (0.71, 3.40)	0.003	0.77 (-0.77, 2.30)	0.328
Sometimes	3.02 (2.26, 3.77)	<0.001	1.90 (-0.07, 3.87)	0.058	1.70 (-0.41, 3.81)	0.115	4.27 (3.18, 5.36)	<0.001	1.69 (0.10, 3.27)	0.037
Often	2.96 (1.96, 3.97)	<0.001	4.40 (2.24, 6.56)	<0.001	1.79 (-0.43, 3.81)	0.114	3.73 (2.05, 5.41)	<0.001	1.49 (-1.22, 4.19)	0.281
Very often	7.25 (5.16, 9.33)	<0.001	2.23 (-1.99, 6.45)	0.300	3.78 (1.42, 6.13)	0.002	11.02 (8.65, 13.39)	<0.001	5.51 (0.61, 10.41)	0.028
Meet family or friends										
Never										
Seldom	1.61 (0.78, 2.44)	<0.001	1.98 (0.04, 3.92)	0.046	1.81 (0.69, 2.93)	0.002	1.39 (-0.50, 3.28)	0.049	2.45 (0.53, 4.37)	0.012
Sometimes	1.85 (1.11, 2.59)	<0.001	1.00 (-0.63, 2.64)	0.229	1.02 (-0.10, 2.05)	0.052	3.44 (1.52, 5.37)	<0.001	1.92 (0.17, 3.68)	0.032
Often	2.61 (1.52, 3.70)	<0.001	0.91 (-1.39, 3.22)	0.438	0.87 (-0.67, 2.42)	0.268	5.44 (3.14, 7.75)	<0.001	3.50 (1.38, 5.63)	0.001
Very often	4.40 (2.77, 6.04)	<0.001	1.87 (-0.56, 4.30)	0.112	1.37 (-1.36, 4.09)	0.326	9.00 (5.57, 12.43)	<0.001	5.27 (1.09, 9.44)	0.013
Walk and play with children										
Never										
Seldom	0.47 (-0.51, 1.44)	0.348	1.56 (-0.13, 3.26)	0.081	1.02 (-0.33, 2.38)	0.140	-0.07 (-2.33, 2.19)	0.950	-1.04 (-4.20, 2.13)	0.521
Sometimes	0.75 (0.05,1.45)	0.050	0.95 (-0.22, 2.12)	0.112	1.44 (0.46, 2.43)	0.004	1.77 (0.13, 3.42)	0.034	-2.38 (-4.29, -0.47)	0.015
Often	0.70 (-0.13, 1.54)	0.100	1.31 (-0.52, 3.28)	0.160	0.42 (-0.67, 1.52)	0.450	1.64 (-0.27, 3.54)	0.092	-1.35 (-3.10, 0.40)	0.130

Very often	0.92 (-0.30, 2.13)	0.140	0.20 (-2.42, 2.81)	0.883	0.93 (-0.52, 2.38)	0.207	4.02 (1.25, 6.79)	0.004	-0.40 (-2.77, 1.98)	0.742
Tranquility										
Never										
Seldom	-0.28 (-1.53, 0.97)	0.660	0.78 (-1.26, 2.81)	0.434	0.87 (-1.46, 3.20)	0.464	-0.96 (-4.08, 2.17)	0.550	-1.49 (-4.45, 1.47)	0.324
Sometimes	2.02 (0.94, 3.09)	<0.001	2.37 (0.51, 4.23)	0.013	1.81 (0.05, 3.56)	0.044	0.79 (-2.09, 3.67)	0.591	2.39 (0.30, 4.49)	0.025
Often	3.60 (2.35, 4.85)	<0.001	5.10 (3.04, 7.15)	<0.001	4.27 (2.56, 5.98)	<0.001	1.52 (-2.15, 5.20)	0.417	3.25 (0.82, 5.68)	0.009
Very often	5.12 (3.66, 6.57)	<0.001	7.73 (4.96, 10.49)	<0.001	4.52 (2.41, 6.63)	<0.001	4.64 (1.36, 7.93)	0.006	4.54 (1.25, 7.83)	0.007
Personal relaxing										
Never										
Seldom	0.71 (-0.14, 1.55)	0.100	2.19 (0.35, 4.02)	0.019	0.19 (-1.07, 1.50)	0.764	1.56 (-0.75, 3.87)	0.185	-0.22 (-2.01, 1.58)	0.814
Sometimes	1.84 (1.13, 2.55)	<0.001	2.45 (0.90, 4.00)	0.002	0.41 (-0.52, 1.34)	0.387	3.07 (1.11, 5.03)	0.002	2.22 (0.82, 3.62)	0.002
Often	3.38 (2.58, 4.18)	<0.001	4.42 (2.52, 6.31)	<0.001	1.94 (0.91, 2.97)	<0.001	5.05 (3.01, 7.09)	<0.001	2.95 (1.30, 4.60)	<0.001
Very often	5.70 (4.49, 6.90)	<0.001	5.95 (3.68, 8.21)	<0.001	3.60 (1.97, 5.22)	<0.001	9.74 (7.10, 12.38)	<0.001	6.14 (3.24, 9.04)	<0.001

The model was adjusted by age, education, neighborhood SES, perceived income, household composition, and marital status, with random intercept at neighborhood level. B =regression coefficient; CI=confidence interval.

7.3.5 Multiple regression and stratification by mental health

Table 20 presents the results of the multiple regression performed for all the populations of the combined sample and of the four cities. In Appendix A it is possible to see the tables for the multiple regression stratified by mental health.

Table 20. Association between activities in green spaces and restoration outcome score, stratified for the mental health score, in a cross-sectional sample of 3134 adults in four European cities

	Poorer mental health ≤76		Better mental health >76	
N	1452		1316	
Type of activity	β (95%CI)	p	β (95%CI)	p
Sport				
Never				
Seldom	0.76 (-0.83, 2.35)	0.347	-1.13 (-4.29, 2.04)	0.485
Sometimes	1.32 (-0.06, 2.70)	0.060	-0.41 (-3.05, 2.24)	0.764
Often	2.25 (0.92, 3.59)	<0.001	0.46 (-2.17, 3.09)	0.733
Very often	3.90 (2.23, 5.56)	<0.001	1.15 (-1.53, 3.84)	0.400
Pic nic				
Never				
Seldom	1.54 (0.61, 2.47)	0.001	1.78 (0.75, 2.80)	<0.001
Sometimes	3.04 (2.01, 4.07)	<0.001	2.54 (1.30, 3.79)	<0.001
Often	3.31 (1.82, 4.79)	<0.001	2.47 (0.64, 4.30)	0.008
Very often	8.36 (5.22, 11.51)	<0.001	5.76 (3.53, 7.99)	<0.001
Meet family or friends				
Never				
Seldom	1.50 (0.38, 2.62)	0.009	1.29 (-0,04, 2.61)	0.057
Sometimes	1.88 (0.88, 2.88)	<0.001	1.37 (0.33, 2.41)	0.010
Often	2.87 (1.36, 4.37)	<0.001	1.84 (0.45, 3.23)	0.009
Very often	5.42 (3.22, 7.62)	<0.001	2.92 (0.88, 4.97)	0.005
Walk and play with children				
Never				
Seldom	1.74 (0.52, 2.97)	0.005	-1.11 (-2.53, 0.31)	0.126
Sometimes	1.75 (0.90, 2.61)	<0.001	-0.61 (-1.72, 0.50)	0.284
Often	1.47 (0.28, 2.67)	0.015	-0.17 (-1.27, 0.93)	0.764
Very often	2.03 (0.20, 3.85)	0.030	-0.22 (-1.64, 1.21)	0.765
Tranquility				
Never				
Seldom	1.08 (-0.57, 2.72)	0.199	-1.45 (-3.46, 0.57)	0.159
Sometimes	3.03 (1.65, 4.42)	<0.001	0.65 (-1.13, 2.44)	0.474
Often	4.57 (3.02, 6.12)	<0.001	2.94 (1.27, 4.62)	0.001
Very often	6.84 (4.91, 8.78)	<0.001	4.21 (2.31, 6.11)	<0.001
Personal relaxing				
Never				
Seldom	0.74 (-0.39, 1.88)	0.199	0.81 (-0.50, 2.11)	0.225
Sometimes	2.19 (1.08, 3.29)	<0.001	1.10 (0.09, 0.73)	0.033
Often	3.60 (2.29, 4.91)	<0.001	3.09 (2.00, 4.18)	<0.001
Very often	6.72 (4.88, 8.56)	<0.001	5.00 (3.55, 646)	<0.001

Model was adjusted by city, age, sex, education, neighborhood SES, perceived income, household composition, marital status, with random intercept at neighborhood level. B=regression coefficient; CI= confidence interval.

7.3.5.1 Combined sample

In the combined sample significant difference was observed for all the different kinds of activities for the poorer mental health (Table 19). “Sport” presented $p<0.001$ for the frequency indicators often and very often. “Picnic” and “walk and play with children” had significant differences for all the frequency indicators. Finally, “meet family or friends”, “tranquility” and “personal relaxing” showed $p<0.001$ for three frequency indicators, from sometimes to very often.

The situation was different when we considered the subsample categorized as ‘better mental health’. In this group, there were no statistically significant associations linking restoration score with “sport” and “walk and play with children”. “Picnic” presented an association with all the frequency indicators, from 1.78 of seldom (95%CI 0.75, 2.80) to 5.76 of very often (95%CI 3.53, 7.99).

7.3.5.2 Barcelona

Barcelona had a similar trend to the combined sample (Table 21 Appendix A). The association between the type of activity and mental restoration was more apparent in the subsample categorized as ‘poorer mental health’ compared to the ‘better mental health’ subsample. For those with poorer mental health, activities related to the reduction of stress (“tranquility” and “personal relaxing”) were associated with higher restoration scores. In the 'better mental health’ subsample, only the activity “tranquility” was associated with higher restoration scores.

7.3.5.3 Doetinchem

Doetinchem had more people with a better mental health (523) than those with poorer mental health (267). The association between the type of activity and mental health was more apparent in the ‘poorer mental health’ subsample (Table 21 Appendix A). For people with ‘poorer mental health’, the activities “sport”, “and “tranquility” were associated with higher restoration score.

Meanwhile, in the 'better mental health' subsample the activities related to the reduction of stress ("tranquility" and "personal relaxing") were associated with higher restoration score.

7.3.5.4 Kaunas

Participants from Kaunas showed big differences between who had poorer and who had better mental health (Table 22 Appendix A). In fact, the subsample with 'poorer mental health' presented a more apparent association between the type of activity and mental health. For those people, the activities "picnic", "meet family or friends", "walk and play with children" and "tranquility" were associated with higher restoration score. For the 'better mental health' subsample, only the activities "picnic" and "personal relaxing" were associated with higher restoration score,

7.3.5.5 Stoke-on-Trent

People from Stoke-on-Trent with 'poorer mental health' showed a more apparent association between the type of activities and mental health. In fact, for this subsample, the activities "meet family or friends", "tranquility" and "personal relaxing" were associated with a higher restoration score. For the 'better mental health' subsample, the activity "walk and play with children" was negatively associated with mental health for the frequency indicator seldom and sometimes.

7.4 Discussion

The goal of the present study was to investigate restoration after visiting green urban space in people with better and poorer mental health and explore mental health as a potential effect modifier. We found that the activities "picnic", "meet family or friends", "tranquility" and "personal relaxing" in urban space were associated with restoration. These associations varied between the four cities. For examples, participants from Kaunas showed the highest number of statistically significant association between restoration and the different type of activity. Participants from

Barcelona presented statistically significant association between the social activities and ROS. Indeed, people from Doetichem showed statically significant association for the activities linked to relaxation (“tranquility” and “personal relaxation”). Finally, association between the type of activity and restoration varied according to the participants’ mental health. In general, participants with poorer mental health showed more significant associations and for more frequency indicators than participants with better mental health. It is possible that people with better mental health need to spend less time in green space, due to their mental health conditions, and this less time is enough for them to continue to have a good mental health. At the same time, it is possible that people with poorer mental health need to spend more time, and to practice a larger variety of activities to have the same restorative effects of people with better mental health.

We found a statistically significant association between the restoration and the kind of activity carried out in the urban green space and statistically significant differences between the four cities involved in the study.

7.4.1 Combined sample

In the combined sample, the activities linked to the social cohesion (“Picnic” and “meeting family or friends’’) and to the relaxation (“tranquility” and “personal relaxing”) showed statistically significant association with the ROS after visiting the green urban space. In particular, “Picnic” and “meet family or friends” presented statistically significant association for all the frequency indicators, for people with poorer mental health. This could mean that activities related to socialization and social cohesion definitely affect restoration, even if these activities are performed infrequently. This is in line with previous studies that suggest natural environments may promote positive social interactions [299,300]. In addition, social interaction and the improvement of social cohesion in the community is one of the different types of mechanisms proposed to explain the beneficial effects

of the green environment [174,301–303]. Our findings for the combined sample was in line with previous studies which showed a higher vitality and restoration in persons that went to green space with companions [19,304]. Instead, activities more linked to the relaxation suggest that the frequency was more important than the activity in and of itself. Previous studies have shown that short-term exposure to forests, urban parks, gardens and other natural environments reduces stress and depressive symptoms, restores attention fatigue, increases self-reported positive emotions and improves self-esteem, mood and perceived mental and physical health [305–308]. These results are important because they highlight the importance of how people perceive the use and the benefits of the green space. It could be a "safe place" in which people can stay and relax without other problems or thoughts. In conclusion, it seems that for people with poorer mental health is not so important the type of activity done in the green urban space, but the most effective aspect is the use of this kind of environment.

Regarding people with better mental health, "walk and play with children'' did not show a strong association with the restorative score. This is in line with other studies. In particular, White et al. found that being with children was associated with lower restoration than being alone. The presence of children tended to reduce the extent of restoration experienced [304]. While spending time with children may have many benefits, it is not necessarily a relaxing/restorative activity [309]. The feeling of restoration remained lower also for visits to the playing field, even without the presence of children [304]. The activity "sport" showed a statistically significant association only for the frequency indictor very often. Korpela et al. found that physical activity was among the potential determinants of the restorative experiences [310], but White et al. found that doing sport was not better than simply walking for the levels of restoration [304]. Even if the beneficial effects of the physical activity are well established, with strong evidence of the relative reduction of risk of mortality, it is not a factor known to facilitate restoration experience. Korpela et al. in their study

presented the importance of experiencing calmness, getting new spirit and vitality, forgetting everyday worries and gaining faith in tomorrow during nature-based recreation [311]. According to our data, the sport practice helps to do this only if people do it very often.

Looking at the results of the cities individually which differed in characteristics that can influence the restoration, the mental health and the attitude towards green urban spaces key, several differences emerged.

7.4.2 Barcelona

Participants from Barcelona showed no statistically significant association between the ROS and "sport", "meet family or friends" or "walking and play with children". This can be related with the characteristics of the city itself. In fact, Barcelona was the largest city, and it is a densely built city (to see more information Smith et al. [28]). In addition, Barcelona is the least green city and has the longest distance from the most used green space for the citizens. Maybe for these reasons people prefer to meet family and friends or to do sport in other kinds of places, such as bars or non-natural open space, such as squares. In Barcelona the satisfaction with the quality and amount of the green space was lower than the other cities [312]. But at the same time, the restoration score showed a statistically significant association with the activities of "tranquility" and "personal relaxing". This can be due to the fact that Barcelona is the busiest city, so people's restoration could be really benefited from being able to escape from the busy Barcelona urban life. For this reason, green spaces in the city, even if they are not particularly appreciated, were used to relax and they significantly influence the restoration experience.

7.4.3 Doetinchem

Doetinchem was the greenest city, with the best access to green space and, in addition, with the joint highest percentage of daily visits (37.8%, as Kaunas). Maybe for this wide/large exposure to green urban space, Doetinchem participants had the lowest score of restoration (11.22, SD 7.15). People from Doetinchem could have a greater habit to use and to see the green space and so they do not feel as restored as the participants from other cities after visiting this kind of environment. This could be fact that everyone had a quite high access to urban green space, and this could reduce the opportunity to see differences in restoration between people. In Doetinchem a statistically significant association was observed with the activity “sport” and “personal relaxing” carried out both “often” and “very often” This could mean that these two kinds of activities influence restoration scores, but only when they are done consistently. This is in accordance with Korpela et al., which reported that the physical activity and natural experiences were among the potential determinants of the restorative experiences [287]. Due to the bigger amount of green in the city, people could have more possibility to perform outdoor physical activity or to relax.

7.4.4 Kaunas

People from Kaunas reported the joint highest percentage of daily visits to green urban space (37.8%, as Doetinchem). This could be linked to the higher sensitivity of the residents of most Northern countries: they usually paid more attention to community parks and to increase awareness to people to use them [313]. For example, in Denmark a nationwide survey suggested that 43.0% of adults visit green space every day and 91.5% of them visit green space at least once a week [314].

7.4.5 Stoke-on-Trent

People from Stoke-on-Trent had the lowest percentage (14.6%) of daily visits, and they also visited green space further away in the city and outside the city less frequently than people from the other cities. At the same time, people from this city have the highest restoration score (20.19, SD 8.74). Apparently, people who visit green spaces more frequently for activities get notable restoration benefit compared with those who do not. However, people from Stoke-on-Trent could have a bigger passive or today exposure through which they could get restoration benefits. This is in line with the results of the combined sample.

7.4.6 Stratification for mental health

Mental health was used as a modifier of the relationship between the restoration and the type of activity carried out in the green urban spaces. Several studies showed beneficial association between the natural outdoor environment exposure and mental health [12,25,248,315,316]. They found that population mental health could benefit from environmental interventions aiming to increase public contact with natural environment [317]. Looking at the stratification for the mental health score, there were some differences between people with a better and a poorer mental health. People with poorer mental health showed more statistically significant associations and for more frequency indicators between the kind of activity done in the green urban space and the restoration score. In the combined sample all the kinds of activity presented statistically significant and a positive coefficient. Participants with poorer mental health from the different cities showed some differences in the relationship between the kind of activities and the ROS, but they presented a similar trend. In general, people with poorer mental health showed more significant associations and for more activity indicators than people with good mental health. In fact, the combined sample showed no significant association for two kinds of activity (sports and walk and play with children).

Regarding these results, it seems that every kind of activity done by people with poorer mental health influences the score of restoration. It could mean that people with poorer mental health were more sensitive to the effects of using the green urban space and so they could be more sensitive also to the feeling of restoration after visiting a green urban space.

7.5 Appendix A

Table 21. Association between activities in green spaces and restoration outcome score, stratified for the mental health score, in a cross-sectional sample of 3134 adults in Barcelona

	Poorer mental health ≤76		Better mental health >76	
N	521		257	
Type of activity	β (95%CI)	p	β (95%CI)	p
Sport				
Never				
Seldom	0.24 (-2.16, 2.64)	0.844	-4.00 (-14.72, 6.72)	0.465
Sometimes	2.27 (0.16, 4.38)	0.035	-0.94 (-4.94, 3.06)	0.645
Often	2.63 (0.72, 4.54)	0.007	0.17 (-3.72, 4.06)	0.931
Very often	3.57 (1.04, 6.10)	0.006	0.40 (-3.84, 4.64)	0.854
Picnic				
Never				
Seldom	1.38 (-0.30, 3.05)	0.108	2.58 (-0.02, 5.18)	0.052
Sometimes	2.29 (-0.21, 4.79)	0.073	0.59 (-2.45, 3.62)	0.704
Often	4.33 (1.76, 6.91)	<0.001	7.20 (3.54, 10.85)	<0.001
Very often	1.87 (-4.48, 8.22)	0.563	3.60 (-0.21, 7.40)	0.063
Meet family or friends				
Never				
Seldom	1.93 (-0.57, 4.47)	0.131	2.88 (-0.33, 6.08)	0.079
Sometimes	0.83 (-1.15, 2.80)	0.411	1.67 (-0.94, 4.29)	0.210
Often	1.59 (-0.72, 3.89)	0.178	-0.43 (-4.17, 3.31)	0.822
Very often	2.36 (-0.71, 5.44)	0.132	1.56 (-1.99, 5.12)	0.389
Walk and play with children				
Never				
Seldom	3.16 (1.47, 4.86)	<0.001	-1.63 (-5.81, 2.55)	0.445
Sometimes	1.84 (0.49, 3.18)	0.007	-0.41 (-3.08, 2.27)	0.766
Often	1.25 (-1.00, 3.49)	0.277	1.71 (-0.72, 4.13)	0.168
Very often	1.38 (-1.91, 4.65)	0.411	-1.87 (-5.76, 2.01)	0.345
Tranquility				
Never				
Seldom	2.16 (-0.54, 4.86)	0.116	-1.99 (-5.77, 1.79)	0.301
Sometimes	2.71 (0.07, 5.35)	0.044	0.64 (-2.85, 4.12)	0.719
Often	5.66 (3.16, 8.17)	<0.001	3.77 (0.76, 6.79)	0.014
Very often	7.97 (4.06, 11.89)	<0.001	7.63 (4.32, 10.94)	<0.001
Personal relaxing				
Never				
Seldom	1.66 (-0.18, 3.50)	0.077	4.69 (0.11, 9.26)	0.045
Sometimes	3.28 (1.35, 5.21)	<0.001	1.49 (-2.32, 5.31)	0.444
Often	5.32 (2.99, 7.64)	<0.001	3.46 (-0.37, 7.29)	0.076
Very often	6.82 (4.00, 9.65)	<0.001	5.68 (0.72, 10.63)	0.025

Model was adjusted by, age, sex, education, neighborhood SES, perceived income, household composition, marital status, with random intercept at neighborhood level. β=regression coefficient; CI= confidence interval.

Table 22. Association between activities in green spaces and restoration outcome score, stratified for the mental health score, in a cross-sectional sample of 3134 adults in the city of Doetinchem

	Poorer mental health ≤76		Better mental health >76	
N	267		523	
Type of activity	β (95%CI)	p	β (95%CI)	P
Sport				
Never				
Seldom	6.11 (-0.66, 12.87)	0.077	2.58 (-3.15, 8.32)	0.378
Sometimes	2.58 (-0.91, 6.07)	0.147	0.41 (-4.19, 5.01)	0.861
Often	5.00 (1.56, 8.44)	0.004	2.64 (-1.99, 7.26)	0.264
Very often	6.91 (3.48, 10.34)	<0.001	3.60 (-0.58, 7.77)	0.091
Picnic				
Never				
Seldom	0.52 (-1.58, 2.62)	0.625	2.31 (0.83, 3.79)	0.002
Sometimes	1.85 (-2.04, 5.74)	0.352	1.58 (-0.84, 4.00)	0.200
Often	1.09 (-2.65, 4.83)	0.568	1.74 (-0.87, 4.34)	0.191
Very often	2.45 (-2.26, 7.16)	0.308	4.43 (2.41, 6.45)	<0.001
Meet family or friends				
Never				
Seldom	2.09 (0.57, 3.62)	0.007	1.49 (-0.09, 3.08)	0.065
Sometimes	1.11 (-0.61, 2.83)	0.206	1.39 (-0.18, 2.97)	0.083
Often	-0.43 (-2.88, 2.03)	0.735	1.33 (-0.57, 3.22)	0.170
Very often	0.88 (-2.40, 4.15)	0.599	1.61 (-2.20, 5.42)	0.407
Walk and play with children				
Never				
Seldom	1.43 (-1.50, 4.36)	0.338	0.81 (-0.97, 2.59)	0.371
Sometimes	1.87 (-0.23, 3.97)	0.081	1.23 (-0.34, 2.79)	0.125
Often	-1.97 (-3.73, -0.22)	0.027	1.16 (-0.16, 2.48)	0.086
Very often	1.14 (-1.51, 3.79)	0.399	0.68 (-1.09, 2.45)	0.449
Tranquility				
Never				
Seldom	2.30 (-2.16, 6.76)	0.312	0.75 (-2.57, 4.08)	0.658
Sometimes	1.11 (-2.03, 4.24)	0.488	2.11 (-0.64, 4.87)	0.133
Often	4.21 (1.14, 7.28)	0.007	4.14 (1.85, 6.43)	<0.001
Very often	4.26 (0.96, 7.56)	0.011	4.38 (1.52, 7.24)	0.003
Personal relaxing				
Never				
Seldom	0.16 (-1.74, 2.05)	0.871	0.58 (-0.96, 2.11)	0.463
Sometimes	0.10 (-1.91, 2.11)	0.920	0.67 (-0.56, 1.89)	0.286
Often	0.50 (-1.64, 2.63)	0.649	2.73 (1.21, 4.26)	<0.001
Very often	2.53 (-0.19, 5.26)	0.069	4.11 (2.04, 6.19)	<0.001

Model was adjusted by, age, sex, education, neighborhood SES, perceived income, household composition, marital status, with random intercept at neighborhood level. β=regression coefficient; CI= confidence interval.

Table 23. Association between activities in green spaces and restoration outcome score, stratified for the mental health score, in a cross-sectional sample of 3134 adults in the city of Kaunas

	Poorer mental health ≤76		Better mental health >76	
N	382		276	
Type of activity	β (95%CI)	p	β (95%CI)	P
Sport				
Never				
Seldom	2.17 (-2.27, 6.61)	0.338	1.05 (-2.66, 4.75)	0.580
Sometimes	3.80 (0.13, 7.47)	0.043	2.27 (-1.67, 6.21)	0.259
Often	3.43 (-0.65, 7.51)	0.099	3.42 (-0.49, 7.33)	0.086
Very often	7.46 (2.96, 11.97)	<0.001	4.07 (-0.32, 8.45)	0.069
Picnic				
Never				
Seldom	2.42 (0.84, 4.01)	0.003	1.79 (-0.80, 4.38)	0.176
Sometimes	4.86 (3.50, 6.23)	<0.001	3.55 (1.25, 5.85)	0.003
Often	4.58 (2.42, 6.75)	<0.001	2.99 (0.30, 5.67)	0.029
Very often	13.88 (10.66, 17.10)	<0.001	8.09 (4.48, 11.69)	<0.001
Meet family or friends				
Never				
Seldom	3.91 (1.67, 6.15)	<0.001	-1.06 (-4.02, 1.89)	0.481
Sometimes	5.41 (3.16, 7.66)	<0.001	1.49 (-1.32, 4.30)	0.298
Often	7.15 (4.11, 10.19)	<0.001	4.53 (1.34, 7.729	0.005
Very often	13.10 (9.34, 16.85)	<0.001	5.51 (1.54, 9.48)	0.007
Walk and play with children				
Never				
Seldom	1.73 (-0.70, 4.15)	0.163	-1.42 (-4.48, 1.65)	0.364
Sometimes	3.87 (2.21, 5.52)	<0.001	-0.46 (-2.47, 1.55)	0.652
Often	3.96 (1.74, 6.18)	<0.001	-0.61 (-3.15, 1.92)	0.637
Very often	7.95 (4.85, 11.05)	<0.001	-0.96 (-4.50, 2.58)	0.596
Tranquility				
Never				
Seldom	1.45 (-2.36, 5.25)	0.457	-5.35 (-9.53, -1.18)	0.012
Sometimes	4.29 (0.88, 7.70)	0.014	-5.78 (-10.12, -1.43)	0.009
Often	4.51 (0.38, 8.63)	0.032	-3.99 (-8.44, 0.47)	0.079
Very often	8.71 (5.43, 11.99)	<0.001	-2.58 (-6.96, 1.80)	0.249
Personal relaxing				
Never				
Seldom	3.23 (0.60, 5.86)	0.016	-0.59 (-3.47, 2.29)	0.689
Sometimes	4.02 (1.65, 6.40)	<0.001	2.03 (-0.38, 4.44)	0.098
Often	5.51 (2.83, 8.19)	<0.001	4.89 (2.31, 7.46)	<0.001
Very often	11.67 (8.18, 15.17)	<0.001	7.62 (4.47, 10.78)	<0.001

Model was adjusted by, age, sex, education, neighborhood SES, perceived income, household composition, marital status, with random intercept at neighborhood level. β=regression coefficient; CI= confidence interval.

Table 24. Association between activities in green spaces and restoration outcome score, stratified for the mental health score, in a cross-sectional sample of 3134 adults in the city of Stoke-on-Trent.

	Poorer mental health ≤76		Better mental health >76	
N	282		260	
Type of activity	β (95%CI)	p	β (95%CI)	p
Sport				
Never				
Seldom	0.68 (-2.50, 3.85)	0.676	0.64 (-6.92, 8.20)	0.869
Sometimes	-1.89 (-4.20, 0.41)	0.108	-0.41 (-5.15, 4.32)	0.864
Often	0.15 (-2.21, 2.51)	0.900	-0.86 (-6.08, 4.35)	0.746
Very often	0.45 (-3.15, 4.05)	0.808	0.20 (-5.19, 5.59)	0.941
Picnic				
Never				
Seldom	1.48 (-0.91, 3.86)	0.224	0.78 (-1.19, 2.74)	0.439
Sometimes	1.56 (-1.13, 4.25)	0.255	2.62 (-0.32, 5.56)	0.080
Often	1.81 (-1.57, 5.18)	0.295	1.84 (-3.97, 7.65)	0.535
Very often	9.66 (2.80, 16.52)	0.006	0.29 (-3.97, 4.54)	0.895
Meet family or friends				
Never				
Seldom	2.05 (-0.34, 4.45)	0.093	3.31 (-0.31, 6.93)	0.073
Sometimes	2.10 (0.33, 3.88)	0.020	1.57 (-0.89, 4.02)	0.212
Often	4.67 (0.88, 8.46)	0.016	3.34 (0.82, 5.85)	0.009
Very often	9.84 (4.28, 15.40)	<0.001	2.44 (-2.32, 7.21)	0.315
Walk and play with children				
Never				
Seldom	0.71 (-3.38, 4.81)	0.733	-4.24 (-9.08, 0.60)	0.086
Sometimes	0.01 (-2.15, 2.17)	0.992	-5.47 (-8.02, -2.92)	<0.001
Often	1.97 (-0.63, 4.48)	0.138	-3.73 (-6.28, -1.20)	0.004
Very often	-1.09 (-4.22, 2.04)	0.494	-0.28 (-3.24, 2.69)	0.855
Tranquility				
Never				
Seldom	-0.39 (-4.46, 3.67)	0.849	-3.25 (-7.86, 1.36)	0.166
Sometimes	4.02 (1.72, 6.32)	<0.001	1.20 (-1.94, 4.33)	0.456
Often	4.20 (1.52, 6.87)	0.002	2.78 (-0.26, 5.82)	0.073
Very often	4.86 (0.30, 9.42)	0.037	4.52 (0.43, 8.61)	0.030
Personal relaxing				
Never				
Seldom	0.34 (-1.70, 2.38)	0.745	-0.17 (-3.98, 3.64)	0.931
Sometimes	2.73 (0.39, 5.07)	0.022	1.99 (-0.39, 4.36)	0.101
Often	3.00 (0.18, 5.82)	0.037	2.99 (0.33, 5.65)	0.028
Very often	9.84 (3.22, 16.47)	0.004	5.49 (2.71, 8.27)	<0.001

Model was adjusted by, age, sex, education, neighborhood SES, perceived income, household composition, marital status, with random intercept at neighborhood level. β=regression coefficient; CI= confidence interval.

8. Study 5: The Effects of Park Based Interventions on Health: The Italian Project "Moving Parks"

This article was published in the International Journal of Environmental Research and Public Health

Toselli, S.; Bragonzoni, L.; Dallolio, L.; Grigoletto, A.; Masini, A.; Marini, S.; Barone, G.; Pinelli, E.; Zinno, R.; Mauro, M.; Astorino, G.; Loro Pilone, P.; Galli, S.; Maietta Latessa, P. The Effects of Park Based Interventions on Health: The Italian Project "Moving Parks". Int. J. Environ. Res. Public Health 2022, 19, 2130. https://doi.org/10.3390/ijerph19042130

Keywords: citizen health; green infrastructure; green urban space; health status; mental health; park; physical activity

Overview

Green space can have a positive influence on promoting PA, so, the aim of the present study was to assess the effectiveness of the project "The moving parks project", which provides for the administration of PA to citizens within Bologna's parks (Italy). An ad hoc questionnaire was administered before and after three months of outdoor PA. At follow-up, all psychosocial parameters showed an improvement, with a reduction in the state of tension, sadness, and fatigue, and an improvement in the state of energy, serenity, and vitality. The impact of the interventions carried out in the "Moving Parks project" was positive and appears to be a good strategy for improving health outcomes.

8.1 Introduction

Body mass index (BMI) has increased steadily in most countries, concurrently with a rise in the proportion of the population living in cities, suggesting that urbanization is one of the most important drivers of the global rise in obesity [318]. As regards Italy, Di Bonaventura et al. reported that 52.26% of the adult population were normal weight, 34.85% were overweight, and 12.89% were obese (9.49% were obese class I, 2.28% were obese class II, and 1.12% were obese class III) [319]. Obesity is a risk factor for a variety of diseases, such as cardiovascular disease, cancer, type 2 diabetes (T2D), osteoarthritis, nonalcoholic fatty liver disease, sleep apnea, and psychiatric conditions [320–322]. Nowadays, it is widely known that being overweight and obese are related to unhealthy lifestyle habits such as physical inactivity and malnutrition [323,324]. Sedentary behavior (SB) has increased in industrialized countries in the last decades, with the average adult spending more than half of the day on SB [158,324,325]. From 2002 to 2017 the European adult population showed an increased trend in SB prevalence, for both males and females [136,158]. To face this situation, the World Health Organization (WHO) recommends limiting the amount of time spent in SB, reducing sedentary time with physical activity (PA) of any intensity to obtain health benefits [136,326]. Participation in PA is useful for maintaining and slowing the physiological age-dependent decline of the musculoskeletal system, a process that leads to degenerative forms of arthrosis, as well as to a prevalent loss of strength and elasticity [138,327]. In addition, PA positively affects psychological mental health, for instance, lowering depression and psychological disease, [59,138,144,145,328]. Despite the evidence, only 31% of Italian adults (35% males and 26% females) reported having a physically active job [327]. Among the strategies to promote health and to reduce physical inactivity, there is the opportunity of improving PA programs and interventions in parks and other natural environments [326].

Improving parks' availability and users' satisfaction with parks may increase visitation and,

consequently, increase physical activity and time spent outdoors [116]. There are different strategies to increase the practice of outdoor PA: changing the physical structure of the parks (i.e., adding walking trails) to facilitate physical activity (place level interventions) and/or providing free or low cost group wellness programs in parks (person level intervention) [329]. Place based interventions were more common than person based interventions [330]. Only a few studies have evaluated person-based interventions in nonclinical populations. These studies were generally numerically limited and included walks in the park. In Singapore, Petrunoff et al. and Müller-Riemenschneider et al. found that a supervised Park Prescription intervention of PA effectively increased recreational PA, park use, park PA, and psychological quality of life [243,331]. Sellers et al. showed that a 30-min self-timed brisk walk taken in a park compared with one taken in an urban setting in Glasgow, Scotland, can impact more healthy adults' capacity to perform health enhancing PA, facilitating the achievement of brisk walking bouts of 10 min in duration [332]. Furthermore, de Bloom et al. considered the effects of park walking and relaxation exercises during the lunch breaks of Finnish workers [333]. The most consistent positive effects throughout the day were reported by the park walking group. Despite the beneficial effects of PA practiced in green spaces, no studies related to this aspect that concern Italy have been conducted.

Thus, there is a strong interest in designing interventions aimed to increase physical activity in Italian adults and understanding their effects. In addition, Good Health and Wellbeing is one of the UNESCO Sustainable Development Goals [334]. For this reason, the project "The moving parks project", was conceptualized to address research evidence gaps and evaluate the effectiveness of a structured PA in the park, carefully developed and supervised by qualified instructors on (1) PA behaviors (intention to practice PA, importance of PA); (2) weight status and psychological general wellbeing. "The moving parks project" aimed to give all citizens the opportunity to become familiar with the public green areas in the municipal territory and to integrate motor experience with health and

wellness education activities. We expect an increase in levels of PA, and an improvement weight status and of the psychosocial wellbeing in project participants.

8.2 Materials and Methods

8.2.1 The Project

Bologna has a green public area that is around 1000 hectares, equal to about the 7% of the municipal territory. In the city, there are around 250 spaces, between parks and gardens [335]. “The moving parks project” was a project created by the Municipality of Bologna in collaboration with the Department of Public Health of the Bologna Local Health Authority in 2010, with the goal to spread the importance of outdoor physical activity. The aim was also to increase the quality of life of all citizens through the regular practice of physical activity and contact with the natural environment. This project was carried out for three months during the summer period and involved six municipal parks. The selected parks were chosen, each in a different neighborhood of the city (Appendix A Figure A1). In addition, the project involved fourteen sports associations offering different types of activities, such as Nordic walking, pilates, tai chi, postural training. All activities were free of charge. Every activity was proposed twice a week and managed by qualified instructors. The study involved the administration of a specific questionnaire before and after the physical activity.

In order to enroll participants in “The moving parks project”, strategies of distribution fliers were adopted and many local commercial activities, such as a pharmacy, market, clinic, etc., were involved. In addition, a specific webpage, at “www.comunedibologna.it (18 November 2021)”, was made to promote and achieve larger adhesion.

8.2.2. Questionnaire

The questionnaire was created ad hoc to investigate the participants’ habits and their health status, before and after the three months of outdoor physical activity. The questionnaire was divided into three parts: (1) general information about the participants, (2) information about physical activity,

and (3) psychological general wellbeing. The first part asked for general information, such as age range (18–44; 45–64, >65), weight, height, neighborhood, means of transport and whether participants usually used stairs or lift. The second part asked about the importance of physical activity on a scale from 0 to 100, in which 0 meant nothing and 100 extremely important. In addition, there were questions about future intentions to exercise once the project is completed. The third part investigated participants' psychological and general wellbeing, and health related quality of life through a previously developed and validated Psychological General Well Being Index short form questionnaire version (PGWB-S) [336]. The PGWBI integral version includes six domains composed of 22 items: anxiety (items 5, 8, 17, 19, 22), depressed mood (3, 7, 11), positive wellbeing (1, 9, 15, 20), self-control (4, 14, 18), general health (2, 10, 13), and vitality (6, 12, 16, 21) [192]. The original scoring by items was 0–5 with a maximum score of 110 or was 1–6 with a score range of 22–132.

To validate the presented short version, some authors assessed a multiple stepwise regression procedure and selected the minimum number of items that explained at least 90% of the variance of the original questionnaire [336]. In addition, a previous study showed that many PGWBI items could be correctly described by others, which are most highly correlated (Pearson moment correlation). According to these results, the following short version could well outline information about five of the original six domains (anxiety, depress mood, positive wellbeing, self-control, and vitality). The PGWB-S presents only six items of the 22 (5, 6, 7, 18, 20, 21) with score ranging from 1 to 6, where 1 means poorest QoL and 6 means best QoL. In particular, the questions were: in the last four weeks, (1) did you feel full of energy?; (2) did you feel nervous?; (3) did you feel downhearted and blue?;(4) did you feel calm and peaceful?; (5) did you feel happy?; and (6) did you feel worn or tired? At the beginning, the possible answers were "none of the time", "a little bit of the time", "some of the time", "a good bit of the time", "most of the time" and "all of the time". Then, each response was transformed into a discrete observation to obtain only items with a Likert

scale.

The questionnaires were administered both on paper and as an online survey using Google Moduli Form. Several trained instructors taught participants how to fill out on paper questionnaire and each participant could opt to complete it on paper or online. Two global social networks were used to promote people participation (Facebook®, Meta Platforms, Inc, Cambridge, MA, USA; LinkedIn®, Microsoft, Sunnyvale, CA, USA). All participants were informed and gave us privacy consent to handle their personal data. They could fill out the survey with no Google sign in request. They could manually enter all general information or allow the social networks to complete them. The questionnaire was self-administered in the Italian language. Each completed survey was saved on a Google database, and we gathered all data as an Excel spreadsheet (Microsoft Office®, Microsoft Corporation, Redmond, WA, USA). The survey was approved by the bioethics Committee of the University of Bologna (prot. N 169182).

8.2.3. Statistical Analysis

The data analysis was performed using Statistica for Windows, version 8.0 (Stat Soft Italia SRL, Vigonza, Padua, Italy). To test the questionnaire's reliability, its dimension was evaluated by a confirmatory factory analysis (CFA), and its internal consistency was calculated by the Cronbach's alpha coefficient on the PGBW-S items. In order to perform the CFA, six items were selected (PGWB-S), ranging from 1 to 6 as a Likert scale. To report the model fit statistic, the comparative fit index (CFI) and the Tucker–Lewis index (TLI) were calculated. Both CFI and TLI values ranged from 0 to 1, with higher values indicating better fit [44]. In addition, the root mean square residual (SRMR) value was calculated, ranging from 0 to 1, where lower value is indicative of an acceptable model. According to conventional criteria, the CFI 0.90, SRMR 0.10 and TLI 0.90 indicated an acceptable fit [337,338]. To estimate how much this model explains PGBWI variability, the total R2 and for each

variable were calculated. Finally, Cronbach's alpha was considered reliable for values between 0.5 and 0.9.

The means SD data from baseline to follow-up were calculated. Variable's normality was verified with the Shapiro–Wilk test. Paired samples Wilcoxon test were carried out to value the differences between the two measurements. Percentage frequency was determined for qualitative variables (weight status) and the differences in the frequencies were tested by the chi-squared test. The results were considered statistically significant if the value was lower than 0.05.

8.3. Results

8.3.1. Sample Size

Figure 5 shows participants' flow-chart. A total of 450 adults completed the questionnaire but a lot of participants did not complete both the surveys, so 121 were excluded from this analysis. Finally, 329 questionnaires were considered valid and evaluated.

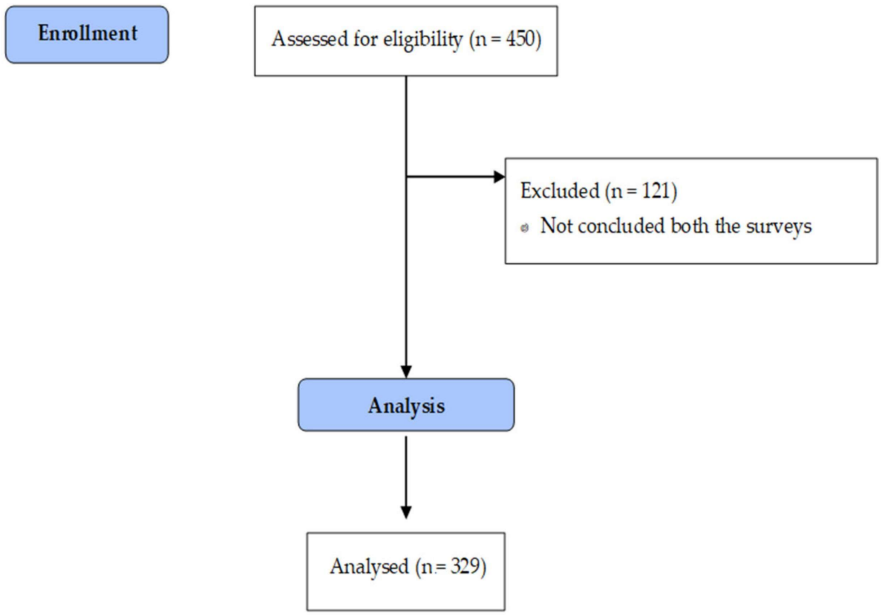


Figure 5. Participants' flow-chart.

8.3.2. Questionnaire

Figure 6 shows the path diagram resulting from the CFA, whereas Table 25 shows the fit statistics. The Cronbach's alpha value was 0.845, which can be regarded as reliable. The model derived from the confirmatory factor analysis showed a fit with the data and all items explained 85% of the model variability. In addition, the chi-squared ($\chi 2$) test statistic was assessed for both model vs. saturated ($\chi 2(7) = 7.983$, $p = 0.33$) and baseline vs. saturated ($\chi 2(15) = 756.5$, $p < 0.001$). Finally, from the baseline comparisons, the comparative fit index (CFI) resulted as equal to 0.999, and the Tucker–Lewis index (TLI) result was 0.997; the standardized root mean square residual, SRMR, was 0.018.

Figure 6. Path diagram of confirmatory factor analysis. Note: psychological wellbeing represents the latent variable, straight arrows represent paths whereas curved arrows covariances, values near each arrow represent the β coefficients of the model.

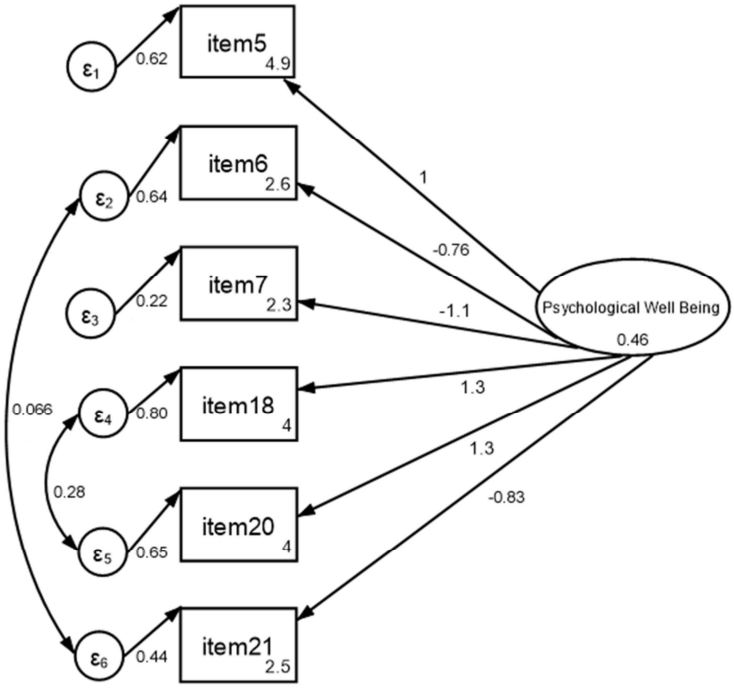


Table 25. CFA fit statistic

Dependent variables	Variance			R^2	χ2	P	CFI	TLI	SRMR	Cronbach α
	Fitted	Predicted	Residual							
item 5	1.075	0.456	0.618	0.424						
item 6	0.897	0.261	0.635	0.291						
item 7	0.752	0.531	0.22	0.706						
item 18	1.522	0.721	0.8	0.474						
item 20	1.4	0.753	0.648	0.537						
item 21	0.752	0.312	0.44	0.414						
Model				0.85	7.983	0.33			0.018	0.845
Baseline					756.5	<0.001	0.999	0.997		

8.3.3. Participant Characteristics

Table 26 shows participant's main characteristics: the place of living, lifestyle habits and intention to practice physical activity. The majority of the participants in the study were females (78.1%); in females the youngest were less represented, while males' sample was more homogeneous.

Table 26. Place of living, lifestyle habits and intention to practice PA of the participants.

	Females (257)					Males (72)				
N(%)	18-44 yrs. 42 (16.3)	45-64 yrs. 115 (44.7)	>65 yrs. 100 (38.9)	X2	p	18-44 yrs. 21 (29.2)	45-64 yrs. 24 (33.3)	>65 yrs. 27 (37.5)	X2	p
Live in the neighborhood (yes)	40.5	61.4	79.8	22.3	0.001	42.9	41.7	63.0	2.9	0.233
Way used for travel (baseline)										
Car, motorcycle, scooter	31.0	43.9	21.4	12.4	0.015	42.9	50.0	40.7	2.2	0.695
Walking or cycling	47.6	38.6	51.0			42.9	33.3	51.9		
Public transport	21.4	17.5	27.6			14.3	16.7	7.4		
Way used for travel (follow-up)										
Car, motorcycle, scooter	33.3	42.1	19.0	14.6	0.006	38.1	41.7	22.2	2.7	0.603
Walking or cycling	47.6	38.6	49.0			47.6	45.8	55.6		
Public transport	19.0	19.3	32.0			14.3	12.5	22.2		
Usually use (baseline)										
Elevators	28.2	33.0	41.8	2.7	0.254	27.8	30.0	41.7	1.1	0.582
Stairs	71.8	67.0	58.2			72.2	70.0	58.3		
Usually use (follow-up)										
Elevators	22.0	27.4	38.5	4.8	0.090	10.0	20.8	48.1	9.2	0.010
Stairs	78.0	72.6	61.5			90.0	79.2	51.9		
Start PA practice with the project (yes)	26.2	32.1	28.9	0.6	0.748	9.5	25.0	25.9	2.5	0.282
Plan to practice PA at the end of the project (yes)	100.0	98.2	97.0	1.4	0.490	100.0	95.5	96.2	0.9	0.631
Frequency with which it intends to practice										
2.5 h	40.5	41.9	50.5	2.2	0.693	28.6	34.8	30.8	1.6	0.816
<2.5 h	16.7	16.2	11.6			19.0	13.0	7.7		
>2.5 h	42.9	41.9	37.9			52.4	52.2	61.5		

Note. Yrs.=years, PA= physical activity, χ2= chi squared, p=p value.

The youngest women who attended the activity came, in a considerable percentage, also from neighborhoods other than the one in which the park was located (59.5%); the participating women who live in the neighborhood increases with the increase in age classes, with significant differences between the age groups. In men, the percentage of participants coming from the neighborhood in which the park was located is highest in the age class >65 yrs, but without significant differences among age groups.

In both sexes, the most commonly used means of transport among people aged 18–44 yrs and >65 is by walk or by bike, while participants aged 45–64 yrs mostly used a car, motorcycle or scooter; the differences were significant only among females, both at baseline and at follow-up. Regarding the difference in the means of transport used at baseline and at follow-up, females presented a significant difference ($\chi 2 = 27.4$, $p = 0.002$), while males did not. In any case, it is worth emphasizing the increase in walking and cycling in males at follow-up.

The majority of people have reported the use of the stairs rather than the elevator. In addition, the frequencies of the use of stairs increased with age and were significant in males at follow-up. An increase in the use of stairs between the two measurements was observed, even if it was not significant. About one third of participants by age and sex declared to have started the practice of physical activity thanks to this project, with a smaller frequency in the youngest males; nevertheless, the differences among age classes were not significant.

Citizens of both sexes and of all the ages classed planned to continue to practice physical activity even after the end of the project, and the majority thought of practicing it with a frequency equal or greater to 2.5 h/week. The differences among age classes were not significant. In both sexes, height was higher in the youngest (Table 27) and BMI increased with the increase in age classes and did not show any significant differences between baseline and follow-up in all the age classes. Males

generally presented a higher percentage of overweight and obese subjects than females, while females showed also underweight subjects. Analogously to BMI, weight status did not show any significant differences between baseline and follow-up (Table 27).

Table 27**.** Anthropometric parameters and weight status of the participants.

	18-44 yrs.						45-64 yrs.						>65 yrs.			
	Mean	SD	Mean	SD	Z	P	Mean	SD	Mean	SD	Z	p	Mean	SD	Mean	SD
Females																
Height	164.5	6.2					163.6	6.4					159.1	5.6		
Weight	60.3	11.1	60.2	10.9	0.7	0.465	61.7	9.1	61.8	9.2	0.0	0.981	63.7	9.7	63.4	9.8
BMI	22.4	3.9	22.5	3.9	1.0	0.300	23.0	3.4	23.1	3.5	1.0	0.340	25.2	3.4	25.0	3.5
Males																
Height	177.7	7.7	177.9	8.4			175.6	7.3	175.3	7.4			174.7	5.8	175.0	6.3
Weight	73.7	10.8	73.6	10.8	0.4	0.674	75.7	11.0	76.1	10.4	1.4	0.154	74.5	7.9	74.8	8.6
BMI	23.5	3.5	23.4	3.7	0.1	0.889	24.6	3.5	24.8	3.6	0.0	1.000	24.4	2.6	24.4	2.6
Weight status	%		%		χ^2	p	%		%		χ^2	p	%		%	
Females																
Underweight	5.1		5.3		0.3	0.957	3.6		2.7		0.3	0.968	1.0		1.0	
Normal weight	76.9		76.3				73.0		73.2				53.5		55.2	
Overweight	10.3		13.2				19.8		19.6				36.4		35.4	
Obese	7.7		5.3				3.6		4.5				9.1		8.3	
Males																
Underweight	-		-				-		-				-		-	
Normal weight	75.0		76.2		0.5	0.785	70.8		65.2		0.4	0.804	61.5		61.5	
Overweight	20.0		14.3				25.0		26.1				38.5		38.5	
Obese	5.0		9.5				4.2		8.7				-		-	

Note. Yrs.=years, SD=standard deviation, Z=Z value, p=p value, χ2= chi squared.

Table 28 shows participant's health status and wellbeing.

Table 28**.** Health status and well-being of the last 4 weeks from baseline to follow-up.

	18-44 yrs.						45-64 yrs.						>65 yrs.					
	Mean pre	(±SD)	Mean post	(±SD)	Z	p	Mean pre	(±SD)	Mean post	(±SD)	Z	P	Mean pre	(±SD)	Mean post	(±SD)	Z	p	Range
Females																			
Importance of PA	71.6	(20.5)	76.4	(15.7)	1.8	0.068	73.1	(16.1)	77.1	(15.1)	3.4	0.001	73.3	(12.7)	76.4	(12.8)	2.7	0.007	0-100
Feel tense	4.5	(1.1)	5.1	(1.1)	2.6	0.010	4.8	(1.0)	5.2	(1.0)	3.1	0.002	5.1	(1.0)	5.4	(0.8)	2.6	0.010	1-6
Fell full of energy	2.7	(1.0)	1.9	(0.8)	3.6	<0.001	2.6	(1.0)	2.2	(0.9)	3.8	<0.001	2.6	(0.8)	2.2	(0.7)	3.7	<0.001	1-6
Feel discouraged	2.5	(0.8)	2.0	(0.8)	2.9	0.004	2.3	(0.8)	2.1	(0.8)	2.4	0.017	2.3	(1.0)	2.0	(0.9)	2.5	0.012	1-6
Feel confident	4.0	(1.1)	4.4	(1.3)	2.0	0.049	4.0	(1.2)	4.2	(1.3)	1.4	0.173	4.1	(1.3)	4.5	(1.2)	3.1	0.002	1-6
Feel calm and happy	4.0	(1.2)	4.5	(1.1)	2.7	0.006	4.0	(1.1)	4.2	(1.1)	2.3	0.019	3.9	(1.2)	4.4	(1.1)	3.5	<0.001	1-6
Feel tied	2.6	(0.9)	2.0	(0.6)	3.1	0.002	2.5	(0.8)	2.2	(0.8)	3.4	0.001	2.4	(0.9)	2.2	(0.8)	2.0	0.048	1-6
Males																			
Importance of PA	72.8	(16.9)	78.6	(16.6)	2.2	0.031	77.7	(16.3)	82.4	(15.1)	1.1	0.270	73.6	(11.6)	74.1	(12.4)	1.2	0.215	0-100
Feel tense	5.0	(1.3)	5.4	(0.6)	1.5	0.123	5.0	(1.0)	5.4	(0.8)	2.0	0.042	5.0	(0.8)	5.3	(0.5)	1.5	0.133	1-6
Fell full of energy	2.5	(1.4)	1.9	(0.9)	1.7	0.093	2.3	(0.8)	1.9	(0.5)	2.3	0.023	2.6	(0.8)	2.0	(0.8)	2.2	0.028	1-6
Feel discouraged	2.3	(1.1)	1.9	(0.7)	1.3	0.178	2.4	(0.8)	2.0	(0.9)	1.9	0.059	2.5	(0.8)	1.8	(0.6)	3.2	0.001	1-6
Feel confident	4.0	(1.5)	4.5	(1.3)	1.4	0.173	4.1	(1.4)	4.6	(1.0)	1.7	0.088	3.9	(1.2)	4.0	(1.2)	0.5	0.629	1-6
Feel calm and happy	4.3	(1.4)	4,.5	(1.3)	0.6	0.529	4.3	(1.0)	4.4	(1.0)	0.6	0.569	3.6	(1.2)	4.3	(1.2)	2.9	0.003	1-6
Feel tied	2.4	(1.0)	2.1	(0.8)	1.2	0.249	2.6	(0.9)	1.9	(0.5)	2.6	0.009	2.3	(1.0)	1.9	(0.7)	2.0	0.041	1-6

Note. Yrs.=years, SD=standard deviation, Z=Z value, p=p value

At follow-up, the importance given to physical activity practice has increased, with significant differences among females in older age classes and in males in the youngest. All psychosocial parameters showed an improvement after following the three months physical activity program, with a reduction in states of tension, sadness and fatigue, and an improvement in the state of

energy, serenity, and vitality. Significant differences were observed in females in all age classes, with few exceptions. Although, in males, the most significant differences are reported in the older age groups, in general, the differences found were not always significant (Table 27).

8.4 Discussion

The aims of the present study were to value the effectiveness of a structured PA intervention, administered to citizens in Bologna's parks (Italy), on physical activity behaviors (intention to practice PA, importance of PA), and on weight status and psychological general wellbeing. A systematic review of interventions aiming to promote PA in urban green spaces has illustrated important gaps in the evidence: person based intervention constituted a very small number of studies overall, usually of low methodological quality [338]. In addition, to our knowledge, in the few studies that considered person based intervention, the PA prescription was delivered and not followed by expert technicians [243,331]. Thus, this study aimed to quantify the effect of a supervised and structured PA on the above-mentioned parameters.

As regards the first aim of this study, it is noteworthy that about a third of the participants reported to have started the practice of physical activity thanks to this project. A high percentage of the participants (97–100% of the females; 95.5–100% of the males) planned to continue to practice physical activity even after the end of the project, and the majority thought to practice it with a frequency equal or greater to 2.5 h/week. These results strongly suggest the importance of involving qualified personnel. Trainers, indeed, can conduct the activities and encourage an increase in participation, by creating an environment of trustworthiness as well as continuity. In addition, trainers can also create and promote a program of events with clearly defined dates and places for local populations. The importance of supervised physical activity also emerges from two other studies [243,331], who valued the effectiveness of a park PA prescription intervention for improving

total moderate to vigorous PA (MVPA) and other PA related behaviors, among adults, comparing participants in the intervention group, who received face to face counselling on PA with participants of the control group, who continued with their daily routine. Supervised PA resulted in meaningful and statistically significant increases in recreational PA, time spent in parks, and PA in parks, but did not improve psychological distress, accelerometer measured moderate to vigorous PA, and cardiometabolic outcomes. Our results confirmed, as in most of the studies, that urban green space plays an important role in promoting physical activity, especially among women and the elderly, improving awareness towards a real change in the active lifestyle [18,47]. It should be noticed, as in other studies results, that women are more prone to physical activity because it is seen by many women as a way to relieve tension, to feel better, and to generate a healthy sense of fatigue [323].

The second aim was to investigate the effect of supervised PA on weight status and psychological general wellbeing. The PA intervention resulted in an improvement in all the selected wellbeing outcomes, with a reduction in the state of tension, sadness, fatigue, and an improvement in the state of energy, serenity, and vitality. The differences were more evident in females than in males. Green space is widely regarded as a health-promoting feature and has been linked to wellbeing, helping people to avoid the sense of isolation and, in this way, reduce the risk of depression and anxiety and improve the resilience and manageability of people. Higher levels of neighborhood green space have been associated with significantly lower levels of symptoms for depression, anxiety, and stress [338]. Being active in nature may be an important mechanism of the intervention effects on behavioral and quality of life outcomes [331]. Sellers et al. explored the effects of the environment on an individual's PA by estimating differences between a 30-min self-timed brisk walk taken in a park compared with one taken in an urban setting in Glasgow, Scotland [332]. This study showed that the environment can impact healthy adults' capacity to perform health-enhancing PA. Indeed, the park environment allows the individuals to walk briskly with fewer stops than in an

urban environment [332]. In addition, de Bloom et al. found positive effects of the park-walking activities on workers' recovery from work during lunch breaks [333]. The most consistent positive effects across the day were reported by the park walking group. Park walks and relaxation exercises during lunch breaks can enhance knowledge workers' recovery from work, but the effects seem small in magnitude and rather short in duration. The results of the present study are in accordance with these results, suggesting that PA in a public park could be a potential strategy to improve the wellbeing of populations. These beneficial effects were seen over a medium-term period (three months) and, in particular, in females in the different age groups.

While many studies have identified positive associations between urban green space and various aspects of individual health, the evidence linking green space to the decrease of obesity rates remains equivocal. In the present study, no significant variations in BMI or weight status have been observed. According to Browning et al. the apparent conflict in existing evidence could be attributable to various methodological issues: the absence of objective measures of obesity in some studies, use of pool rather than individual data, or insufficient control for potentially confounding factors, and short term follow-up periods that cannot match the effects induced by aerobic exercise, considering the importance of a dosage administered with a progressive and long term principle to achieve this goal [49]. Even if, in the present study, the direct effects of the supervised PA on BMI did not emerge, it should be considered that the duration of the intervention was limited. However, the desired effect of a reduction in a sedentary lifestyle, capable of reducing weight imbalances in the long term, emerged from the intentions of the participants to continue to practice physical activity even after the end of the project.

Despite the contributions that the present study provides to the knowledge of the subject, some limitations and strengths deserve discussion. The questionnaire was the main data collection tool. The main criticisms raised concerning this approach are related to "nonobjectivity", to the mixture

between the object of study and the detecting, and to the degree of a priori knowledge of the population itself, not only on the size of the sample. Therefore, the interpretation of these associations as causal effects must be made with due caution. The strength of the study is undoubtedly the three-month follow-up, which is often absent in similar studies. This period was sufficient to highlight the increased value of the practice of physical activity with important findings in the change of an active lifestyle, with significant differences in females in the older age groups and males in the younger classes.

The perspectives above concern the reliability of the data that would require confirmation through quantitative research with experimental data. The modern phase of the development of technological systems for the sampling of biological and environmental parameters, and the processing of the data thus obtained for research purposes, began several years ago.

Thus, so called “smart technologies” can help us acquire valuable data with simple acquisition methods for the user, both for the observed person or the operator carrying out the observation. It is also possible to organize remote control protocols during the activity for the individuals to whom physical activity is administered to maintain performance and psychophysical integrity or in a clinical context. The wearable devices are equipped with sensors whose characteristics allow a new way of detecting biovital indicators and parameters of daily life activities, providing targeted analyses of the individual lifestyle. These devices have many advantages, including the acquisition of signals that occur in a noninvasive, prolonged, and personalized, also allowing a new ability to interrelate environments, activities, and behaviors. All this would allow greater reliability in the control of physical activity, both in terms of methodology and in the recording and acquisition of parameters useful for identifying the volume of work to be correlated with the effects induced in short, medium, and long term control groups. An important avenue for further research is also to increase

knowledge aimed at understanding what types of green spaces matter and how they could be restored and redesigned to optimize the health and wellbeing of the population.

8.5 Appendix A

Figure 7. Map of Bologna, with highlighted the six parks considered.

The six parks are in different neighborhoods of Bologna and have different character- istics, listed below.

□ VELODROMO PARK

This park covers about 3 hectares. This park has several sports facilities, a children's play area, green meadows and a bar. It also has an area equipped for physical activity, called "Ability Park", in which anyone can train without barriers.

□ LUNETTA GAMBERINI PARK

This park covers about 14.5 hectares, it houses sports facilities, four schools, a com- munity center, and a youth center. The main feature of the park is that it is surrounded by a thick mixed hedge that

acts as a barrier against the traffic and noise of the surrounding streets. In addition, the park also has a play area for children, a skating rink and a dog area.

□ NICHOLAS GREEN PARK

This park covers about 8 hectares, has several play areas for children and a part dedicated to municipal vegetables gardens. In addition, it has wide lawns with pedestrian paths, but with few trees.

□ CEDRI PARK

This park covers about 11 hectares, it is characterized by large lawns, some woodland and a grove that runs along the river Savena, which defines the boundaries of the park. In the park, there is a wide plant variety, and, in addition, a children's play area, benches, and fountains.

□ SAN DONNINO PARK

This park covers about 8 hectares. The park is located between the ring road and the railway and was born to redevelop the area. It is composed of large green areas, pedestrian paths, and rest areas. It also houses an educational garden and a wooden pavilion where there is an association of citizens who take care of the park itself.

□ VILLA ANGELETTI PARK

This park covers about 8.5 hectares, and is along the right bank of the canal Navile. In the park there is a long strip of natural vegetation that offers the possibility of naturalistic observations.

9. Study 6: Effect of a Park-Based Physical Activity Intervention on Psychological Wellbeing at the Time of COVID-19

This article was published in the International Journal of Environmental Research and Public Health

Toselli, S.; Bragonzoni, L.; Grigoletto, A.; Masini, A.; Marini, S.; Barone, G.; Pinelli, E.; Zinno, R.; Mauro, M.; Pilone, P.L.; Arduini, S.; Galli, S.; Vitiello, M.; Vicentini, B.; Boldrini, G.; Musti, M.A.; Pandolfi, P.; Liberti, M.; Astorino, G.; Maietta Latessa, P.; Dallolio, L. Effect of a Park-Based Physical Activity Intervention on Psychological Wellbeing at the Time of COVID-19. Int. J. Environ. Res. Public Health 2022, 19, 6028. https://doi.org/10.3390/ijerph19106028

Keywords: citizen; green infrastructure; green urban space; park; physical activity; green exercise; health status; psychological wellbeing

Overview

The aim of the study was to assess the effect of a structured park-based physical activity intervention, the “Moving Parks” project, on citizens’ wellbeing at the time of COVID-19. The intervention was carried out in six public parks in Bologna (Italy) and administered by qualified instructors (from May 2021 to September 2021). The Psychological General Well Being Index short form questionnaire was administered before and after the three months of outdoor activities.

9.1 Introduction

Physical inactivity (PI) is an established risk factor for premature mortality and a global public health problem [160]. This term is used to refer to inability to achieve the recommended levels of physical activity for health [159]. With the effort to control the spread of the COVID-19 pandemic, many opportunities for being physically active were suspended and a declining trend of levels of PA has occurred in all age groups [339]. Hall et al. pointed out that we are currently confronted with two pandemics occurring at the same time (COVID-19 and PI pandemic) and they predict a troubling future, where people will continue to move less and then will experience a poorer health trajectory as a result [340].

The negative effects of the lockdown have been reported not only on PA levels but also on general health in several studies and particularly for Italy in the review by Zaccagni et al. [341–343]. As expected, this review highlights a significant reduction in the amount of performed PA compared to before lockdown, in both the general population and in individuals with chronic conditions [344]. This fact has negative consequences on both general health, in terms of increased body mass, and on specific chronic conditions, especially obesity and neurological diseases [344,345]. Given this strong link between PA and major non-communicable diseases, among the nine WHO global targets for improving the prevention and treatment of non-communicable diseases to be attained by 2025, one is the 10% relative reduction in prevalence of insufficient PA [164]. However, if this current trend continues, the 2025 global PA target will not be met, thus now more than ever there is an increasingly strong need to promote PA for the population [159]. Petrunof et al., in their study on the associations between park access, park use, park PA time, and wellbeing, found that the association between the duration of PA in parks and wellbeing was particularly strong and evident, suggesting that promoting PA in parks, is a promising strategy for improving wellbeing in urban settings [346].

Many researchers have used these results to argue the potential importance of parks and green spaces during the pandemic for maintaining or improving health [347]. Heckert and Heckert conducted a scoping review on the relationship between health and green infrastructure use (such as use of parks, natural areas, private gardens) during the COVID-19 pandemic. Based on six articles, their conclusions showed mixed results for COVID- 19 specific health outcomes (i.e., COVID-19 reproductive rate, cases, and deaths), while improved non-COVID-19 health outcomes (i.e., depression, sleep quality, life satisfaction) were found from 15 studies, in particular regarding improved mental health [347]. The COVID-19 pandemic represents an unprecedented opportunity for exploring the deep integration between green infrastructure and public health [347].

The aim of the present study was to assess whether the "Moving Parks project", during spring and summer 2021, one year and a half since the start of the COVID-19 pandemic has increased the practice of physical activity even by people who did not practice it before and whether it has influenced the intention to continue. Another goal was to evaluate if the project may have contributed to the improvement of the psychological well-being of its participants. We hypothesize that citizen participation in park-based PA intervention affects the intention to practice PA and improves their psychological well-being.

9.2 Materials and Methods

9.2.1 The Project

The "Moving Parks project" was created by the Municipality of Bologna, a northern Italian city with approximately 391,686 inhabitants in January 2021. The project was carried out in six public parks from May to September 2021 for a total of 90 days and involved 20 sport associations offering different types of organized activities (i.e., yoga, postural training, Nordic walking; etc.). All activities were free of charge and administered by qualified trainers. Different strategies to enroll citizens in

the project were adopted such as billposting of posters in public spaces and buses, television advertising, distribution of fliers in many local commercial activities (i.e., pharmacies, shops), newsletters, and social media.

The study design was longitudinal with two different times of evaluation: the first at the beginning of the project (pre May 2021) and the second at the end of the project (post September 2021). Participants were directly approached by research teams in parks who also provided the administration of questionnaires. Participants were enrolled if they met these criteria: aged 18 years; able to write and read in Italian.

Approval for the study was obtained from the University of Bologna Bioethics Committee, (Prot. n. N 169182).

9.2.2 Questionnaire

A structured anonymous questionnaire was used to investigate the participants' PA habits and their psychological wellbeing before and after the three months of green exercise. This questionnaire, previously described [30], was divided into three parts: (1) general information about the participants, (2) information about their PA habits, and (3) psychological general wellbeing using the Psychological General Well Being Index short form questionnaire (PGWB-S) [336].

The PGWB-S is the short version of a 22-item HRQoL questionnaire developed in the US. This short version explores the following six HRQoL domains: anxiety, vitality-energy, depressed mood, self-control, positive well-being, and vitality-tiredness. Each possible answer ("none of the time", "a little bit of the time", "some of the time", "a good bit of the time", "most of the time" and "all of the time" was transformed into a discrete observation to obtain only items with a Likert scale, where 1 means the poorest score and 6 means the best one. The questionnaire used during this project was

validated by Toselli et al. using data from a previous study [163]. The questionnaires were administered both on paper and as an online survey using Google Moduli Form.

9.2.3 Statistical Analysis

Continuous variables were described using mean and standard deviation (SD), while categorical and Bernoulli variables were described through absolute and relative frequencies. Normal distribution of dependent continuous variables was assessed graphically using density graphs and tested with the Shapiro–Wilk test. The mean comparisons between continuous variables were analyzed using the student t-test (t), whereas the mean comparisons within the same continuous variables at different times were tested by the paired student t-test. The proportion differences were evaluated with the Z test of proportion (Z). The significance level was set as $p < 0.05$ (p).

Statistical analyses were carried out using STATA software, version 17 (StataCorp LP, College Station, TX, USA) [348].

9.3 Results

Figure 8 shows the survey flowchart. At the beginning of the project (May 2021), a cohort of 619 subjects was enrolled in the study and only 337 returned the post-questionnaire in September 2021. Of these, nine participants were excluded for missing data. Finally, a total of 328 participants were included in the analysis.

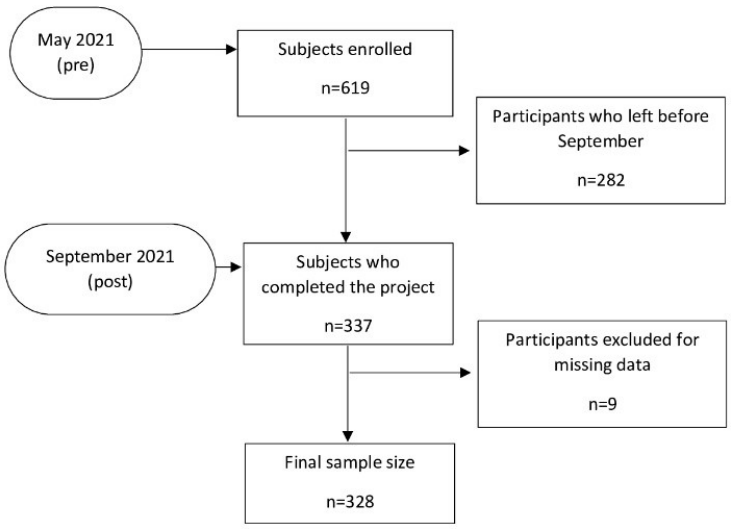


Figure 8. Flow chart of participants.

Table 29 shows the sex and age characteristics of the participants.

The age distributions were divided into three categories: 18–44 years old (n = 153, 46.65%), 45–64 years old (n = 115, 35.11%), elder than 65 years (n = 50, 15.24%). The proportion of 25.5% of the younger participants (n = 39) began to practice PA with the “Moving Parks project”, whereas the proportions were 21.74% (n = 25) and 32% (n = 16) for the 45–64 and over 65 groups, respectively. In addition, 59.45% (n = 195) of the participants lived near the parks in which the activities were proposed. Finally, a greater proportion of female participants who attended the ‘Moving Park project’ was observed in 2021 compared to the previous decade ($Z = 9.02$, $p < 0.0001$), while the percentage of male participants did not change ($Z = 0.23$, $p = 0.82$).

Table 29. Proportion differences between sexes.

General	*Female*		*Male*		*Δ*	
	n	***%***	***n***	***%***	***Z***	***p***
	253	77,13	75	22,87	23,3	<0,0001*
Age distribution						
18-44 years	131	39,94	32	9,76	4,88	<0,0001*
45-64 years	87	36,52	28	8,57	3,27	<0,001*
>65 years	35	10,67	15	4,57	1,6	0,11

Note: n, number of observations; %, percentage; Δ, differences between sexes; Z, test of proportion Z; p, p-value; *, statistically significant.

Table 30 the anthropometric characteristics, intention and importance to practice PA of the participants are reported.

Table 30 the anthropometric characteristics, intention and importance to practice PA of the participants are reported.

	Females (*n* = 253)		**Males (*n* = 75)**		**Δ Female (pre-post)**		**Δ Male (pre-post)**		**Δ Female-Male (pre)**		**Δ Female-Male (post)**	
	Pre	**Post**	**Pre**	**Post**	**p. t or Z**	***p***	**p. t or Z**	***p***	**t or Z**	***p***	**t or Z**	***p***
Anthropometric characteristics [Mean (±SD)]												
height	162.03 (±6.1)	-	175.68 (±6.22)	-	-	-	-	-	- 16.94	<0,0001*	-	-
weight	60.35 (±9.44)	59 (±9.41)	75.93 (±11.69)	75.25 (±10.1)	1,8	0,07	0,41	0,68	-11,8	<0,0001*	- 12,9	<0,0001*
BMI	23.05 (±4)	22,47 (±3,43)	24,64 (±3,88)	24.35 (±2,79)	2,12	<0,05*	0,53	0,6	-3,04	<0,01*	- 4,34	<0,0001*
Weight status [%]												
underweight	7,51	10,67	1,33	2,66	-1,63	0,1	-0,72	0,47	1,96	<0,05*	2,14	<0,05*
normalweight	73,52	68,77	58,67	58,66	1,63	0,1	0,01	0,99	2,47	0,01*	1,63	0,1
overweight	15,81	17,79	34,67	34,66	-0,82	0,41	0,01	0,99	-3,58	<0,001*	-3,12	0,001*
obese	3,16	2,77	5,33	4,00	0,38	0,7	1,35	0,18	-0,88	0,38	-0,54	1
Plan to practice PA at the end of the project (yes) [%]	97,23	96,44	95,83	97,33	0,68	0,5	-0,81	0,42	0,62	0,54	-0,38	0,71
Frequency planned for practice (hours) [Mean (±SD)]	2,29 (±0,67)	2,22 (±0,71)	2,43 (±0,71)	2,48 (±0,67)	0,9	0,37	-0,13	0,89	-1,49	0,14	-2,7	<0,01*
Importance to practice PA regularly [Mean (±SD)]	5,3 (±1.01)	6,05 (±0.97)	5,3 (±1.17)	6,25 (±0.92)	-36	<0,0001*	-17,54	<0,0001*	-0,02	0,99	-2,7	<0,01*

Note: PA, physical activity; n, number of observations; SD, standard deviation; t, student' t-test; p. t, paired student' t-test; Z, Z-test of proportion; p, p-value; D, difference; *, statistically significant.

Significant differences were observed in BMI and weight status between sexes both at baseline and follow-up, since women showed a higher prevalence of underweight and normal weight subjects. As a consequence, BMI is always significantly lower in women than in men. Only in females was a significant decrease in BMI observed between baseline and follow-up. Conversely, no proportion differences were observed within and between sexes in the planification of practice PA at the end of the "Moving Park project", but male participants reported a higher mean of hours in post evaluation. In addition, both female and male samples retained the practice of PA more importantly after the project participation.

In addition, an investigation on participants lifestyle habits was assessed in order to understand which ways participants used to travel and whether they used stairs or elevators. Female subjects preferred to walk or cycle more than males, with a significant difference in post evaluation (F = 55.29%, M = 40%; $Z = 2.14$, $p < 0.05$). Additionally, both sexes increased the use of cars or motorcycles for city transport after the project (M: pre = 42.16%, post = 50.67%; F: pre = 32.73%, post = 34.90%), with a significant difference in post-test ($Z = 2.48$, $p = 0.01$). As regards the use of stairs or elevators, a significant difference was found between sexes before the project, where males preferred the stairs compared to female subjects ($Z = 2.85$, $p < 0.01$). Although no significant results were found, after the project both sexes groups increased elevator usage.

Table 31 shows psychological wellbeing before and after attending the "Moving Parks".

A significant improvement of wellbeing at the end of the project was observed in women for all the six domains. In men an improving trend was observed only in domain two and domain six. Significant differences were observed in pre- and post-evaluation between genders in domains four ("feel emotionally stable"), five ("feel cheerful"), six ("feel tired")).

Table 31. Psychological differences within and between sexes.

	Females (*n* = 253)		Males (*n* = 75)									
	Pre	Post	Pre	Post	Δ Female (pre-post)		Δ Male (pre-post)		Δ Female-Male (pre)		Δ Female-Male (post)	
	Mean (±SD)	Mean (±SD)	Mean (±SD)	Mean (±SD)	p. t	*p*	p. t	*p*	t	*p*	t	*p*
Feel nervous	4.51 (±1,33)	4.94 (±1,14)	4.81 (±1,3)	5,09 (±0,98)	-4,12	<0,0001*	-1,5	0,11	-1,73	0,09	-1,03	0,31
Feel full of energy	4.14 (±1,01)	4.55 (±0,87)	4.41 (±1,04)	4.73 (±0,76)	-4,78	<0,0001*	-2	0,05*	-2,05	0,05*	-1,70	0,09
Feel downhearted	4.42 (±0,97)	4.72 (±0,87)	4.63 (±0,93)	4.84 (±0,85)	-3,67	<0,0001*	-1,44	0,16	-1,65	0,1	-1,09	0,29
Feel emotionally stable	3,77 (±1,17)	4.05 (±1,21)	4.12 (±1,21)	4.35 (±1,18)	-2,7	<0,01*	-1,08	0,28	-2,27	<0,05*	-1,92	0,05*
Feel cheerful	3,68 (±0,99)	3,96 (±1,1)	4.04 (±1,11)	4.29 (±1,08)	-3,08	<1,0001*	-1,39	0,17	-2,68	0,01*	-2,3	<0,05*
Feel tired	4.23 (±0,96)	4.59 (±0,91)	4.49 (±0,84)	4.97 (±0,77)	-4,42	<1,0001*	-3,64	<0,001*	-2,19	<0,05*	3,28	0,001*

Note: n, number of observations; SD, standard deviation; t, student' t-test; p. t, paired student' t-test; p, p-value; D, difference; *, statistically significant.

9.4 Discussion

The aim of the present study was to evaluate the effect of the "Moving Parks project", a PA intervention conducted during the spring and summertime in 2021, one year a half since the start of the COVID-19 pandemic, on physical activity practice, on the intention to continue it, and on citizens' psychological wellbeing. Our results appear to confirm the effectiveness of the proposal on the expected outcomes. It is to be considered that, after China, Italy was the second country in the world to be affected by the COVID-19 pandemic and the first country in Europe to implement a national lockdown to contain the spread of COVID-19. As a result, like many other activities, in Italy, gyms, pools, fitness and dance studios were closed until the end of May 2021 (only physiotherapy centers were open). In particular, sports participants stopped training due to social distancing restrictions and quarantine guidelines and on the use of sports facilities [349]. Therefore, the project

was proposed at the end of the restrictions. It should be remembered that the closure of sports facilities due to COVID-19 prior to the considered period may have had a negative impact on mental health and a decrease in the level of happiness, since continuous sports practice leads to mental health happiness due to exercise [350]. Since the beginning of the SARS-CoV-2 outbreak, researchers have conducted several studies on the importance of participation in PA, also during self-quarantine, on mental health and well-being [351–353]. Reports state that for those who participate in physical activities such as sport for all, discover their active side and achieve new challenges and efforts on their own, which positively affect life satisfaction [354–356]. In the study period, probably people were relieved after the easing of quarantine policies; however, they could have been affected by the realistic fear of COVID-19 infection and so outdoor PA practice in green space may have given them more safety.

Most participants were women and, there was a large number of them who took part for the first time in the “Moving Parks” initiative in 2021 (65.32%) with respect to men. The willingness of the participants to follow the project is evidenced by the percentage of subjects (about one third) willing to move from their own station to follow the proposed activity of the project.

A considerable percentage of subjects (about a quarter) started to practice PA with the project, with a prevalence in females. Van Uffelen et al. reported that women preferred activities at a fixed time, whereas men were more likely to prefer activities that require skill and practice, that are vigorous and that involve competition [356]. In addition, women were more likely to prefer supervised activities, and activities with people the same age and gender as them. Thus, women have stronger preferences than men for whom they are active with, which matches with the findings showing that they are more likely to be motivated by social factors. Waters et al. found that most participants in a PA intervention trial were healthy but sedentary women (63%), and middle-aged [357]. In addition, women are more likely to respond to surveys than men [358,359]. Among those who

started PA with the projects, a significant difference connected to age was observed: in females the 18–44 year old woman prevailed, while in males rather the >65 aged man. The data regarding women are in disagreement with previous studies that showed that parks were generally underutilized by young people [360].

Moreover, young people tend to spend most of their leisure time on the internet, rather than engaging in outdoor activities [356]. Probably the restrictions and relative isolation due to COVID-19 that characterized the period preceding the study fostered even in the youngest the need to be outdoors and to share activities with other people.

As regards lifestyle habits, women showed healthier habits: a significantly higher number of women than men declared using the stairs or walking, while a higher number of men than women preferred to use car, motorcycle, or scooter.

The intention to continue PA practice at the end of the project was very high. In this regard, it is important to note that consideration of participation intention precedes that of intention. Intention means that each individual's beliefs are transferred to concrete actions towards the planned future [253]. The term, "intention" should necessarily be premised on all participatory actions of each individual. Similarly, the intention to participate in sports also indicates the decision on which situation to participate in, and the state of final resolution accordingly [360]. Researchers have reported that level of PA declined as age grew, and intrinsic motivation was identified as the only predictor of daily PA that can be measured objectively and might be positively linked to exercise adherence [361–363]. Indeed, participants with higher levels of intrinsic motivation have been shown to persist in activities for longer, and report higher levels of adherence [364]. In light of such considerations, the results of the present study appear to be very positive. In support of this, in both

genders a significant increase in the importance given to the practice of PA regularly was observed between baseline and follow-up.

After the participation in the “Moving Parks” project, all psychosocial parameters significantly improved in women and in vitality-energy and vitality-tiredness domains in men. The improvement of these parameters is in line with the data regarding pre-COVID-19 pandemic: using data from the past project’s editions, where a reduction in the state of tension, sadness, and fatigue, and an improvement in the state of energy, serenity, and vitality of the participants was observed [163].

This study confirms that physical-activity interventions have beneficial effects on wellbeing [365–367] supporting its efficacy also in young adults. This represents the strength of the study, since most of the studies in literature have examined older adults and, on the other hand, there is less evidence with regard to young and midlife adults [366]. In addition, there are not many studies on this topic and in general they were not conducted in the “real world” at the time of COVID-19.

The main limitation of the study concerns the absence of a control group, which might have allowed a better interpretation of the results. The numerosity of the follow-up sample has nearly halved, probably due to the summer holidays and/or the resumption of work activities. In addition, no information on the level of education and real age were collected. The type of activities carried out during the Moving Park Project were not collected in the questionnaires. Nevertheless, it is necessary to take into account that summertime and the illusion of the end of the pandemic could have influenced the results. Further research should consider collecting additional quantitative and objective outcomes such as type of activities performed and to carry out a comparison with a control group in order to establish the effectiveness and the dose-response relations of the intervention.

Although more rigorous research is needed, our results seem to support the health-related benefits generated by PA in parks. As reported by Larson and Hipp, these benefits during the COVID-19 pandemic could be more conspicuous now than ever before [368].

10. Study 7: Physical Activity Behavior, Motivation, and Active Commuting:Relationships with the Use of Green Spaces in Italy

This article was published in the International Journal of Environmental Research and Public Health

Grigoletto A, Loi A, Maietta Latessa P, Marini S, Rinaldo N, Gualdi-Russo E, Zaccagni L, Toselli S. Physical Activity Behavior, Motivation and Active Commuting: Relationships with the Use of Green Spaces in Italy. Int. J. Environ. Res. Public Health 2022, 19, 9248.

https://doi.org/10.3390/ijerph19159248

Keywords: active commuting; green urban space; motivation; physical activity; COVID-19

Overview

Public parks may be an attraction for many people living in the cities and could help to achieve the recommended dose of PA. The present study aimed to understand the motivation that drives people to go to a park and evaluate the amount of PA practiced by park-goers. A questionnaire was anonymously administered to 383 voluntary visitors to the Arcoveggio park (Bologna), aged 18–70 years. The main motivations for using the park were related to relaxation, performing PA, or both. The time per week spent at the park, the method of getting there, and the kind of PA were significant explanatory variables of the amount of PA practiced. The highest number of minutes of PA was achieved by those who travelled to the park by running, while those who used vehicles presented the lowest number.

10.1 Introduction

The recent emergence of SARS-CoV-2 has influenced the lifestyle of the population, reducing PA and becoming a serious concern, mainly for the elderly who are typically more prone to chronic diseases and less active, compared to younger people [369–371]. Strategies are therefore needed to increase PA and reduce the sedentary lifestyle of the population. One of the strategies that could help to achieve the goal of the recommended levels of PA can be active transport such as walking or cycling from home to work, shopping, recreational places, and vice versa [372]. In this light, a suitable plan for promoting PA, maintaining a healthy weight, and improving mental health may be to empower citizens to switch from using private motor vehicles to active transportation [373–376]. In addition, public transportation options (e.g., buses or trains) can encourage people to walk from and to various public transportation stops, increasing their PA levels, albeit to a lesser extent. A worldwide study showed that PA levels are higher in walkable cities, because they allow active commuting and allow more frequent to travel from home to downtown or other destinations within the city by bicycle or on foot [377]. According to Zijlema et al., the increase of PA may be most successful when integrated into daily life habits. Another factor that can help people to achieve the right amount of PA is the use of green parks [165]. Public green spaces provide multiple health benefits by facilitating PA, contact with nature, and social interaction [95,115,168,169,235,378]. Despite several pieces of evidence on the health benefits of parks, they are generally underutilized, and visitors are often engaged in low levels of PA during their park visits [115,116]. Initiatives created to increase PA in green spaces have been linked with improvements in social networking and feelings of connectivity and companionship, an increased appreciation of nature, improvement in self-esteem, and a means of escape from modern life [229,379]. Even though there is an increasing literature about the practice of PA, and on the motivations and interventions related to the increase in outdoor PA in green spaces, few studies have been carried out in Italy [380]. In addition, the motivations that cause

people to use green space are still unclear and, therefore, it is important to understand how these can be linked to PA practice [179,180]. Understanding the motivations that drive people to use green urban space is important to implement adequate strategies.

The purposes of this study were: (1) to assess people's motivations to use the park, (2) to assess how many people in each sex and age group use the park to do PA, and therefore to understand how much park use affects PA levels, and (3) to evaluate the contribution of active, vehicle-free transportation (walking, jogging, bicycling) in achieving of the recommended levels of PA.

To achieve these goals, a new questionnaire ad hoc designed was developed and administered in Arcoveggio park, in Bologna (North Italy), which is the capital of the Emilia-Romagna region, with nearly 4.4 million inhabitants over an area of 22,446 km2 [259]. Arcoveggio park covers nine hectares in the city's northern sector. The park contains outdoor fitness equipment, picnic areas, trails, and bicycle paths. As the COVID-19 pandemic has changed the lifestyle habits, this research could be a starting point to understanding the motivation that leads people to use the park and plan interventions to increase PA.

10.2. Materials and Methods

10.2.1. Questionnaire Development and Procedures

A new questionnaire was developed. To design the questionnaire, we drew on our personal experience and previous studies in the literature [165]. The items were independently submitted to the opinion of three researchers with expertise in PA to assess their clarity and relevance. The questionnaire, administered anonymously, and was divided into two sections (see Supplementary Materials, Figure S1): the first section was designed to collect demographic information, including age, sex, weight, height, profession, and level of education. The Body Mass Index (BMI, kg/m^2) was calculated from the referred values of weight and stature, and the weight status was assessed

according to the World Health Organization guidelines [381]. The second part of the questionnaire consisted of 15 questions designed to assess important motivation to use the park, and the quality and amount of PA practiced. The total amount of PA and the time of active commuting were calculated by multiplying the active time and the journey time by the number times a week that the participants visited the park. Finally, the two amounts were summed to calculate the total amount of PA and of active commuting.

10.2.2. Participants

Three hundred eighty-three individuals were randomly recruited among park-goers. The same researcher administered a printed questionnaire to all participants at Arcoveggio Park in Bologna (North Italy). The park, which is one of the largest parks in the city, is located in a neighborhood of socio-economic variability, representing, therefore a cross- section of the population of Bologna [382]. Questionnaire administration began in March 2021, during the pandemic, and was completed in April 2021.

The study included a sample of men and women who met the following inclusion criteria: having signed the informed consent; being a park-goer; and aged between 18 and 70 years. Pregnant women were excluded from the study.

The survey was approved by the Bioethics Committee of the University of Bologna (prot. N. 0224254 of 9 October 2020).

10.2.3. Statistical Analysis

The internal consistency of the questionnaire was evaluated by Cronbach's alpha coefficient on the answers of the recruited sample. Cronbach's alpha is considered reliable for values between 0.5 and 0.9. In addition, a test–retest method was used to assess the reliability of the questionnaire 15 days later. Subsequently, to better achieve the objectives of the study, we performed an a priori power

analysis using G*Power (version 3.1.9.2, Universität Kiel, Kiel, Germany) to determine sample size, given α, power, and effect size. When ANOVA was performed (α = 0.05; 1-β = 0.95; effect size f = 0.25), a sample size of 303 participants was detected. The outcomes parameters for the multiple regression detected a sample size of 123 participants. Additional subjects were involved to ensure the availability of data in the case of problems with data collection. Variables' normality was verified with the Shapiro–Wilk test. Descriptive statistics (mean and SD for continuous traits, and frequency for discontinuous traits) were calculated. Differences in frequency distribution between groups were evaluated by the Chi-squared test. Two-way ANOVAs were carried out to assess differences among sexes and age classes in anthropometric characteristics and questionnaire items. When a significant F ratio was obtained, the Tukey post hoc test was used to evaluate the differences between the groups. Finally, a multiple regression analysis was carried out to assess possible predictors of the amount of PA. Before performing the multiple regression, all the assumptions were verified. The Shapiro–Wilk test and the variance inflation factor (VIF) test were performed to verify the normal distribution and the multicollinearity of the variables. Anthropometric and sociodemographic variables and information regarding the use of the park were included in the model as independent variables. Predictors inputted into the model were those found to have significant associations with the total minutes of PA (i.e., $p < 0.05$). The data analysis was performed using Statistica for Windows, version 8.0 (Stat Soft Italia Srl, Vigonza, Padua, Italy).

10.3 Results

The questionnaire was validated using the test–retest method and Cronbach's alpha was used to provide a measure of the internal consistency. The value was 0.70 which is acceptable. Twenty-five people were asked to complete the questionnaire twice, at a distance of two weeks, in order to assess the reliability of the survey. The correlation values are presented in Table 32.

Table 32. Correlation values and p-value calculated for the validation of the questionnaire.

Questions	Correlation value	*p*-Value
Q1. Way to reach the park	0.74	<0.001
Q2. Active commuting (min/week)	0.98	<0.001
Q3. From 1 to 10, how tired were you when you reached the park?	0.68	<0.001
Q4. How far (in meters, approximately) is your home from the park?	0.99	<0.001
Q5. Do you go to the park to practice PA?	0.83	<0.001
Q6. If you do not practice PA at the park, why do you go to the park?	0.70	<0.001
Q7. Kind of PA	0.86	<0.001
Q8. How many times per week do you go to the park?	0.88	<0.001
Q9. How many hours of PA do you practice at the park?	0.93	<0.001
Q10. If there wasn't this park, would you have practiced PA in an indoor environment?	0.85	<0.001
How often would you practice indoor PA if there wasn't a park (h/week)?	0.71	0.04
Q11. Where do you like to exercise the most?	0.88	<0.001
Q12. If you practice indoor exercise, in which type of indoor environment?	0.80	<0.001
Q13. Are you satisfied with this park?	0.76	<0.001
Q14. I feel more energetic, after practicing PA in the park	0.75	<0.001
Q15. I feel more energetic, after visiting the park	0.81	<0.001

Most of the respondents were females (n = 215, 56.1%). Since the age range of the participants was wide (from 18 to 70 years), people were divided into 10-year age class groups, with the exception of the first group (first group: 18–30 years). The class most represented was the first (n = 130, 34%), followed by those aged 31–40 years (n = 75, 20.1%), 41–50 years (n = 67, 19.6%), 51–60 years (n = 65, 17%), and 61–70 years (n = 46, 12%).

Table 33 summarizes the anthropometric characteristics of the study participants.

Table 33. Anthropometric characteristics of the participants

	Females (n=215)					Males (n=168)				
Age (years)	18-30	31-40	41-50	51-60	61-70	18-30	31-40	41-50	51-60	61-70
N	70	36	43	34	32	60	39	24	31	14
%	32.6	16.7	20.0	15.8	14.9	35.7	23.2	14.3	18.5	8.3
Weight (kg)	58.2	68.1	66.9	78.3	74.7	63.4	67.8	73.3	76.1	85.9
SD	9.2	16.6	13.5	12.6	10.6	10.3	13.4	11.7	9.4	12.5
Height (cm)	165.8	164.8	164.1	164.2	164.4	177.9	178.5	175.8	175	177.4
SD	8.1	6.7	5.3	7.2	5.2	8	5.1	7.1	7.7	7.9
BMI (kg/m^2)	21.2	25.4	25.3	25	25.3	23.1	24.5	24.6	24.4	27.2
SD	2.8	3.8	5.8	4	4.8	2.9	3.1	2.7	2.8	3.5
Weight status (%)										
Underweight	17.3	11.2	4.7	-	3.1	5	-	-	-	-
Normal weight	75.6	69.5	53.5	56	59.4	73.3	64.1	66.6	70.9	21.4
Overweight	4.3	5.5	27.8	25.6	28.1	20.0	30.7	33.4	22.6	55.2
Obese	2.8	13.8	14.0	18.4	9.4	1.7	5.2	-	6.5	21.4

N (%) for categorical data; mean and standard deviation (SD) for continuous data.

As expected, men had significantly higher mean values of weight and height (76.1±11.8 kg and 176.9±7.3 cm) than women (63.9±13.1 kg and 164.3±7.6 cm) ($p < 0.001$). In both sexes, the youngest age class had the lowest mean weight values, while males of the oldest age class and females of the age class of 51–60 years had the highest values. Regarding BMI, both women and men presented a significantly higher incidence of overweight and obesity with age ($p < 0.001$ for both women and men). In particular, the men belonging to the age class 61–70 years had the highest value while those belonging to the age class of 18–30 years had the lowest. Females showed higher frequencies

of underweight than males, but also of obesity. An exception is represented by the oldest age group, where males showed a higher prevalence of overweight and obesity.

Table 34 summarizes the demographic and socio-economic characteristics of the subjects who participated in the study and the categorical questionnaire items. Most of the participants were employed (n = 285, 74.4%), followed by students (n = 45, 11.7%), retired (n = 37, 9.7%), and, finally, unemployed (n = 16, 4.2%). A large proportion of the sample reached the park by walking (n = 151, 39.4%), followed by running (n = 86, 22.5%), using a motor vehicle (n = 69, 18%) or a bicycle (n = 43, 11.1%). Most of the participants preferred outdoor PA (88.9%), perhaps because outdoor PA was considered safer than gym training during the COVID-19 pandemic [383]. Significant differences among the age groups separately by sex were observed in all items, except for Q12, "If you practice indoor exercise, in which type of indoor environment?" in both sexes, for Q5, "Do you go to the park to practice PA?" in females and, for Q6, "If you do not practice PA, why do you go to the park?" in males. Regarding the way to reach the park, females of all ages preferred to walk and secondarily to use a motor vehicle; males also preferred to walk and using a vehicle was their last preference. Men of all age classes frequented the park to practice outdoor PA, except the oldest ones. Regarding the kinds of exercise practiced in the park, women showed an increase in walking with an increase in age, while men presented a bigger variability among the different age classes. With increasing age, both sexes preferred to practice outdoor PA instead of indoor PA. To the Q6, "why do you go to the park?" young women generally answered that they go to the park to relax or to socialize, but increasing age increased the percentage of women who go to the park to get in touch with nature or to relax, while the percentage of those who go there to socialize decreased. For men, the percentage of those visiting the park to relax decreased with the increasing age. In particular, considering the sub-categories, some differences emerged. As regards occupation, differences between sexes were observed for all the categories. In particular, in females there were fewer

employed subjects in the youngest and oldest age categories and a greater number of students in the youngest. No significant difference was observed between sexes in educational level, and, as expected, the distribution of different levels of education differed significantly among each age class. For Q1, the differences between sexes were always significant, except for running; significant differences were almost always observed among age classes, but the majority of people preferred walking. The use of the park to do physical activity (Q5) differed between sexes, as the majority of males went to the park to do PA at every age, as opposed to females. No differences were observed between sexes for Q6 because the majority went to the park to relax; differences among age classes were more marked in females. The kind of PA practiced (Q7) differed between sexes because the majority of females preferred walking, whilst men gave more heterogeneous results. Q10 did not show differences between sexes, while differences were observed among age classes, as with increasing age, more subjects would not have practiced PA indoors. No significant differences were shown for Q12, both between sexes and age classes.

Table 34. Sociodemographic characteristics and questionnaire responses of participants (n=383): comparison among age groups and sexes

	Females						Males						Females	Males	
	18-30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	61-70 yrs	p-values	18-30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	61-70 yrs	p-values	18-70 yrs	18-70 yrs	p-values
N(%)	70 (32.6)	36 (16.7)	43 (20.0)	34 (15.8)	32 (14.9)		60 (35.7)	39 (23.2)	24 (14.3)	31 (18.5)	14 (8.3)		215 (56.1)	168 (43.9)	
Occupation						<0.001						<0.001			<0.001
Employed	61.5	91.6	95.4	79.5	18.7	<0.001	75.0	94.9	95.9	96.8	28.6	0.12	67.9	82.7	<0.001
Student	37.1	2.8	-	-	-	<0.001	16.7	-	-	-	-	<0.001	16.3	6.0	<0.001
Unemployed	1.4	5.6	4.6	11.7	-	0.29	8.3	5.1	-	3.2	-	<0.001	3.7	4.8	<0.001
Retired	-	-	-	8.8	81.3	<0.001	-	-	4.1	-	71.4	<0.001	12.1	6.5	<0.001
Education level						0.06						0.07			0.23
High school	40.0	50.0	46.5	67.7	62.5	<0.001	45.0	61.5	41.7	58.1	92.9	<0.001	49.7	55.4	0.75
Bachelor's degree	48.6	16.7	11.6	14.7	25.0	<0.001	26.7	15.4	12.5	16.1	-	0.07	27.9	17.3	0.10
Master's degree	10.0	30.6	32.6	17.6	9.4	0.01	28.3	15.4	41.7	22.6	7.1	0.01	19.1	24.4	0.53
PhD	1.4	2.7	9.3	-	3.1	<0.001	-	7.7	4.1	3.2	-	<0.001	3.3	2.9	0.98
Q1. Way to reach the park						<0.001						<0.001			<0.001
Walking	52.8	83.3	60.4	79.4	65.6	0.02	40.0	43.5	45.8	54.8	50.0	<0.001	65.6	56.7	0.01
Running	11.4	-	2.3	2.9	-	0.09	35.0	17.9	29.1	9.6	7.1	0.16	4.7	24.6	0.24
Bicycle	18.5	11.1	13.9	11.7	3.1	0.05	15.0	33.3	20.8	25.8	14.2	<0.001	13.0	11.2	<0.001
Vehicle	17.1	5.6	23.3	5.8	31.2	0.74	10.0	5.1	4.1	9.6	28.5	0.04	16.7	7.5	0.04
Q5. Do you go to the park to practice PA?						0.29						0.01			<0.001
No	41.4	50	55.8	55.9	62.5	0.04	20.0	23.1	16.7	25.8	64.3	0.04	51.2	25.0	<0.001
Yes	58.6	50	44.2	44.1	37.5	0.15	80.0	76.9	83.3	74.2	35.7	<0.001	48.8	75.0	<0.001
Q6. If you do not practice PA at the park, why do you go to the park?						0.01						0.15			0.60
Get in touch with Nature	11.9	19.4	29.3	25.8	16.7	0.02	7.4	14.3	13.0	7.7	53.8	<0.001	19.8	17.3	0.60

Relax	67.8	74.2	46.3	61.3	83.3	0.20	77.8	67.9	73.9	92.3	30.8	0.48	65.6	70.7	0.57
Socializing	20.3	6.5	24.4	12.9	-	<0.001	14.8	17.9	13.0	-	15.4	0.16	14.6	12.0	0.52
Q7. Kind of PA						<0.001						<0.001			<0.001
Light running	23.2	18.7	10.6	-	-	0.40	18.2	24.2	36.8	22.7	14.3	<0.001	7.0	17.9	0.07
Outdoor fitness equipment	7.7	-	10.6	-	7.1	0.01	68.2	27.6	-	-	-	<0.001	5.5	36.9	<0.001
Skating	3.7	-	10.6	-	-	<0.001	-	-	-	-	-	0.05	1.3	-	0.27
Walking	38.7	81.3	47.2	100	71.4	0.03	4.5	24.2	42.1	59.1	57.1	<0.001	75.3	32.3	<0.001
Football	-	-	-	-	7.1	<0.001	2.3	10.4	-	-	-	<0.001	1.3	1.2	0.90
Bicycling	19.3	-	5.2	-	-	0.02	-	13.7	-	18.2	28.6	<0.001	7.0	8.3	0.54
Stretching	3.7	-	10.6	-	-	<0.001	6.9	-	10.5	-	-	<0.001	1.3	2.4	0.67
Nordic walking	3.7	-	5.2	-	14.4	0.42	-	-	10.5	-	-	<0.001	1.3	1.0	0.28
Q10. If there wasn't this park, would you have practiced PA in an indoor environment?						0.01						<0.001			0.75
Yes	51.4	50.0	37.2	32.4	21.9	0.19	58.3	28.2	66.7	29.0	21.4	0.02	40.9	44.0	0.89
No	38.6	25.0	39.5	55.9	68.8	0.05	31.7	59.0	33.3	51.6	42.9	0.27	43.7	42.9	0.99
I don't know	10.0	25.0	23.3	11.8	9.4	0.14	10.0	12.8	-	19.4	35.7	0.05	15.4	13.1	0.84
Q11. Where do you like to exercise the most?						0.01						0.03			<0.001
Outdoor	77.1	82.9	95.3	94.1	90.6	0.79	91.5	89.7	91.7	93.5	91.7	0.08	86.9	91.5	0.63
Indoor	22.9	17.1	2.3	5.9	9.4	<0.001	8.5	10.3	8.3	6.5	8.3	0.09	13.1	8.5	<0.001
Q12. If you practice indoor exercise, in which type of indoor environment?						0.53						0.19			0.75
Home	37.9	28.1	28.9	46.4	47.8	0.56	35.8	37.5	29.2	32.0	27.2	0.56	39.9	33.8	0.64
Gym	59.1	59.4	63.2	50.0	52.2	0.95	62.3	56.3	70.8	48.0	54.5	0.86	57.8	59.3	0.85
Swimming pool	3.0	12.5	7.9	3.6	-	0.28	1.9	6.3	-	20.0	18.2	0.01	2.3	6.9	0.57

Note. Yrs= years; Differences between the overall categories are reported in bold

In addition, since the distance between home and the park could be an important factor that influences the decision on the way to reach the park, a Chi-squared test was conducted between these two variables. The distance was divided into the following five categories: less than 300 m, from 300 m to 1000 m. from 1000 m to 2000 m, from 2000 m to 4000 m and over 4000 m. The p-value of the Chi-squared test was statistically significant for the total sample (<0.001) and for all the other subcategories. The results of the two-way ANOVAs to evaluate sex and age group differences are reported in Table 35. Significant differences were found in Q10, "How often would you practice indoor PA if there wasn't a park (h/week)?", in the preference to practice indoor PA, the level of satisfaction with the park, and in the level of fatigue when reaching the park. From what the question, "How often would you practice indoor PA if there wasn't a park (h/week)", the respondents of age class 51–60 years would have practiced little activity, while the youngest ones would have practiced it anyway. Participants in the age class 31–40 years showed the highest preference for indoor PA. Most participants in all the age groups were satisfied with the park, but the most satisfied were those in the age class 41–50 years. The respondents in the age class 18–30 years took the longest time to reach the park, because they came from more distant places. Regarding sexes, significant differences were found in levels of fatigue when reaching the park: women reported higher levels of fatigue than men. The oldest men used the park more often (3.75±1.94 times a week), while the oldest women used it less (2.33±1.22 times a week). Generally, the participants felt more energetic and more peaceful after visiting the park. Of the total of 383 participants, 232 (60.6%) usually practiced outdoor PA. Figure 9 shows the amount of PA practiced in the park and active commuting to reach the park by sex and age classes. The figure shows that, generally, men practiced more PA than women, except for the age group 61–70 years, in which women practiced more PA than men. However, only men in the age class 18–30 years achieved the

goal of 150 min/week of moderate PA, on average, while men in the age class 61–70 years showed the lowest PA level.

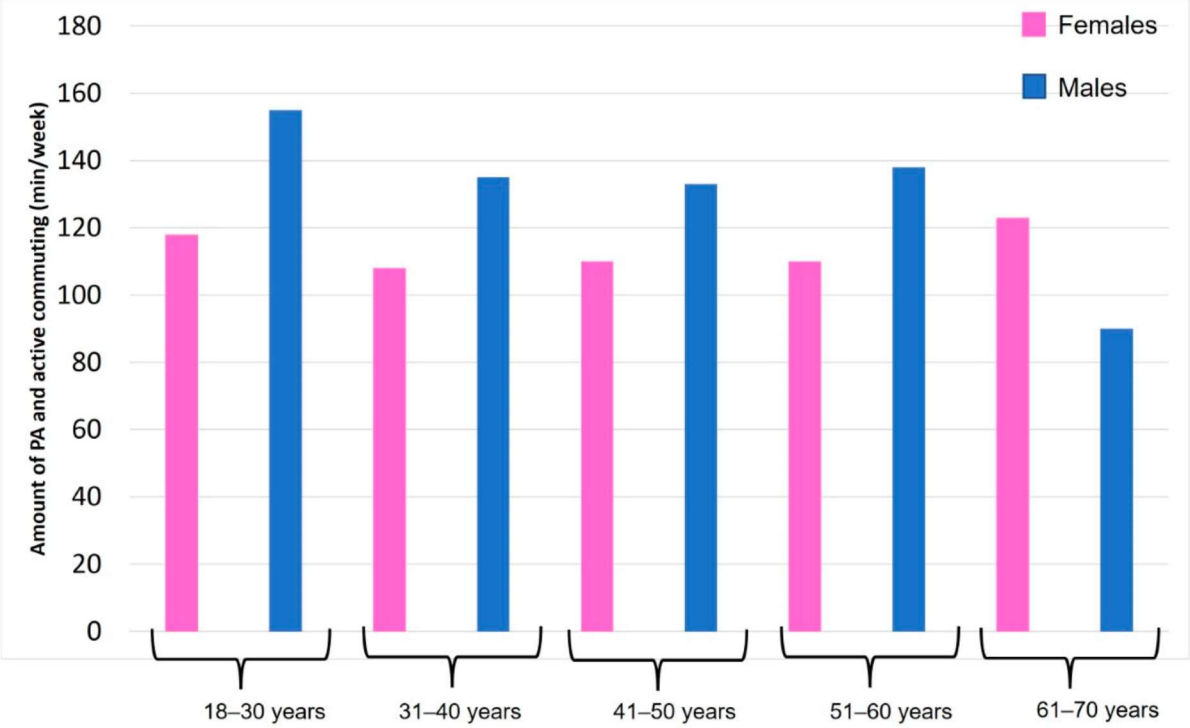


Figure 9. Amount of PA and active commuting in the park by sex and age classes

Table 35 Descriptive statistics and ANOVA by sex, age groups, and interaction between sexes and age groups

	Female					Male									
	18-30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	61-70 yrs	18-30 yrs	31-40 yrs	41-50 yrs	51-60 yrs	61-70 yrs	Age class		Sex		Age class*sex	
Variable	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	F	p	F	p	F	p
Q2. Minutes to reach (min)	72.85 (48.25)	65.13 (42.27)	68.61 (50.63)	56.41 (46.67)	64.18 (43.41)	81.80 (47.31)	76.12 (56.43)	53.41 (42.26)	68.14 (34.00)	75.86 (38.80)	1.58	0.17	0.77	0.37	0.82	0.50
Q3. From 1 to 10 how tired are you to reach the Park?																
	2.33 (0.88)	1.94 (0.75)	1.57 (0.81)	2.53 (1.43)	2.58 (1.08)	1.53 (0.67)	1.42 (0.51)	1.13 (0.35)	1.10 (0.32)	1.40 (0.55)	2.45	0.04	34.64	<0.001	1.57	0.18
Q4. How far (in meters, more or less) is your home from the park?																
	2971.4 (3034.0)	2582.7 (5512.7)	2110.2 (4662.4)	1962.1 (2344.3)	2422.8 (2024.0)	2631.6 (2819.9)	2311.5 (1265.6)	1706.2 (1903.7)	3220.9 (3910.2)	2342.3 (3001.3)	0.80	0.53	0.00	0.97	0.76	0.55
Q8. How many hours of daily training do you do at the park?																
	1.33 (0.61)	1.33 (0.49)	1.29 (0.73)	1.47 (0.64)	1.83 (1.70)	1.65 (0.63)	1.27 (0.45)	1.63 (0.67)	1.35 (0.57)	1.20 (0.45)	1.16	0.32	3.48	0.06	1.39	0.23
Q9. How often indoor PA if there wasn't a park (h/week)?																
	2.67 (1.12)	2.11 (0.76)	1.94 (0.44)	1.91 (0.30)	2.00 (0.00)	2.57 (1.07)	2.45 (0.82)	2.19 (0.66)	2.11 (0.60)	2.67 (0.58)	3.42	0.01	2.50	0.11	0.65	0.62
Q10. Where do you like to exercise the most?																
Indoor	2.54 (0.94)	3.19 (0.98)	2.90 (0.55)	2.55 (0.82)	2.14 (0.90)	2.30 (0.88)	2.48 (0.73)	2.63 (1.06)	2.00 (0.85)	3.00 (0.00)	2.40	0.05	0.97	0.32	1.34	0.25
Outdoor	3.00 (1.38)	2.89 (1.41)	2.04 (1.46)	2.05 (1.47)	2.50 (1.54)	2.58 (1.50)	2.66 (1.52)	2.50 (1.55)	2.56 (1.53)	2.71 (1.60)	1.51	0.19	0.08	0.77	1.12	0.34
Q12. Are you satisfied with this park?																
	4.20 (0.83)	4.11 (0.87)	4.42 (0.88)	4.29 (1.14)	4.38 (0.75)	3.78 (0.99)	4.08 (1.16)	4.42 (0.58)	4.50 (0.63)	3.77 (1.59)	3.33	0.01	2.12	0.14	1.75	0.13
Q13. I feel more energetic after PA in the park																
	3.21 (1.36)	3.72 (1.32)	3.57 (1.35)	3.94 (1.58)	3.34 (1.73)	3.08 (1.34)	3.10 (1.65)	3.25 (1.36)	3.45 (1.71)	3.46 (1.66)	0.51	0.19	2.52	0.11	0.69	0.59
Q14. I feel more peaceful, after visiting the park																
	3.35 (1.33)	3.69 (1.37)	3.55 (1.43)	4.09 (1.36)	3.69 (1.53)	3.98 (1.25)	3.35 (1.34)	3.88 (1.45)	3.32 (1.28)	3.85 (1.46)	0.24	0.91	0.02	0.87	3.32	0.01
Amount of PA (min/week)																
	79.76 (36.50)	80.00 (29.10)	77.37 (43.95)	88.00 (38.40)	110.00 (101.80)	98.75 (37.62)	76.00 (26.99)	97.50 (39.98)	80.87 (34.37)	72.00 (26.83)	0.62	0.65	0.09	0.76	2.18	0.07
PA and active commuting (min/week)																
	117.12 (73.32)	107.49 (63.33)	111.08 (76.15)	111.46 (78.14)	125.00 (91.51)	155.20 (69.21)	134.12 (75.18)	132.44 (63.95)	139.30 (62.09)	92.90 (55.30)	1.16	0.32	3.48	0.06	1.39	0.23

Note. F=F test, p=p value, *= interaction between the two variables, yrs=years

Considering only the amount of PA in the park, only seven participants (3.0%) achieved the goal of the 150 min/week moderate PA. On the other hand, if the time to actively reach the park, through walking, running, or bicycling, was considered as a part of PA, the amount of PA increased, and the participants who achieved the goal of 150 min/week increased to 118 (64.5%). Most of those who achieved the goal were men (n = 70, 59.3%), and the most represented age class was 18–30 years (n = 50, 42.4%). Concerning people who did not achieve 150 min/week, the largest number of these people reached the park by walking, running or bicycling (n = 95, 83.3%), and only a few people used motor vehicles (n = 19, 16.7%). Fifty-one percent of these participants were women (n = 59) and were in the age class 18–30 years (n = 31, 27.2%).

A multiple regression model was carried out to quantify the relationship between the dependent variable (total minutes of PA including active commuting) and the explanatory variables. The VIF was less than 10 for all the variables considered, so there was no multicollinearity. The results of the multiple regression are shown in Table 36.

Table 36. Multiple regression model for total minutes of PA.

Predictors	B	T	**p-Value**
Sex (females)	-0.11	-0.12	0.90
BMI	0.04	0.51	0.61
Distance from the park	0.15	1.56	0.12
Times per week at the park	0.18	2.12	0.04
Age class			
18-30 years	-0.01	-0.08	0.93
31-40 years	0.01	0.06	0.95
41-50 years	-0.01	-0.11	0.92
51-60 years	0.04	0.38	0.17
Occupation			
Student	-0.05	-0.45	0.66
Employed	0.07	0.55	0.58
Unemployed	-0.17	-1.45	0.15
Education level			
High school	0.01	0.02	0.98
Bachelor's degree	0.07	0.87	0.38
Master's degree	0.08	0.93	0.36
Way to reach the park			
Walking	0.14	1.19	0.24
Motor vehicle	-0.36	-2.94	0.04
Running	0.22	1.98	0.04
Kind of PA at the park			
Light running	-0.13	-1.36	0.18
Outdoor fitness equipment	0.07	0.64	0.52
Skating	0.30	2.95	0.03
Walking	0.28	2.17	0.03
Football	0.06	0.68	0.49
Bicycling	-0.07	-0.67	0.50
Stretching	0.04	0.47	0.64
R^2	0.28		
Adjusted R^2	0.14		
P	0.01		

This model explained 14% of the variance. The number of visits per week to/at the park, reaching the park by running, and skating or walking at the park showed a positive relationship with the total minutes of PA, while using a vehicle (car, scooter, or public transport) showed a negative relationship.

10.4 Discussion

The purposes of the present study were to assess people's motivations to use the park, and among the motivation, particular attention was paid to PA, to understand how much park use affects PA levels. The final purpose was to evaluate how active vehicle-free transportation (walking, jogging, bicycling) influences the achievement of the recommended levels of PA. These aspects have become

particularly important in relation to the lifestyle changes imposed by COVID. Regarding the participants of the present study, there were slightly more women than men. This is in accordance with the results of other studies which have reported that women have a greater willingness to participate in surveys than men and have a greater engagement with the neighborhood environment [13,268–270]. Regarding age classes, the oldest people presented the highest values in weight, BMI, and overweight/obesity, highlighting the greatest health risk of these groups, since overweight/obesity is a potential risk factor for the occurrence of cardiovascular diseases, although their involvement in PA is a healthy habit to be maintained and strengthened [384]. The youngest age class is the group that took the most time to reach the park. This is in accordance with previous studies, which have suggested that young people are willing to walk for longer distances than the recommended 300 m, to have access to green urban space, if parks have some attractive features [59,248]. At the same time, the age class 18–30 years was the most likely to carry out PA, regardless of where it takes place. Regarding the interaction between age classes and sexes, it is noteworthy that men in the age class 61–70 years were the ones who used the park the most. According to previous studies, people of the oldest age group usually have a better perception of the green urban space and often spend their leisure time in this kind of environment [276]. On the contrary, in the present study, women aged 61–70 years had the lowest score for time spent in the park. These data are in contrast with the study by de Vries et al. (2003), which found that women over 65 generally showed a higher frequency of use of a park, in comparison with men or people belonging to other age groups [46]. This result could be linked to the COVID-19 pandemic situation, since the oldest people could have been more afraid about going out and visiting public spaces, due fear of becoming infected with the virus. As regards the study's first purpose, the two main motivations to reach the park were to relax and to practice PA. The opportunity to perform PA, by promoting leisure walking, walking through the space when running errands, active playing, and sports, is another mechanism

that has been proposed to explain the beneficial effects of a green environment [44,235,251,270,276]. Several studies have observed the efficacy of outdoor PA, but it is still unclear what might be the best kind of PA [74]. For this reason, we investigated the relationship between BMI and PA, since the results are not consistent in the literature. While some studies have suggested an inverse relationship between BMI and PA [385,386], other studies have demonstrated a weaker association [387,388]. The present study did not show any relationship between the two parameters (p value = 0.10), suggesting that the practice of PA is independent of BMI. Another motivation to reach the park was to relax. Although there is increasing literature about the beneficial effects of the outdoor natural environment, the mechanisms that explain this relationship are still unclear. Thinking of the park as a place in which it is possible to relax is consistent with the "restoration theory", which explains the beneficial effects by the intrinsic quality of the natural outdoor environment. So, health perception and well-being are influenced by watching a green space [33,75,386,389]. The results of the present study could be linked to other studies that have found that short-term exposure to forests, urban parks, gardens, and other natural environment reduces stress and depressive symptoms, restores attention fatigue, increases self-reported positive emotions, and improves self-esteem, mood and perceived mental and physical health [33,74,133,186,389–391]. The result relating to the use of the park to relax is important because it highlights how the population perceives the use and the benefits of this park. It can be considered a "safe place" in which they can stay and relax without other problems or thoughts, and it demonstrates the success of the project carried out by the city of Bologna to improve the use of green urban space [392]. After visiting the park, the largest part of the sample reported positive sensations, such as feeling "more energetic", and "more peaceful", which are in accordance with previous studies that observed a beneficial association between exposure to green space and mental health, using a wide range of measures [15,315,359,392–395]. The largest proportion of the

participants who used the park to relax were women and people belonging to the youngest age class group (18–30 years)..

Regarding the second purpose of this study, 232 (60.6%) out of 383 participants usually practiced outdoor PA. These data are in contrast with previous studies that found that parks were generally underutilized to perform PA [115,116]. In this case, the park seemed to be a facilitator of PA, due to the large numbers of people that used it as a training environment. However, even in this study, the PA performed in the park was not sufficient to achieve the goal of 150 min/week. In fact, when only PA in the park was considered, the majority of the sample did not achieve the goal of 150 min/week. This could mean that people did not do enough PA in the park, as reported in previous studies, showing that parks are more of a destination for light activities and low levels of PA, rather than a venue for moderate or vigorous PA, perhaps due to insufficient education regarding PA [115,116]. So, even if performing PA is one of the main motivations that drives people to use the park, the level or the intensity of PA were still not sufficient. Moreover, considering the third purpose of this study (to assess how active commuting influences the achievement of recommended levels of PA), the scenario changes. In fact, considering active commuting as a part of the PA, an increasing number of people who achieved the goal of recommended PA was observed. Active commuting is an important aspect to consider for the daily level of PA. Incorporating PA into daily life habits may make it easier to be physically active [64]. To our knowledge, even though the importance of active commuting is well established, few studies have analyzed together the minutes to reach the place of training by active commuting and the minutes of PA practiced. This result is particularly interesting because, while the PA carried out in green urban space alone is not enough to reach the goal of 150 min/week, the combination of this PA with active commuting makes it possible to reach this goal.

From the multiple regression, it emerged that the number of visits per week at the park had a positive relationship with the amount of PA. If people have to walk more times in a week to reach the park, obviously their amount of PA increases. Regarding the way to reach the park, running was mostly associated with the total minutes of PA, while the use of motor vehicles presented a negative association. In any case, it is interesting to note that only 13.6% (n = 52) of the participants reached the park by motor vehicle. This pattern depends on the good walkability to reach the Arcoveggio park, thus providing evidence in favor of Bologna city policies.

This study is not without limits: the anthropometric measurements were self-reported by participants, and, in addition, this study was carried out only in one park in the city of Bologna, so the continuation of the study in other city parks may lead to a better understanding of the analyzed aspects. In addition, behavioral heterogeneity was not considered in the present study. For future research, it could be an important issue to consider [15,396,397].

This study also has numerous strengths. There is an increasing interest in active commuting and its importance in combination with PA. Active commuting is not only considered “an active way” to reach a place but it is considered a part of PA. To our knowledge, there have been no similar studies in the Italian setting, and this could be an important forerunner for future research.

11. Study 8. Effects of Nordic Walking Training on Anthropometric, Body Composition, and Functional Parameters in the Middle-Aged Population

This article was published in the International Journal of Environmental Research and Public Health

Grigoletto, A.; Mauro, M.; Oppio, A.; Greco, G.; Fischetti, F.; Cataldi, S.; Toselli, S. Effects of Nordic Walking Training on Anthropometric, Body Composition and Functional Parameters in the Middle-Aged Population. Int. J. Environ. Res. Public Health 2022, 19, 7433.

https://doi.org/10.3390/ijerph19127433

Keywords: anthropometric measure; body composition; middle-aged; Nordic walking; outdoor physical exercise; physical exercise

Overview

Nordic walking (NW) is an easy physical exercise that is usually proposed for clinical populations and for the elderly. The aim of the present study was to examine the effects of a period of NW training in a non-clinical middle-aged population on anthropometric, body composition, and functional parameters. A pre-test/post-test study design was conducted, and the measurements were carried out with physical tests at the baseline and at the follow up. Participants had significantly less stress and anxiety after the NW training. Body fat parameters showed a significant decrease, especially for women. Phase angle and strength of lower body presented a significant increase in both sexes after the training period.

11.1 Introduction

It is important to identify forms of physical activity that are easily accessible and that can be performed by a large number of people to improve fitness and health status [398]. This aspect is important for people of all ages, especially for middle-aged and elderly. To improve public health, green space represents an ideal environment that promotes PA due to its easy accessibility and no cost [95,235]. Additionally, a recent review showed that participants who practiced PA with contact with nature improved their psychological well-being [133].

Nordic walking (NW) is a particular kind of walking in which specially designed poles are used [399]. NW was initially designed for cross-country skiing athletes' training during the summer, and since then it has gained popularity worldwide as a health-promoting activity and as a physical exercise [235,389,400]. By incorporating upper-body muscle activity similar to that in cross-country skiing, NW incorporates a total-body version of walking with a greater caloric expenditure due to the higher amount of muscle mass used and potentially enhanced physical fitness benefits [400,401]. According to previous systematic reviews, NW has a lot of important benefits for people [398,402], such as resting the heart rate, blood pressure, exercise capacity, maximal oxygen consumption and quality of life. For these reasons, NW is suitable as prevention, and nowadays, it is more and more frequently recommended for the elderly [403]. Fritschi et al., in their review, found that most of the NW practitioners were mid to older aged men and women, from the clinical population (i.e., a diagnostic medical condition) [402]. The population studies included people suffering from diabetes, cardiovascular disease, peripheral artery disease, muscle-skeletal conditions, chronic obstructive pulmonary disease, Parkinson's disease and breast cancer [404–412]. There were two studies in the nonclinical population, but both participants were only elderly women [400,413]. The effects of NW on the nonclinical population have been little investigated.

In the middle-aged and elderly population, one of the main problems is the decline in lean mass and the increase in fat mass, in addition to the decline in strength. Body composition is an important index of health and nutritional status, aging, and functional capacity [414]. In fact, the decline in body composition increases the risk of age-related diseases [415]. So, monitoring body composition has become crucial to evaluate the nutritional status in elderly and middle-aged people. Reference methods for assessing body composition present a high accuracy but are time-consuming and costly, and so cannot easily be applied on a regular basis [416]. Bioelectrical impedance analysis (BIA) can be considered practicable given that it is easy to use; in addition, precision and accuracy is usually reasonably high, with the latter being within 3.5 to 5% [416–418]. In recent years, one of the most popular methods to evaluate body composition was the bioelectrical impedance analysis (BIA) due to a combination of cost-efficiency, user friendliness and portability [419,420]. Several studies compared BIA with other reference methods and concluded that BIA has an accepted validity for the body composition assessment, especially in the evaluation of body fluids, fat free mass, and fat mass [416,421–424]. By employing bioimpedance-based predictive equations, it is possible to estimate and monitor changes in body composition parameters such as fat mass, total body water and muscle mass [399]. In addition, by using the qualitative analysis, it is possible to estimate the body composition through the raw bioimpedance parameters (resistance (R) and reactance (Xc)) as a point on the R-Xc graph in which both length and slope are considered. The vector slope indicates the integrity of the cell membrane and extracellular/intracellular (ECW/ICW) ratio [415,425]. Previous studies have shown that the PhA can be modulated by exercise. These studies showed significant changes in PhA after a resistance training program with a frequency of two or three times [426–428]. Tomeleri et al. and Souza et al. investigated the effects of resistance training on PhA in older women. Both studies found an inverse relation between PhA and inflammatory biomarkers, and

a positive association with cellular health [426,428]. The same kind of result was found by Ribeiro et al. in young adults: an increase in PhA and a rise in cellular hydration after the period of training [427]. To our knowledge, there are no studies which consider NW and body composition together in healthy middle-aged and elderly population. The aim of the present study was to value the effectiveness of a period of NW training in counteracting the aging effects on body composition, BIVA patterns and functional parameter measurements (resistance, handgrip and lower body strength) in a healthy middle-aged population. In addition, a valuation regarding the attitude toward the green urban spaces and the appreciation in doing outdoor PA was performed.

11.2 Materials and Methods

11.2.1 Study Design and Participants

This is a longitudinal study design with 3 months of follow-up and two measurements, one at baseline and one after the training treatment. Recruitment occurred thanks to the sport society "Nordic walking in Italy", specifically with the headquarters of Venice. They do activities throughout the province of Venice, in the city parks, along the banks and always in the open air. They manage different walking groups in Mestre, Marghera, Spinea and Martellago. The study protocol was explained to the 94 members of the sport society, and those who voluntarily decided to participate in the study were included. In total, 19% of the members of the sport society decided to not participate, and 6% did not complete the entire period of training. Participants had to meet the following criteria to qualify for inclusions: (1) not have a chronic disabling disease, (2) not be bedridden, institutionalized or hospitalized, (3) be independently mobile without requiring human assistance or the aid of devices such as crutches, walkers, etc., (4) be without amputations, and (5) not have a pacemaker or the presence of chronic metabolic diseases. All participants signed an informed consent to participate in the study.

The study was approved by the Bioethics Committee of the University of Bologna (prot. N.

022254).

11.2.2 Intervention Training Programs

The baseline was set at the end of February 2021 after the stop related to the pandemic situation in Venice due to COVID-19, while the post-test was done in June 2021. Participants did two weekly training sessions of about 60 min each. Every training session included a 10 min warm-up, a 45 min main part during which people marched in the park following their trainer and a final 5 min of relaxing and stretching exercises. Three instructors followed the groups in different parks, and they were instructed to propose the same kind of training to the different groups, with the same kind of intensity. The intensity of training was decided a priori with the rate of perceived exertion, the Borg scale, and it was set at 5 on a scale of 10 points [41]. Five means that it was a moderate activity and participants were able to talk and hold short conversation.

11.2.3 Anthropometric Characteristics

The anthropometric measures were recorded at baseline and after the training period. Each participant's height was recorded to the nearest 0.1 cm with a standing stadiometer (GPM, Steckborn, Switzerland), and body mass was measured to the nearest 0.1 kg using calibrated electronic scales (Seca, Basel, Switzerland). Body mass index (BMI) was calculated as the ratio of body weight to height squared (kg/m^2), and the WHO cut-off was used to estimate the weight status of the subjects; less than 18.5 was classified as underweight, from 18.5 to 24.9 was considered normal weight, from 25 to 29.9 was overweight and more than 30 was classified as obese [429]. The operator took the following circumferences: relaxed arm, contracted arm, waist, hip and calf. All the circumferences were taken to the nearest 0.1 cm using a non-stretchable tape measure (GPM, Steckborn, Switzerland). Skinfolds were also measured with a skinfold caliper (Lange, Beta Technology, Santa Cruz, CA, USA) at the biceps, triceps, subscapular, suprailiac, supraspinal, lateral and medial calf. According to Frisancho, the total upper-arm and calf area,

upper-arm and calf muscle area and upper-arm and calf fat area were calculated [430,431]. All the anthropometric measurements were carried out by the same operator, specifically trained according to a standardized protocol [430,432].

11.2.4 Body Composition

The impedance measurements were performed with a bioimpedance analyzer (BIA 101 Anniversary, Akern, Florence, Italy) at a frequency of 50 kHz. The accuracy of the BIA instrument was validated before each test session following the manufacturer's instructions. The participants were assessed in the supine position with legs (45◦ compared to the median line of the body) and arms (30◦ from the trunk) abducted. After cleansing the skin with alcohol, two electrodes were placed on the right hand and two on the right foot. Body composition parameters were estimated using specific bioimpedance-derived equations [433–435].

1. Fat percentage (%F) = [(4.950/D) − 4.500] × 100
2. Fat mass (FM) = (%F × weight)/100
3. Fat free mass (FFM) = Weight − FM

In addition, bioimpedance values were analyzed according to classic and specific BIVA methods [425,435–437].

11.2.5 Physical Test

Right and left handgrip strength was measured with a dynamometer (Takei Scientific Instruments Co., Niigata City, Japan) in a sitting position at a 90-degree flexion of their elbow. Each participant performed three trials with a 1 min rest period between each test. The highest value of all three measurements was used for analysis. To avoid any confounding effect of time of day, all test sessions were performed in the morning, at the baseline and after three months [438]. To assess the strength and the endurance of the lower limbs, the chair stand test has been executed. Before each test, the operator gave orally clear and simple instructions and demonstrated the test.

Participants were allowed one practice trial before the actual measurements. A standard chair without armrests was used for all the participants. Participants were instructed to sit in the middle of the chair, back straight, feet approximately shoulder-width apart and placed on the floor at an angle slightly back from the knees with one foot slightly in front of the other to help to maintain balance when standing. Instructions to participants were to stand up and sit down again as many times as possible for 30 s. Participants were encouraged to continue to sit and stand throughout the test. The number of repetitions was recorded, and represented the units for this measure [439]. The Six-Minute Walk Test is a simple test to measure exercise capacity. Participants had to walk for six minutes and they were instructed to go their gait and to slow down or stop if they became fatigued, but to resume once able [440]. A lap was recorded each time the subject passed the starting position. Using an even-toned encouraging phrase, the time remaining in the test was reported to the participants at one-minute intervals. The timer was not stopped if the participants needed to rest. Once the six minutes concluded, the participants were instructed to stop and remain stationary while the end point was marked. Once marked, the total distance walked was calculated in meters [440].

11.2.6 Questionnaire Post the Training Period

At the end of the study, a questionnaire was administered to the participants, in order to understand their habits about general physical activity, their attitude towards green urban space and how they feel after the participation in outdoor training. The questionnaire was validated in a previous study [359]. Attitude represents a synthetic assessment of a psychological object evaluated in positive or negative dimensions [252,253]. The survey was divided into three subsections: (1) physical activity habits and feeling after having done outdoor activities (NW), (2) attitude toward green space components and (3) their evaluation of the park characteristics. The statements were evaluated using the Likert scale, from 1 to 5, in which 1 meant “strongly

disagree” and 5 “strongly agree”.

11.2.7 Statistical Analysis

All statistical analyses were performed with Statistica for Windows, versión 8.0 (Stat Soft Italia srl, Vigonza, Padua, Italy). A post hoc analysis was assessed to compute an achieved power given alfa = 0.05 sample size = 77, effect size = 0.43. The test family select was t-test for means difference within groups (matched pairs). The final statistical power was 0.97. Descriptive analysis and independent Student t-test were used to assess baseline characteristics and gender differences. Each result was reported as the variable Mean Standard Deviation (SD) at two different times (Pre and Post). The Shapiro–Wilk test was used to check the normal distribution of each body composition and physical test variable. When variable data did not distribute as a Gaussian curve, a transformation function (natural logarithm) was applied to reduce the curve skewness. Longitudinal differences were calculated as post-pre among groups for each variable, and mean±SD, paired Student’s test (t) and probability (p) values were outlined. Additionally, analysis of variance (ANOVA) was performed to evaluate the differences between male and female groups in the answers to the questionnaire, and the Snedecor–Fisher (F) and probability values (p) were reported.

Statistical significance was set at $p < 0.05$.

11.3 Results

11.3.1 Baseline Characteristics of the Participants

Eighty-two people decided to participate in this study, but five people did not complete the period of training so they were excluded from the study. Therefore, 77 participants did the measurements before and after the period of training. The flow chart with a schematic representation of participant allocation is presented in Figure 10.

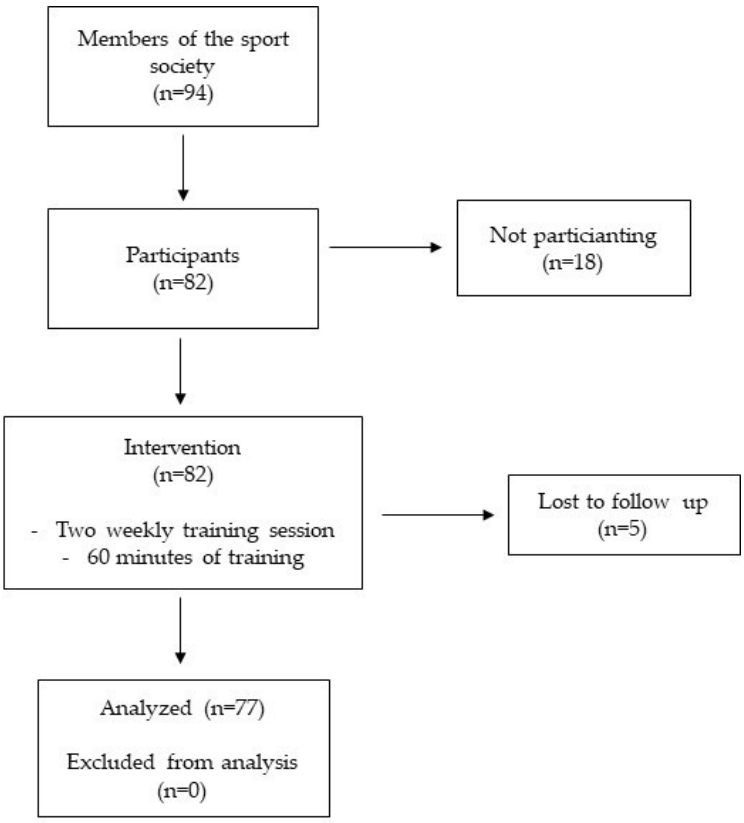


Figure 10. Flow chart.

The largest part of the sample was composed of females (56, 72.7%), and their mean age was 55.53 9.73 years. Men who participated in the study (21, 27.3%) were older than women (60.51 8.15 years vs. 55.53 9.73). Entire sample characteristics are presented in Table 37, and women and men characteristics are presented in Table 37.

Table 37. Paired Students' test and entire sample's anthropometric measures, body composition and physical test values

Variables	Pre Mean±SD	Post Mean±SD	Differences post-pre Mean±SD	t	P
Weight, kg	70.81±1.58	70.39±1.57	-0.43±0.63	-0.68	0.50
Height, cm	168.32±8.38	-	-		
BMI, kg/m^2	24.88±0.44	24.37±0.55	-0.51±0.35	-1.48	0.14
Triceps, mm	19.53±0.48	18.36±0.48	-1.17±0.53	-2.22	0.03
Biceps, mm	12.09±0.49	11.08±0.49	-1.01±0.47	-2.16	0.03
Subscapular, mm	18.07±0.72	15.26±0.54	-2.81±0.53	-5.29	<0.001
Suprialiac, mm	20.08±0.71	19.32±0.61	-0.75±0.56	-1.35	0.18
Supraspinal, mm	19.29±0.70	17.61±0.72	-1.67±0.60	-2.77	0.01
Medial calf, mm	16.25±0.49	15.52±0.74	-0.73±0.70	-1.05	0.30
Lateral calf, mm	10.45±2.22	10.39±4.84	-0.04±1.31	-0.10	0.65

Arm circumferences, cm	28.83±0.38	29.29±0.40	0.46±0.26	1.80	0.08
Contract arm circumferences, cm	30.16±0.38	30.17±0.38	0.01±0.22	0.02	0.98
Waist circumferences, cm	84.27±1.52	83.03±1.56	-1,24±0.80	-1.55	0.13
Hip circumferences, cm	102.69±0.89	101.74±0.91	-0.95±0.40	-2.38	0.02
Calf circumferences, cm	37.09±0.32	36.04±0.64	-1.05±0.61	-1.73	0.09
Resistance	513.39±9.50	500.56±9.54	-12.84±13.05	-0.98	0.34
Reactance	55.52±1.04	56.11±1.21	0.59±1.26	0.47	0.64
Phase angle	6.32±0.15	7.13±0.20	0.82±0.19	4.34	<0.001
FM, kg	26.46±0.77	24.96±0.82	-1.49±0.51	-2.95	<0.001
FFM, kg	44.28±0.89	44.55±1.09	0.27±0.64	0.42	0.68
%F	37.04±0.38	35.57±0.41	-1.46±0.33	-4.50	<0.001
Total upper arm area, cm^2	67.27±1.75	68.61±2.07	1.34±1.51	0.88	0.38
Upper arm muscle area, cm^2	41.86±1.34	44.57±1.43	2.73±1.05	2.62	0.01
Upper arm fat area, cm^2	25.43±0.76	24.04±0.93	-1.39±0.91	-1.53	0.13
Total calf area, cm^2	109.73±1.93	107.27±2.50	-2.46±2.06	-1.20	0.24
Muscle area of the calf, cm^2	78.90±1.62	76.34±2.80	-2.57±2.28	-1.12	0.27
Fat area of the calf, cm^2	30.83±0.79	26.71±1.05	-4.12±1.09	-3.78	<0.001
Right handgrip	30.52±1.24	30.59±1.18	0.06±0.67	0.09	0.93
Left handgrip	30.09±1.13	30.01±1.13	-0.08±0.60	-0.14	0.89
6 minutes Walking test, m	537.16±8.99	573.49±7.78	36.34±8.54	4.25	<0.001
Squat test, n	15.15±0.45	17.39±0.44	2.24±0.57	3.94	<0.001

Table 38**.** Paired Students' test and participants' anthropometric measures, body composition and physical test values.

Variables	Women					Men				
	Pre Mean±SD	Post Mean±SD	Differences post-pre Mean±SD	T	P	Pre Mean±SD	Post Mean±SD	Differences post-pre Mean±SD	t	P
Weight, kg	65.65±11.69	65.34±12.05	-0.31±0.36	0.40	0.69	84.58±8.99	83.86±7.52	-0.72±1.47	0.70	0.49
Height, cm	165.23±7.07	165.23±7.07	-	-	-	176.54±6.89	176.54±6.89	-	-	-
BMI, kg/m^2	24.01±3.80	23.39±5.03	-0.62±1.22	1.36	0.18	27.19±3.02	26.97±2.81	-0.17±0.21	0.61	0.55
Triceps, mm	20.55±3.43	19.29±3.85	-1.27±0.42	2.26	0.03	16.81±4.86	15.90±4.31	-0.90±0.55	0.73	0.48
Biceps, mm	12.57±4.62	11.25±4.62	-1.32±0.22	2.40	0.02	10.81±3.09	10.62±4.09	-0.19±1.00	0.21	0.83
Subscapular, mm	17.00±6.54	14.55±4.66	-2.45±1.88	4.04	<0.001	20.90±4.65	17.14±4.52	-3.76±0.13	3.48	<0.001
Suprialiac, mm	19.05±6.40	18.32±5.34	-0.73±1.06	1.13	0.26	22.81±4.88	22.00±4.51	-0.81±0.38	0.72	0.48
Supraspinal, mm	18.42±6.07	16.89±5.98	-1.54±0.09	2.28	0.03	21.57±5.86	19.52±6.78	-2.05±0.92	1.55	0.14
Medial calf, mm	17.63±3.44	16.58±6.00	-1.04±2.56	1.35	0.18	12.57±4.32	12.68±7.00	0.10±2.68	-0.07	0.95
Lateral calf, mm	12.57±4.32	12.68±7.00	0.10±2.68	-0.07	0.95	8.32±2.68	8.10±0.12	0.22±2.56	0.10	0.45
Arm circumferences, cm	28.38±3.55	28.97±3.45	0.60±0.10	-2.53	0.01	30.10±1.97	30.13±3.48	0.05±1.50	-0.08	0.94
Contract arm circumferences, cm	29.44±3.42	29.54±3.40	0.09±0.02	-0.40	0.69	32.09±2.42	31.87±2.56	-0.22±0.04	0.40	0.69
Waist circumferences, cm	79.66±11.58	78.49±12.17	-1.18±0.59	1.18	0.24	96.56±9.53	95.14±9.42	-1.41±0.11	1.09	0.29
Hip circumferences, cm	101.94±8.69	100.71±8.78	-1.22±0.09	2.43	0.02	104.68±4.52	104.46±4.44	-0.21±0.08	0.39	0.70
Calf circumferences, cm	36.58±2.62	35.62±5.17	-0.95±2.54	1.58	0.12	38.15±3.02	37.10±6.40	-1.05±3.38	0.77	0.45
Resistance	527.61±73.84	510.97±68.28	-16.64±5.56	0.75	0.46	485.20±52.15	473.74±74.65	-11.46±22.49	0.60	0.56
Reactance	57.18±7.15	56.30±9.13	-0.87±1.98	0.65	0.52	52.90±9.76	57.11±8.97	4.21±0.80	-1.55	0.15
Phase angle	6.27±0.94	7.06±1.46	0.79±0.52	-3.49	<0.001	6.29±1.29	7.31±1.24	1.02±0.06	-2.58	0.03
FM, kg	24.48±6.30	23.06±7.07	-1.43±0.78	2.19	0.03	31.64±4.68	30.29±3.89	-1.35±0.78	2.56	0.02
FFM, kg	41.17±5.82	41.16±8.33	-0.01±2.51	0.01	0.99	52.94±5.29	54.06±5.21	1.18±0.09	-1.05	0.31
%F	36.85±3.57	35.46±3.76	-1.39±0.19	3.92	<0.001	37.32±2.84	35.90±3.10	-1.42±0.26	2.22	0.04
Total upper arm area, cm^2	65.10±16.67	66.55±18.55	1.46±1.89	1.45	0.40	72.32±9.21	74.36±15.59	2.04±6.38	-0.31	0.76
Upper arm muscle area, cm^2	38.99±11.35	41.78±12.01	2.80±0.66	2.79	0.02	49.36±8.81	52.39±10.30	3.03±1.49	-1.05	0.31
Upper arm fat area, cm^2	26.11±6.72	24.77±7.95	-1.34±1.22	1.37	0.18	22.96±6.47	21.97±8.36	-0.99±1.89	0.71	0.49
Total calf area, cm^2	107.06±15.48	105.18±18.13	-1.88±2.65	1.06	0.29	116.55±18.43	113.14±29.64	-3.42±11.21	0.66	0.51
Muscle area of the calf, cm^2	74.92±11.76	71.72±21.91	-3.19±10.15	1.27	0.21	90.07±14.19	89.26±26.80	-0.81±12.60	0.16	0.88
Fat area of the calf, cm^2	32.14±6.01	27.72±6.01	-4.42±3.49	3.48	<0.001	26.49±8.22	23.88±7.69	-2.61±0.53	1.51	0.15
Right handgrip	25.89±6.00	26.05±5.80	0.17±0.19	-0.95	0.35	42.83±10.34	42.05±10.36	-0.78±0.62	0.59	0.57
Left handgrip	25.41±4.96	25.44±5.70	0.03±0.75	-0.87	0..39	41.90±8.54	41.29±8.61	-0.62±0.07	0.68	0.51
6 minutes Walking test, m	540.36±70.52	577.53±66.10	37.16±4.42	4.19	<0.001	531.98±95.20	564.02±64.45	32.04±27.75	-1.53	0.14
Squat test, n	15.58±3.80	17.45±3.71	1.87±0.09	-2.74	<0.001	14.00±3.57	17.52±3.63	3.52±0.06	-3.06	<0.001

Note: SD= standard deviation, p=p-value.

11.3.2 Effects of NW on Anthropometric Characteristics

The entire sample and women's sample showed significant differences in several anthropometric characteristics between the baseline and follow-up (Tables 36 and 37).

Generally, a decrease in fat parameters was observed: a decrease in the triceps (entire sample: pre = 19.53±0.48, post = 18.36±0.48, women: pre 20.55±3.43, post 19.29±3.85), biceps (entire sample pre 12.09±0.49, post 11.08±0.49, women pre 12.52±4.62, post 11.25±4.62), subscapular (entire sample pre 18.07± 0.72, post 15.26±0.54, women pre 17.00±6.54, post 14.55±4.66) and supraspinal (entire sample pre 19.29±0.70, post 17.61±0.72, women pre 18.42±6.07, post 16.89±6.00) skinfolds was shown. Hip circumference (entire sample pre 102.69±0.89, post 101.74±0.91, women pre 101.94±8.69, post 100.71±8.78), calf fat area (entire sample pre 30.83±0.79, post 26.71±1.05, women pre 32.14±6.01, post 27.72±6.01), FM (entire sample pre 26.46±0.77, post 24.96±0.82, women pre 24.48±6.30, post 23.06±7.07) and %F (entire sample pre 37.04±0.38, post 35.57±0.41, women pre 36.85±3.57, post 35.46±3.76) showed a significant de- crease, too. On the contrary, arm muscle area showed a significant increase (women pre 38.99±11.35, post 41.78±12.01). In men the variations were more contained, showing a significant decrease only in subscapular skinfold (pre 20.90±4.65, post 17.14±4.52), FM (pre 31.64±4.68, post 30.29±3.89) and %F (pre 37.32±2.84, post 35.90±3.10) after the period of NW training.

11.3.3 Effects of NW on Physical Tests

Regarding the physical test, women and the entire sample presented significant differences in two of them: the 30'' squat test (entire sample: pre 15.15±0.45, post 17.39±0.44; women: pre 15.58±3.80, post 17.45±3.71) and the six-minute walking test (entire sample: pre 537.16±8.99, post 573.49±7.78; women: pre 540.36±70.52, post 577.53±66.10) showed significant increases after the training period. The handgrip did not show significant

improvement after the period of NW training. Men showed a significant increase only in the squat test (pre 14.00±3.57, post 17.52±3.63).

11.3.4 Effects of NW on BIVA

The entire sample and the sample divided by sex presented a significant increase in the phase angle after the period of training (entire sample pre 6.32±0.15, post 7.13±0.20, women pre 6.27±0.94, post 7.06±1.46, men pre 6.29±1.29, post 7.31±1.24).

11.3.5 Questionnaire

Table 39 shows the participants' answers.

Table 39. Participants' answers to the questionnaire and differences between sexes (ANOVA).

Variables	Female Mean (SD)	Male Mean (SD)	F	p-value
I prefer to do outdoor physical activity	4.37 (0.94)	4.92 (0.28)	4.38	0.04
Green space in cities is important	4.52 (0.86)	4.92 (0.28)	2.76	0.10
Nature parks improve quality of life	4.50 (0.86)	4.62 (0.65)	0.20	0.65
Tax dollars should be spent on nature parks	4.48 (0.88)	5.00 (0.00)	4.41	0.04
Contact with nature is important for well-being	4.50 (0.86)	4.85 (0.38)	1.98	0.16
It is important to have convenient nature parks in cities	4.52 (0.86)	4.77 (0.60)	0.98	0.32
Nature parks in the cities provide valuable contacts with nature	4.31 (0.99)	4.15 (0.80)	0.30	0.59
The time spent in an urban nature park relaxes you	4.35 (0.97)	4.69 (0.63)	1.43	0.24
I expect to feel refreshed after visiting a nature park	4.24 (1.03)	4.23 (0.93)	0.00	0.97
I enjoy talking with neighbours at local nature park	3.39 (1.23)	2.54 (1.27)	4.92	0.03
I like the structure of the park you use	3.59 (1.06)	3.46 (0.88)	0.17	0.68
After outdoor physical activity you feel.				
Physical well-being	4.54 (0.99)	4.69 (0.48)	0.29	0.59
Psychological well-being	4.54 (0.97)	4.54 (0.66)	0.01	1.00
Lessening of anxiety	4.41 (1.00)	4.38 (0.87)	0.02	0.95
Lessening of stress	4.43 (1.00)	4.46 (0.66)	0.02	0.90
Personal satisfaction (physical)	4.44 (1.06)	4.62 (0.51)	0.32	0.57
Mood improvement	4.52 (0.99)	4.38 (0.77)	0.20	0.65
Fatigue	2.67 (1.29)	3.46 (1.27)	3.89	0.05
General well-being	4.56 (0.96)	4.85 (0.38)	1.08	0.30
How do you consider your physical health?	3.67 (0.89)	3.77 (0.60)	0.27	0.61
How do you consider your mental health?	3.89 (0.77)	3.77 (0.87)	0.10	0.75

Note: SD= standard deviation, p=p-value.

Only three items ("I prefer to do outdoor physical activity", "Tax dollars should be spent on nature parks" and "I enjoy talking with neighbors at local nature parks") showed significant differences. Men had higher scores in the first two items (men 4.92 ± 0.28 and 5.0 ± 0.00, women 4.37 ± 0.94 and 4.48 ± 0.88) and women had higher scores in the item "I enjoy talking with neighbors at the local nature park" (women 3.39 ± 1.23, men 2.54 ± 1.27).

11.4 Discussion

NW is a particular kind of walking in which specially designed poles are used and actively involve the upper body and arms [401]. In recent years, it has gained popularity worldwide as a health-promoting activity [389]. NW is frequently recommended for the elderly with chronic diseases. Despite the evidence, there are few studies on the effects of a period of NW training for the nonclinical middle age and elderly population, for which, considering the efficacy of this activity it is important to have indications.

The main aims of the present study were to evaluate the effectiveness of a period of NW training in a healthy middle-aged population and evaluate the appreciation in doing outdoor PA. Regarding the first goal, men and women showed different effects. Women showed a significant decrease in fat parameters, as skinfolds, calf fat area FM and %F and in hip circumference. In addition, the arm muscle area increased. Men showed a significant decrease only in a skinfold, in FM and %F. Both men and women presented a significant increase in lower body strength, and women showed an increase also in the six-minute walking test.

Regarding the previous literature about the positive effects of NW, several studies showed that NW influenced more the cardiorespiratory fitness than the normal walking, because of the use of poles that involved a higher amount of muscle mass [401]. NW has positive effects on chronic diseases such as diabetes or obesity, by benefits the resting heart rate, blood pressure, maximal oxygen consumption, exercise capacity and quality of life [398,400,402]. Most of the participants to the studies about this kind of physical activity were mid to older aged men and women from the clinical population (diabetes, cardiovascular disease, muscle-skeletal conditions, Parkinson's disease, etc.) [404–412]. Only two studies considered the nonclinical population, but both populations consisted of elderly women

[400,413]. Both studies compared the efficacy of a period of NW and walking training, but women in the study by Figarde-Faber et al. were obese and middle-aged and in the study by Kukkonen-Harjula et al. were sedentary and aged 50–60 years [400,413]. The results of the two studies are in contrast, because in the first the authors found that within the same walking time, the use of NW poles provided an increase in the intensity and of the energy expenditure. On the contrary, Kukkone-Harjula et al. showed that NW did not improve upper body muscle strength more than walking and, in addition, they assumed that the poles in NW, used as a support, reduced the training effects on lower extremities [413]. However, in both studies, NW emerges among the safest kind of physical activity [400,413,441]. In fact, Kukkonen-Harjula et al. found that injuries rate of NW and walking (1.4 NW and 1.9 walking) were lower than that of other kind of activities (volleyball, swimming, tennis, lifestyle activity, etc.) [413]. So, walking and NW were among the safest kinds of activity [441]. Figarde-Fabre et al. found that the obese women of their study increased their stability thanks to the use of the poles [400]. This is an important feature of NW, that can be practiced with a very low risk of injury and as a primary kind of prevention. The results of Kukkon-Harjula et al. are partially in contrast with the results of the present study [413]. In fact, similarly to the study by Kukkon-Harjula et al. we found no significant differences in the handgrip test, but a significant decrease in the arm's skinfolds and an increase in the arm's circumference were observed in our study [413]. Maybe the period of three months is too short to observe significant change in upper body muscle strength, but it may be a sufficient time to observe changes in the body composition of the arm. This is in line with previous studies which showed that NW is a more complete activity than normal walking, due to the use of poles that involve the upper part of the body [403,442–444]. In addition, all the participants showed on average an increase in the number of squats done

in 30 s, and this could be linked with an increase in the strength of the lower body. This result is in line with other previous studies [444,445]. Regarding the last physical test, women did more meters in the post training six-minute walking test, showing an increase in capacity of resistance. This could be linked to the result of Figarde-Fabre et al., which found that the subjects perceived the NW as less demanding than the walking without the poles [400]. This could be a positive aspect, because could drive people to continue physical activity for a longer period and to be more active. For this reason, NW could also be considered a primary kind of prevention.

Usually, for middle-aged people, the more common kind of physical activity proposed is walking and resistance training, because they reverse the adverse effects of aging in cellular integrity and function [420,428,446]. Resistance training improve bioimpedance parameters and induce changes in cellular volume and cellular potential [419,421,428,446]. As regards the phase angle, a significant increase was observed both in women and in men, in accordance with the results of resistance training. Several studies have considered the phase angle and its relationship with the health status; in particular, the increase in this parameter was associated with an increase in strength and the alteration in cellular membrane integrity or body fluid or a combination of both [426,447]. So, NW could be considered a “protective” activity for the aging process. In addition, Takeshima et al. compared the effects of NW, conventional walking and band-based resistance exercise in older adults [445]. They observed that conventional walking only improves cardiorespiratory fitness and the resistance training improve muscle strength, so NW could be a combination of the two kind of activities and provide improvements to each of those components [445]. In addition, performing NW take less time than performing the same amount of conventional walking with additional resistance training sessions. Some studies

showed that NW increased also the stability and the dynamic balance, which is an important aspect, especially considering the aging process [405].

Regarding the second goal of the study, the first thing to consider is that the popularity of this sport has increased a lot in the last ten years and mainly in this last two years, may be due to the SARS COVID-19 pandemic situation. To contain the virus diffusion, the Italian Government enforced quarantine and after this period there was increasing research for outdoor activities, considered safer than the indoor [448]. However, NW could be considered an easily accessible and universal kind of activity. In fact, NW, such as walking, is a universal form of physical activity that is appropriate regardless of sex, ethnic group, age, education or income level. It does not require expensive equipment (poles are cheaper than other kinds of sport equipment), special skills or special facilities. In addition, it is a kind of outdoor physical activity and several studies have highlighted a relationship between exposure to the natural environment and better health perception [66]. Experimental research suggested that performing physical activity in nature has additional benefits in comparison with compared to doing it in an indoor environment and, in addition, exposure to nature could prove restoration from stress and mental fatigue [252,441]. This is in line with the results of the present study. In fact, participants appreciated the activity and the fact that it was done outdoors, enjoying the contact with nature. In addition, participants showed a good well-being after the practice of NW, with a decrease in anxiety and stress. NW also represents the possibility of enhancement of social interaction and to improve improving social cohesion in the community [442–445]. This could be an important aspect, especially for women. According to Richardson et al. one of the motivations reported by women for the non-use of the park is the fear for their safety [250]. This could in part explain the lower preference of the women of this study, to do outdoor physical activity in

comparison with men. Men tended to agree more with the use of tax dollars on nature park. This disagrees with a previous study that suggested that women were more sensitive in the importance of neighborhood [13,269,270]. However, the sample of men of the present study was small and make generalized interpretations difficult. Generally, the total score of the attitude towards green urban space was high and in line with a previous study [449].

As a conclusion, considering the results in the present study, NW seemed to be a good, complete and safe kind of activity. The practice of NW has several benefits, not only for clinical populations, and it could be considered as a primary preventive kind of activity. In addition, it is an easy kind of physical activity that everyone could practice and could improve social interaction and cohesion.

The present study has some limitations that should be addressed. Three months of intervention can be considered a relatively short period. Therefore, it is necessary to determinate whether the results would differ over a longer timeframe (six months or a year). Additionally, the intensity of the training was decided a priori, and it is possible that for some participants the intensity was too low. For future research it might be useful to use other methods to monitor the intensity of training, such as VO2max. The training intervention did not consider diet. Participants were asked to not change their diet habits, but for future research it will be an important aspect to consider.

12. Study 9: Evaluation of the effectiveness of a Nordic walking and an indoor training program: Anthropometric, Body Composition and Functional Parameters in the Middle-aged Population

The present manuscript is under review in European Journal of Investigation in Health, Psychology and Education

Grigoletto A., Mauro M., Toselli S.

Keywords: anthropometric characteristics, body composition, indoor training, Nordic walking, outdoor training, physical activity, physical test

Overview

The aim of the present study was to compare the effects of a period of outdoor training (Nordic walking, NW) with indoor resistance training in a non-clinical population on anthropometric characteristics, body composition and functional parameters. Both types of physical activity determined significant improvements after the training period: both the samples presented a significant decrease in fat parameters (fat mass and percentage of fat mass) and a significant increase in two physical tests (6'minutes walking and squat test). Considering the two sexes separately, women who performed NW showed a higher decrease in fat parameters than women who practice indoor resistance training. In men, the practice of NW caused a higher increase of phase angle and a significant displacement in BIVA graph.

12.1 Introduction

Several factors influence the participation in PA and greater attention has recently focused on the role of the environment in promoting PA [166,450]. Green spaces seem to be an optimal environment for exercise, due to safety, accessibility and attractiveness of this place [163]. In fact, several observational studies have searched to establish whether a relationship between green spaces and PA exists [166]. However, the studies in this area are still missing and far from conclusions [113]. In fact, in a systematic review demonstrated the paucity of high quality evidence of the studies carried out so far, and the necessity of further research in this area [177]. At the moment, it is not possible to establish if PA carried out in green space is more effective than indoor PA in producing physical, physiological and motor changes in the participants. At this purpose, the analysis of body composition can provide useful information, since it is an indicator of health, nutritional status and functional capacity [451]. In the last years, the analysis of body composition by bioelectrical impedance analysis (BIA) has become one of the most used method, due to its easy use, precision and accuracy [416–418].

Identify what is the best type of activity to achieve the most efficient improvements in body composition and physical parameters represent an important goal for middle-age population. To our knowledge, there are no studies which compare the effectiveness of indoor and outdoor PA on body composition and physical parameters in Italy. NW is an easy type of PA which is usually proposed for clinical population and for elderly, but that shows several potential benefits also for nonclinical population [452]. Resistance training is a kind of PA which can maintain a good health condition and reverse the adverse effects of aging on cellular integrity and function [419]. So, the aim of the present study was to value the efficacy of a period of three months of training in outdoor (in particular, Nordic walking, (NW)) and indoor (resistance training) environment in healthy middle-age population.

12.2 Materials and Methods

12.2.1 Study design and participants

This is a follow-up study design that comprehended 3 months of PA (NW as outdoor PA and resistance training as indoor PA) and two measurements, at baseline and after the training programme. Recruitment occurred thanks to two sport society: “Nordic walking in Italy”, specifically with the headquarter of Venice, and “Arca” based in Mirano (VE). Nordic walking in Italy does activities throughout the province of Venice, in the city parks, along the banks and always in the open air. They manage different walking groups in Mestre, Marghera, Spinea and Martellago. Instead, Arca is based in Mirano (VE) and does activities in the school gym of the municipality. The inclusions criteria were:

- Do not have a chronic disabling disease,
- Do not be bedridden institutionalized or hospitalized,
- Be independently mobile without requiring human assistance or the aid of devices such as crutches, walkers etc,
- to be without amputations,
- do not have pacemaker or the presence of chronic metabolic diseases.

After a preliminary explanation of the study protocol, a total of 114 subjects decided to adhere to the study. Twelve people did not complete the period of training, so they were excluded from the study. Therefore, the sample was finally composed by 102 participants who did both the measurements (before and after the training period). NW participants were 77 and indoor group was composed by 25 people. The mean age of the whole sample was 58.17±9.66. All participants signed an informed consent to participate in the study. The study was approved by the Bioethics Committee of University of Bologna (prot. N. 022254).

12.2.2 Intervention training programs

Participants were engaged in two training sessions of about 60 minutes each for two times a week. Every training session was composed by 10-minutes of warm-up, 45-min of main part and of 5 minutes of stretching exercise. For the NW, three instructors followed the groups in different parks, proposing the same kind of training to the different groups, with the same kind of intensity. For the indoor training, the same instructors followed all the groups and proposed the same kind of resistance training, with the same kind of intensity.

12.2.3 Anthropometric characteristics

The methodology carried out for the anthropometric measurements is reported in chapter 11, point 11.2.3, page 174.

12.2.4 Body composition

The methodology carried out for body composition assessment is reported in chapter 11, point 11.2.4, page 175.

12.2.5 Physical test

Three physical tests were conducted by participants. The procedure used for physical tests are described in chapter 11, point 11.2.5, page 175.

12.2.6 Statistical analysis

The analysis was performed with Stata (software for Windows 10, version 17 (Publisher: StataCorp. 2021. Stata Statistical Software: Release 17. College Station, TX, USA, StataCorp LP). Descriptive analyses were performed, and each result was reported as the variable Mean± Standard deviation (SD) at the two different times (baseline and after three months of PA). To check the normal distribution of the variables, the Shapiro-Wilk test was carried out. A

transformation function (natural logarithm) was applied to reduce curve skewness if variable data did not distribute as a Gaussian curve. In addition, the analysis of variance (ANOVA for repeated measurements and two-way ANOVA) was carried out to assess the differences between baseline and after three months of training and the differences between the two types of training program. The Hoteling's test was performed to observe eventually differences in the BIVA representation.

Statistical significance was set a <0.05.

12.3 Results

12.3.1 Baseline characteristics of the participants

The largest part of the sample was composed of females (70, 69.3%) and their mean age was 56.96±6.64 years. Men who participated in the study (31, 36.7%) were older than women (61.30±8.37).

Table 1 reported the differences connected to sex in the kind of training performed (NW or indoor activity).

Table 40. ANOVA for repeated measurement and two-way ANOVA divided for sex for anthropometric characteristics, body composition and physical tests.

		Women							Men					
		Indoor			NW		NW vs I		Indoor			NW		NW vs I
Variables		Mean±SD	t p		Mean±SD	T p	T p		Mean±SD	t p		Mean±SD	T p	T p
Weight, kg	Baseline	59.88±10.69	1.89	Baseline	65.65±11.69	-0.33	3.40	Baseline	78.40±7.06	-1.36	Baseline	84.58±8.99	-0.65	0.57
	After 3 months	63.41±14.00	0.063	After 3 months	65.34±12.05	0.739	0.070	After 3 months	76.20±7.80	0.533	After 3 months	83.86±7.53	0.915	0.458
BMI, kg/m2	Baseline	22.54±3.57	1.46	Baseline	24.01±3.80	-1.28	3.53	Baseline	24.99±1.66	-1.30	Baseline	27.19±3.02	-0.58	0.55
	After 3 months	23.96±5.63	0.149	After 3 months	23.39±5.03	0.204	0.065	After 3 months	24.29±1.98	0.572	After 3 months	26.97±2.81	0.937	0.466
Triceps,mm	Baseline	16.07±3.87	0.28	Baseline	20.55±3.43	-2.49	1.86	Baseline	9.80±5.33	1.14	Baseline	16.81±4.86	-0.83	1.99
	After 3 months	16.36±3.86	0.780	After 3 months	19.29±3.85	0.015	0.178	After 3 months	11.60±3.34	0.669	After 3 months	15.90±4.31	0.840	0.169
Biceps,mm	Baseline	14.64±5.30	-1.29	Baseline	12.57±4.62	-2.52	0.00	Baseline	10.00±3.86	-0.26	Baseline	10.81±3.09	-0.24	0.01
	After 3 months	13.29±5.75	0.200	After 3 months	11.25±4.62	0.014	0.976	After 3 months	9.70±7.31	0.993	After 3 months	10.62±4.09	0.995	0.938
Subscapolar,	Baseline	15.00±3.09	0.70	Baseline	17.00±6.54	-4.37	6.67	Baseline	15.30±3.43	1.24	Baseline	20.90±4.65	-3.60	9.34
mm	After 3 months	15.79±3.26	0.485	After 3 months	14.55±4.66	<0.00 1	0.012	After 3 months	16.70±2.75	0.609	After 3 months	17.14±4.52	0.006	0.005
Suprialiac, mm	Baseline	18.71±4.89	-0.06	Baseline	19.05±6.40	-1.23	0.24	Baseline	21.30±4.16	-0.57	Baseline	22.81±4.88	-0.83	<0.00
	After 3 months	18.64±4.98	0.952	After 3 months	18.32±5.34	0.224	0.622	After 3 months	20.50±4.09	0.940	After 3 months	22.00±4.51	0.838	1 0.995
Supraspinal,	Baseline	18.86±5.32	-1.07	Baseline	18.42±6.07	-2.42	0.02	Baseline	20.60±5.10	-1.27	Baseline	21.57±5.86	-1.80	<0.00
mm	After 3 months	17.50±4.72	0.289	After 3 months	16.89±5.98	0.018	0.900	After 3 months	18.50±4.67	0.586	After 3 months	19.52±6.78	0.394	1 0.979
Medial calf, mm	Baseline	17.88±7.23	-1.68	Baseline	17.63±3.44	-1.43	0.74	Baseline	11.30±2.87	0.37	Baseline	12.57±4.32	0.08	0.07
	After 3 months	15.43±5.17	0.098	After 3 months	16.58±6.00	0.158	0.392	After 3 months	12.00±1.05	0.982	After 3 months	12.68±7.00	0.987	0.795
Lateral calf, mm	Baseline	13.64±4.65	-0.05	Baseline	12.57±4.32	-1.11	0.20	Baseline	9.50±2.27	1.23	Baseline	8.32±2.68	-0.68	1.96
	After 3 months	13.57±3.99	0.959	After 3 months	12.68±7.00	0.272	0.655	After 3 months	10.00±2.11	0.612	After 3 months	8.10±0.12	0.904	0.172
Arm	Baseline	25.70±3.13	0.87	Baseline	28.38±3.55	2.81	0.24	Baseline	28.83±2.21	0.77	Baseline	30.08±1.97	1.47	0.12
circumferences, cm	After 3 months	26.08±3.08	0.386	After 3 months	28.97±3.45	0.006	0.626	After 3 months	29.23±2.03	0.868	After 3 months	30.13±3.48	0.466	0.729
Contract arm	Baseline	26.23±3.14	0.90	Baseline	29.44±3.42	0.44	0.37	Baseline	30.26±2.11	-1.24	Baseline	32.09±2.42	-0.25	0.77
circumferences, cm	After 3 months	26.60±3.12	0.372	After 3 months	29.54±3.40	0.661	0.546	After 3 months	28.65±7.00	0.606	After 3 months	31.87±2.46	0.994	0.386
Waist	Baseline	80.49±8.27	-0.93	Baseline	79.66±11.58	-1.28	0.06	Baseline	95.69±6.07	-0.52	Baseline	96.56±9.53	-1.28	0.09
circumferences, cm	After 3 months	78.79±6.98	0.357	After 3 months	78.49±12.17	0.203	0.800	After 3 months	94.85±4.65	0.953	After 3 months	95.14±9.42	0.584	0.770
Hip	Baseline	98.53±7.28	-1.16	Baseline	101.94±8.69	-2.63	0.02	Baseline	100.69±5.29	-1.18	Baseline	104.68±4.82	-0.43	0.53
circumferences, cm	After 3 months	97.45±6.17	0.248	After 3 months	100.71±8.78	0.010	0.892	After 3 months	99.84±4.15	0.642	After 3 months	104.46±4.44	0.972	0.472

Calf	Baseline	31.43±7.09	1.92	Baseline	36.58±2.62	-1.46	5.62	Baseline	36.75±1.92	0.10	Baseline	38.15±3.01	-0.92	0.37
circumferences, cm	After 3 months	34.14±3.41	0.060	After 3 months	35.62±5.17	0.149	0.021	After 3 months	36.92±1.76	0.998	After 3 months	37.10±6.40	0.793	0.548
Resistance	Baseline	579.56±78.25	-1.01	Baseline	527.61±73.84	-0.86	0.18	Baseline	452.00±38.43	-0.45	Baseline	488.03±52.69	-0.86	0.04
	After 3 months	555.60±82.39	0.318	After 3 months	510.97±68.28	0.392	0.675	After 3 months	442.72±41.92	0.968	After 3 months	473.74±74.65	0.826	0.850
Reactance	Baseline	60.45±11.93	-3.16	Baseline	57.18±7.15	-0.66	5.61	Baseline	57.37±8.52	-0.06	Baseline	52.52±9.98	2.31	2.27
	After 3 months	52.96±6.99	0.003	After 3 months	56.30±9.13	0.510	0.022	After 3 months	57.23±10.23	0.988	After 3 months	57.11±8.97	0.125	0.146
PhA	Baseline	5.82±0.53	-0.96	Baseline	6.27±0.94	3.87	7.85	Baseline	7.27±0.88	0.45	Baseline	6.36±1.40	3.31	3.59
	After 3 months	5.51±0.59	0.340	After 3 months	7.06±1.46	0.000	0.007	After 3 months	7.44±1.12	0.968	After 3 months	7.49±1.23	0.017	0.073
FM, kg	Baseline	15.75±6.76	3.30	Baseline	24.48±6.30	-0.84	11.06	Baseline	15.28±4.50	-0.87	Baseline	32.00±4.50	-2.95	0.97
	After 3 months	14.28±6.02	0.002	After 3 months	23.06±7.07	0.406	0.001	After 3 months	14.57±4.08	0.818	After 3 months	30.29±3.89	0.031	0.332
FFM, kg	Baseline	45.06±4.63	0.63	Baseline	41.17±5.82	-0.02	0.33	Baseline	63.12±3.59	-1.34	Baseline	53.01±5.42	0.83	2.48
	After 3 months	43.00±11.03	0.530	After 3 months	41.16±8.33	0.988	0.569	After 3 months	60.73±8.96	0.545	After 3 months	54.06±5.21	0.839	0.126
%F	Baseline	25.29±6.76	0.96	Baseline	36.85±3.57	-4.24	7.58	Baseline	19.22±4.19	-0.85	Baseline	37.57±2.66	-2.56	0.62
	After 3 months	23.08±6.17	0.041	After 3 months	35.46±3.76	0.000	0.008	After 3 months	18.43±3.68	0.831	After 3 months	35.90±3.10	0.072	0.439
TUA, cm3	Baseline	53.31±13.73	2.37	Baseline	65.10±16.67	0.73	3.19	Baseline	66.53±10.35	0.48	Baseline	73.36±8.06	0.37	0.03
	After 3 months	54.85±13.65	0.021	After 3 months	66.55±18.55	0.465	0.078	After 3 months	68.32±9.55	0.964	After 3 months	74.36±15.59	0.982	0.864
UMA, cm3	Baseline	34.72±11.43	0.86	Baseline	38.99±11.35	2.55	0.14	Baseline	53.23±9.86	-0.25	Baseline	49.85±8.73	1.24	0.85
	After 3 months	35.63±11.28	0.391	After 3 months	41.78±12.01	0.013	0.712	After 3 months	52.50±9.32	0.994	After 3 months	53.39±10.30	0.607	0.364
UFA, cm3	Baseline	18.59±4.65	0.36	Baseline	26.11±6.72	-1.52	0.99	Baseline	13.30±7.27	1.13	Baseline	23.51±6.11	-0.20	1.61
	After 3 months	19.22±4.81	0.723	After 3 months	24.77±7.95	0.134	0.323	After 3 months	15.82±4.65	0.677	After 3 months	21.97±8.36	0.997	0.215
TCA, cm3	Baseline	82.36±30.20	2.49	Baseline	107.06±15.48	-0.83	6.77	Baseline	107.79±10.97	0.13	Baseline	117.22±18.65	-0.80	0.33
	After 3 months	93.63±18.79	0.015	After 3 months	105.18±18.13	0.408	0.011	After 3 months	108.75±10.10	0.999	After 3 months	113.13±29.64	0.852	0.572
CMA, cm3	Baseline	60.84±25.88	1.82	Baseline	74.92±11.76	-1.24	4.77	Baseline	89.60±11.02	-0.03	Baseline	90.06±14.56	-0.19	0.01
	After 3 months	70.22±12.95	0.073	After 3 months	71.72±21.91	0.219	0.032	After 3 months	89.40±9.25	0.978	After 3 months	89.26±26.80	0.998	0.936
CFA, cm3	Baseline	21.52±6.50	0.78	Baseline	32.14±6.01	-3.66	5.47	Baseline	18.19±3.97	0.44	Baseline	27.16±7.82	-1.79	1.95
	After 3 months	23.41±8.04	0.436	After 3 months	27.72±6.01	0.000	0.022	After 3 months	19.35±2.66	0.970	After 3 months	23.88±7.69	0.299	0.174
Right handgrip	Baseline	22.99±4.61	0.99	Baseline	25.89±6.00	0.51	0.42	Baseline	40.20±7.94	<0.00	Baseline	42.83±10.34	-0.39	0.05
	After 3 months	23.93±4.48	0.328	After 3 months	26.05±5.80	0.614	0.521	After 3 months	40.20±7.64	1	After 3 months	42.25±9.93	0.979	0.823
										1.000				
Left handgrip	Baseline	23.64±4.38	0.27	Baseline	25.41±4.96	0.19	0.02	Baseline	38.00±6.70	0.67	Baseline	41.90±8.54	-0.86	1.09
	After 3 months	24.00±4.24	0.791	After 3 months	25.44±5.70	0.849	0.881	After 3 months	38.70±6.58	0.906	After 3 months	41.29±8.61	0.823	0.305
6 minutes	Baseline	460.60±50.77	1.25	Baseline	540.36±70.52	4.50	0.86	Baseline	592.00±48.76	2.08	Baseline	531.98±95.20	1.74	0.48
walking test, m	After 3 months	481.61±63.52	0.215	After 3 months	577.53±66.10	0.000	0.358	After 3 months	644.00±82.13	0.183	After 3 months	562.73±67.90	0.322	0.493
Squat test, n	Baseline	14.36±2.76	3.37	Baseline	15.58±3.80	2.83	2.84	Baseline	22.00±6.73	1.52	Baseline	14.00±3.57	3.43	0.54
	After 3 months	18.50±3.92	0.001	After 3 months	17.45±3.71	0.006	0.097	After 3 months	24.10±5.53	0.440	After 3 months	17.35±3.63	0.010	0.467

TUA= total upper arm area, UMA= upper arm muscle area, UFA= upper arm fat area, TCA= total calf area, CMA= muscle area of the calf, CFA= fat area of the calf

12.3.2 Effects of three months of training

Table 40 shows several significant differences induced by the two types of training. Indoor group presented a statistically significant decrease in FM and %F. In addition, participants of the indoor activity showed a statistically significant increase in the two physical tests: 6' minutes walking and squat test. Instead, NW group presented a statistically significant decrease in subscapular and supraspinal skinfolds, hip circumferences, FM, %F and CFA and a statistically significant increase in PhA, UMA, 6' minutes walking test and squat test.

Considering the comparison of the two group, people who practiced NW had a higher decrease in the values of triceps and subscapular skinfolds, FM, %F and CFA than people who did indoor activity. On the contrary, total calf area showed a significant higher decrease in NW group in comparison with the indoor group. The calf circumference and the reactance showed a reverse trend. In fact, people of the NW group showed a decrease of the parameters and people of the indoor group presented an increase of the values.

Considering the women sample who participated in indoor activity, a statistically significant decrease was observed in medial calf skinfold, in reactance, FM and %F. Furthermore, they presented a statistically significant increase in TUA, TCA and squat test.

Women of the NW group showed a statistically significant increase in arm circumference, PhA, UMA, 6' minutes of walking and squat test. In addition, they presented a statistically significant decrease in triceps, biceps, and supraspinal skinfolds, hip circumference, FM, %F and CFA.

In women, the comparison between the groups of activity showed a significant higher decrease in subscapular skinfold, FM and %F in those who practiced NW than in the indoor group. The PhA presented a significantly higher increase in the NW group than in the indoor group. The TCA and

CFA showed a reversed trend: NW women presented a decrease of the values and indoor group an increase.

As regards men, indoor training group showed no significant difference between baseline and after three months of PA, while the men who participated in NW activity presented a significant decrease in subscapular skinfold, FM and %F. Indeed, they showed a statistically significant increase in PhA, and in squat test.

As a consequence, the men sample of NW showed a significant higher decrease in the subscapular skinfold and a significant higher increase in the PhA than indoor group.

12.3.3 Effects of NW and indoor training on BIVA parameters

The BIVA analysis showed significant difference in body composition at baseline and after the three months of training, both in women doing indoor training (Figure 1) and men doing NW (Figure 4). Women who did indoor training and men who did NW showed a change in vector length after the period of training, indicative of a change in hydration.

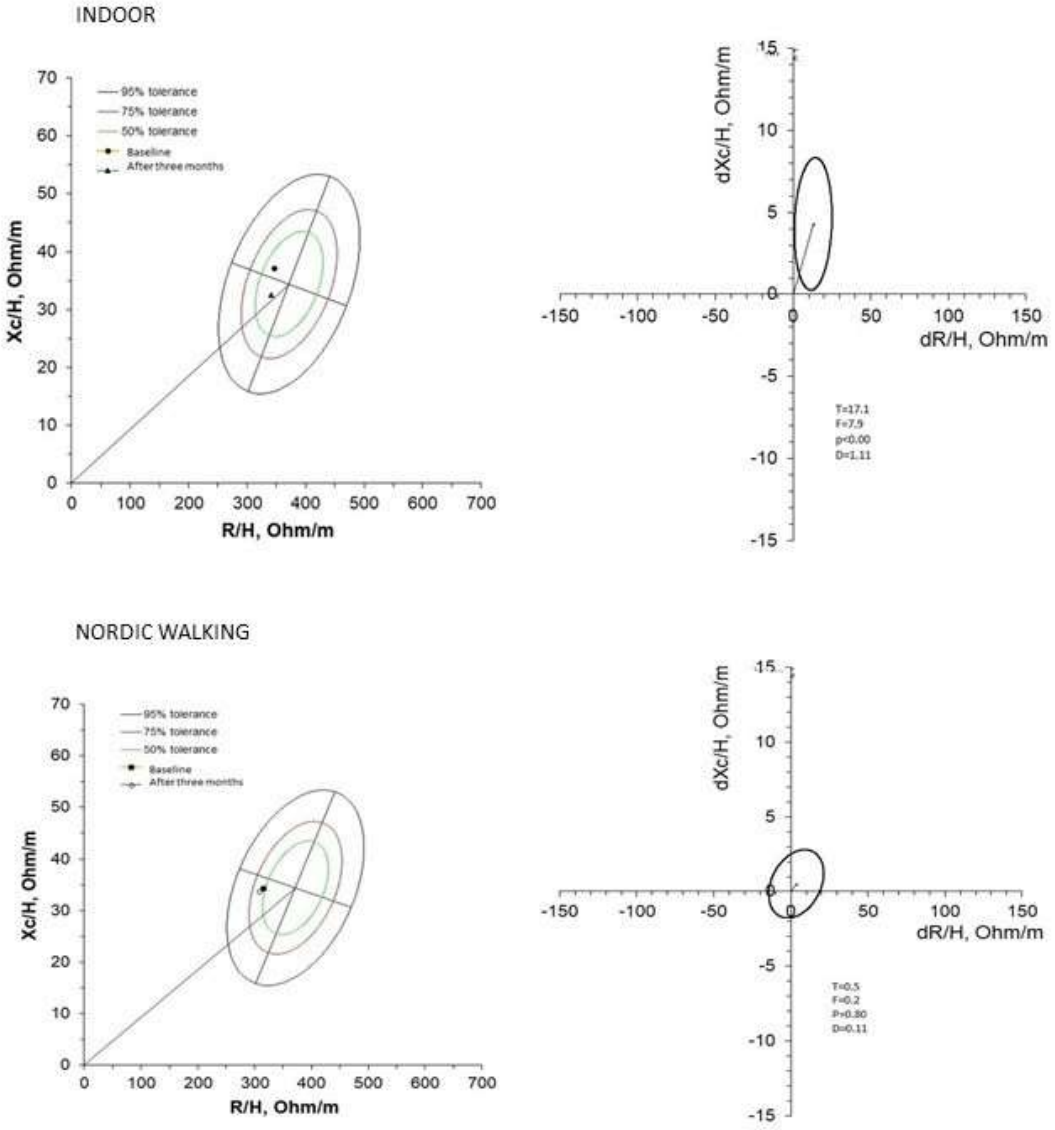


Figure 11. R-Xc and paired graphs for the multivariate changes in classic resistance and reactance are shown in the indoor and NW women group. On the left bioimpedance data are plotted on the tolerance ellipses of the reference population. On the right panels, mean vector displacements with 95% confidence ellipses and results of the Hotelling's T2 test are shown.

Women who did indoor PA showed a reduction in vector length after the period of training, indicative an increase in hydration and the paired one sample Hotelling's Test^2 indicated a significant difference in the mean vector between the first measurement (baseline) and the second measurement (after three months) ($p<0.001$). Women who did NW showed no significant changes linked to hydration and cellularity. Also, the paired one sample Hoteling's T^2 indicated no significant difference between the two measurements.

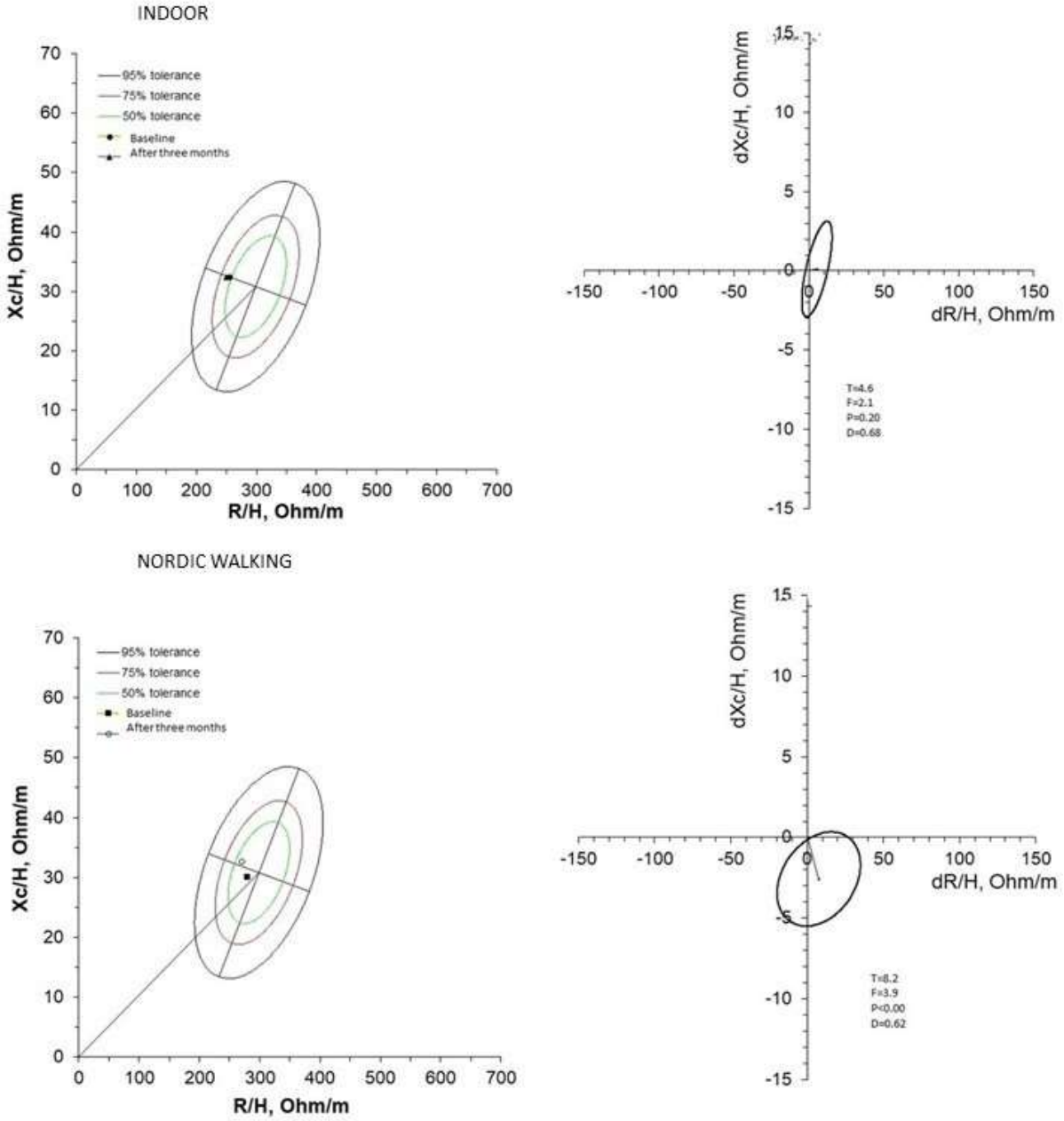


Figure 12. R-Xc and paired graphs for the multivariate changes in classic resistance and reactance are shown in the indoor and NW men group. On the left bioimpedance data are plotted on the tolerance ellipses of the reference population. On the right panels, mean vector displacements with 95% confidence ellipses and results of the Hotelling's T2 test are shown.

Men who did indoor PA did not show significant changes in hydration and in the presence of soft tissue. Also, the paired one sample Hoteling's T^2 indicated no significant difference between the two measurements. Men who did NW presented an increase in the vector length, indicate an increase of hydration and a displacement in increase in the ratio of intracellular and extracellular water. The

paired one sample Hotelling's T^2 indicated a significant difference in the mean vector between the first measurement (baseline) and the second measurement (after three months) ($p<0.001$).

12.4 Discussion

In Italy only the 31% of adult population reported having a physically active job and there is an increasing in the prevalence of obesity [319,327]. Understand how to motivate people to spend more time participating in PA is an important goal [177]. One of the possible factor that could influence participation in PA is the use of natural environment, that offers a safe, accessible and attractive place for exercise [163]. However, studies in this area is young and even if they have presented an increase during the last years, they are far from conclusive [113]. For this reason, the aim of the present study was to evaluate the effectiveness of a period of three months of training in outdoor (NW) and indoor (resistance training) in healthy middle-aged people. To our knowledge, there are no studies which consider the comparison between the two types of training (NW and indoor training) on body composition and physical motor characteristics. NW is a particular type of walking in which participants use specially designed poles to actively involve the upper body and arms [401]. In recent years, it has gained popularity worldwide as a health-promoting activity [389]. NW could be considered a total body version of walking, with a greater body muscle activity due to the use of the poles and potentially enhanced physical fitness benefits [400,401]. Fritshi et al., in their systematic review , observed that most of the participants in NW activity were mid to older aged people, with several chronic diseases [402]. According to this systematic review, NW has several important benefits for the population, such as resting the blood pressure and heart rate, increasing exercise capacity, quality of life and maximal oxygen consumption [403]. For these reasons, NW is suitable for prevention. Resistance training is one of the most used type of PA and in addition it has the potentiality to help people to maintain a good health condition and reverse the adverse effects of aging on cellular integrity and function [419]. Westcott, in his systematic

review, found that resistance training has several potential positive benefits for the population [453]. In fact, the author reported improvements in physical performance, movement control, walking speed, functional independence and may assist prevention and management in several chronic diseases [453]. In addition, resistance training improved cardiovascular health and increase in bone mineral density [453]. Although both the two types of PA potentially could have positive changes after a period of training but they need other research to reveal optimal dose-response relationship [454].

In the present study, considering the whole sample the three months of NW and indoor trainings showed positive effects: in both the activities a significant decrease in FM and %F and a significant increase in 6' minutes walking and squat test were observed. This represents a positive aspect, which could be linked to an increase in the strength of the lower body and to an increase in capacity of resistance. This is partially in contrast with a previous study about NW which assumed that the use of poles, used as a support, reduced the training effects on lower extremities [413]. Having more strength and resistance could drive people to continue PA for a longer period and to be more active [452]. Previous study also showed a significant increase in handgrip strength, in contrast with the results of the present study [413,455]. Maybe the period of three months was too short to observe significant change in upper body muscle strength. In addition, the whole sample of NW showed significant decrease in other parameters such hip circumference. Regarding the comparison between the two groups, NW group seemed to have more positive effects. In fact, NW had higher decrease in several parameters connected to body fat (triceps, and subscapular skinfold, FM and %F) and a higher increase in PhA. The increase in this parameter is generally associated with an increase in strength (in this case of the lower body) and alteration in cellular membrane integrity or body fluid or a combination of both [447,456]. This aspect is important, because muscle strength is recognized as a good predictor of adverse health outcomes [457]. Women presented a higher

number of significant changes than men after the period of training. Even in this case, women in both groups showed a significant decrease in FM and %F and a significant increase in squat test. Comparing the values of FM and %F, NW group showed significantly higher decreases than indoor group. Similarly, men who did NW showed a higher decrease between the baseline and after the three months of training in comparison to indoor resistance group.

It should be highlighted that, both in women and in men the NW group a showed a higher significant increase in PhA. This result indicates the promotion of additional positive effects on cellularity cell size and integrity in cell membrane. The PhA changes highlighted are in line with the result of previous studies [428,458]. Several studies have considered the PhA and its relationship with the health status and it is an important factor to prevent the aging process [447,456]. So, NW could be considered as a "protective" type of activity. Considering BIVA, women who practice indoor resistance training and men who practiced NW showed a significant vector displacement in the BIVA graph. The men group of NW presented a significant increase in soft tissue indicative of a better cellular health, that could be link to a preserving action for muscle mass [425]. So, it seems that for men the NW training could be more effectiveness than indoor resistance training. At the same time, women who did indoor training showed a significant decrease in the ICW/ECW ratio, that could be due both to a reduction of R (body fluid change) and Xc (link to the decrease in cell membrane health). These changes may be due to change in nutritional habits during the intervention period, an aspect that have not been monitored and that could have caused a disparity changes in R and Xc, as reported in previous studies [455,459]. The present result partially contrasts with a previous study, which found significant improvement in BIVA parameters and in fat parameters after a resistance training period [446]. In the present study, women who participated indoor resistance training showed a significant decrease in FM and %F, according to the previous study, but not in BIVA parameters. This could also be linked to the period of training: Fukuda et al. (2016) found a

significant increase in BIVA parameters after a period of six months of resistance training [446]. So, probably, three months of training are too few to observe significant changes in BIVA parameters.

A previous study compared the effects of conventional walking, NW and resistance training in older adults [445]. The results showed that walking improves cardiorespiratory fitness, the resistance exercise improve muscle strength, and the NW is a combination of the two types of activities and provide improvement to both components [445]. Performing NW take less time than performing the same amount of walking with additional resistance training sessions. Experimental research suggested that performing activity in nature has additional benefits in comparison with compared to doing it in an indoor environment [252] and, in addition, exposure to nature could prove restoration from stress and mental fatigue [442]. A higher long-term adherence to exercise participating was showed in outdoor PA by some studies than indoor exercise interventions [95–97]. So, initiatives created to increase PA in green spaces are important also to improve social networking and feelings of connectivity and companionship, improvement in self-esteem, an increased appreciation of nature and a means of escape from modern life. The present study has some limitations that should be addressed. The period of training of three months could be considered relatively short. It could be interesting to extend the period of training, to six months or a year, to determinate if the results could be different. In addition, the sample size was limited, it could be interesting for future research to include more participants and with a more similar distribution between women and men. In addition, participants were not asking information about diet and alimentary behaviour. So, for future research it will be an important aspect to consider.

13. Study 10: Women Walking over 65: results of a pilot study

Manuscript in preparation

Keywords: Anthropometric measurements, body composition, elderly, outdoor physical activity, walking

Overview

Walking is a universal form of physical activity, and it does not require expensive equipment or special skills. For these reasons, it is one of the more proposed kind of physical activity (PA) initiatives. Such as other kinds of PA, it has several benefits for health, especially in older adults. The present pilot study aimed to evaluate the effectiveness of a period of three months of outdoor walking for eleven women over 65 years.

13.1 Introduction

Walking is the easiest and the most popular way to remain active, so it is one of the major focuses of the PA initiative. It is probably because of its accessibility that walking is a universal form of PA which is appropriate regardless of sex, ethnic group, age, education, or income level. In addition, walking does not require expensive equipment, special skill or special facilities. Walking outdoors at least once a week has been associated with achieving more time spent in moderate to vigorous PA than walking indoors and it also provides a means to participate in meaningful activities [213]. Walking is also important for elderly people. Limited walking is also effective in preventing falls and fall injuries in older adults [214]. A meta-analysis of four studies that included walking reported a 44% reduction in fall injuries in the intervention group [460]. Therefore, the costs of medical care are substantially lower in physically active adults and walking has the potential to reduce the expenditure [211,217]. Walking also improves health, in fact, Wu et al. demonstrate that a walking program activity could improve perceived fatigue, and another study, reported an improvement in the happiness of the participants [218,460].

Aging is associated and accompanied by a decline in body composition and strength, which increase the risk of age-related diseases, such as sarcopenia [137]. Inactivity seems to be a factor that accelerates the decline in body composition and the decrease in body function, while regular physical exercise can slow down these processes [137]. Consequently, the importance of exercise for the elderly is evident [461]. Monitoring the body composition has become crucial to evaluate the nutritional status and the functional capacity of elderly and middle-aged people [462].

This study was a pilot study, with the aim to evaluate the effectiveness of three months of walking in a group, supervised and monitored for elderly people (through anthropometric measurements and two physical tests) and the potential change in body composition. Walking in group could be

an important instrument to improve the PA in elderly people, to increase the cohesion and the adherence in the PA practice.

13.2 Material and methods

13.2.1 Study design and participants

This was a pilot longitudinal study design with 3 months of follow-up and two measurements, at baseline and after the training period. Recruitment occurred thanks to the sports association which do activities in Vignola (MO, Italy) and to the general doctor. In accordance with the Municipality of Vignola and the medicine sport association, the general doctor decided who to propose participating to this activity. The study protocol was explained to the potential participants and who voluntarily decide to participate were included. Participants had to meet the following criteria to qualify for inclusions: (1) not having a chronic disabling disease, (2) not being bedridden institutionalized, or hospitalized, (3) being independently mobile without requiring human assistance or the aid of a device such as crutches, walkers etc, (4) be without amputations, (5) not have a pacemaker or chronic metabolic disease. All participants signed informed consent to participate in the study. The activity was completely free for participants and was conducted by experienced graduates in Sports Sciences. In addition, in the walking group there were some "leader walk" that helped people if they had difficulties and encouraged them.

The study was approved by the Bioethics Committee of the University of Bologna (prot. N. 022254).

13.2.2 Intervention training programs

The baseline was set at the end of April 2021 after the stop related to the pandemic situation in Emilia-Romagna due to Covid-19, while the post-test was done in July 2021. Participants did two weekly training sessions of 60 minutes each. Every training session included a 10-minute warm-up, a 45-minute main part during which people marched in the park following their trainer, and the final

5 minutes of relaxing and stretching exercises. The same instructor followed the group for the three months.

13.2.3 Anthropometric characteristics

The methodology carried out for the anthropometric measurements is reported in chapter 11, point 11.2.3, page 174.

13.2.4 Body composition

The methodology carried out for body composition assessment is reported in chapter 11, point 11.2.4, page 175.

13.2.5 Physical test

Three physical tests were carried out. The procedure used for physical tests are described in chapter 11, point 11.2.5, page 175.

13.2.6 Statistical analysis

All statistical analysis were performed with Statistica for Windows, version 8 (Stata Soft Italia Srl, Vigonza, Padua, Italy). Descriptive analysis and independent Student t-test were used to assess baseline characteristics and gender differences. Each result was reported as the variable Mean± Standard Deviation (SD) at two different times (baseline and follow-up). The Shapiro-Wilk test was used to check the normal distribution of each body composition and physical test variable. When variable data did not distribute as a Gaussian curve, a transformation function (natural logarithm) was applied to reduce the curve skewness. Longitudinal differences were calculated as baseline and follow-up among groups for each variable, and mean ± SD, paired Student's test (t) and probability (p) values were outlined. Statistical significance was set at $p \leq 0.05$.

13.3 Results

13.3.1 Baseline characteristics of the participants

Seventeen people decided to participate in this study, but five people did not complete the period of training and were excluded from the study. So, 11 participants did both the measurements before and after the period of training.

The mean age was 66.24±6.49 years and their characteristics are presented in Table 41.

Table 41. General characteristics of the sample, at baseline and at the follow-up

	Pre	post	Diff	T	P
Variables					
Height	1.60±0.04	-	-	-	-
Weight, kg	65.68±11.95	64.90±11.88	0.77±0.75	3.40	0.007
BMI, kg/m^2	25.52±4.35	25.21±4.30	0.30±0.30	3.31	0.008
Triceps sk, mm	19.09±3-01	20.27±3.20	-1.18±3.51	-1.11	0.291
Biceps sk, mm	11.72±3.23	11.18±3.74	0.55±3.56	0.51	0.622
Subscapolar sk, mm	14.45±4.48	15.73±4.11	-1.27±3.35	-1.26	0.236
Suprialiac sk, mm	17.36±6.05	18.45±5.77	-1.09±3.30	-1.09	0.298
Supraspinal sk, mm	18.18±4.94	18.73±4.15	-0.54±2.70	-0.67	0.518
Medial calf sk, mm	15.27±3.38	15.73±2.33	-0.45±2.66	-0.56	0.583
Lateral calf sk, mm	14.36±2.46	15.72±3.98	-1.36±2.25	-2.01	0.072
Arm circumferences, cm	30.1±4.39	39.40±3.24	0.70±1.61	1.44	0.180
Contract arm circumferences, cm	30.49±4.43	29.75±3.47	0.75±1.48	1.67	0.127
Waist circumferences, cm	82.55±14.02	82.60±12.31	-0.25±8.89	-0.09	0.926
Hip circumferences, cm	105.11±10.19	98.87±22.40	6.28±20.45	1.02	0.332
Calf circumferences, cm	32.79±9.31	35.49±3.58	-2.71±9.25	-0.970	0.345
Resistance	579.98±66.29	534.84±73.98	45.15±48.05	3.12	0.011
Reactance	53.73±10.66	53.34±9.27	0.39±8.47	0.15	0.881
Phase angle	5.41±0.59	5.69±0.62	-0.28±0.89	-1.05	0.320
FM, kg	23.73±5.90	23.90±6.19	-0.17±1.16	-0.49	0.632

FFM, kg	41.00±5.91	41.95±6.40	0.95±1.16	2.71	0.022
%F	35.80±2.93	36.42±2.91	-0.62±1.67	-1.24	0.244
TUA, cm^2	73.53±22.41	69.58±15.75	3.95±8.57	1.53	0.157
UMA, cm^2	47.46±16.90	42.70±9.59	4.76±8.38	1.89	0.089
UFA, cm2	26.07±6.60	26.88±6.71	-0.81±4.19	-0.64	0.535
TCA, cm^2	96.63±22.62	101.21±19.87	-4.59±16.76	-0.91	0.385
CMA, cm^2	75.50±17.56	74.98±14.55	-2.47±13.14	-0.622	0.547
CFA, cm^2	24.12±6.40	26.27±6.47	-2.12±4.43	-1.59	0.142
Right handgrip	22.73±4.15	22.45±6.36	0.27±3.16	0.29	0.781
Left handgrip	21.63±6.75	21.63±3.69	0±4.26	0.00	>0.999
Squat test, n	13.91±3.11	15.64±3.07	-1.73±3.17	-1.81	0.100

Note. Diff= difference between the baseline and the follow-up, P= p-value, sk=skinfold, TUA=total upper arm area, UMA=upper arm muscle area, UFA=upper arm fat area, TCA=total calf area, CMA=muscle area of the calf, CMA=fat area of the calf

13.3.2 Effects of walking training on anthropometric characteristics

As regards the anthropometric characteristics (Table 41) significant differences between baseline and follow-up were observed for weight and BMI. A little decrease in fat parameters (weight:pre-65.68±11.95, post 64.90±11.88;, BMI:pre-25.52±4.35, post 25.21±4.30), and an increase in the FFM (pre-41.00±5.91, post 41.95±6.40) were observed.

13.3.3 Effects of walking training on physical tests

Regarding the physical test, no significant differences in both the handgrip test and the 30" squat test (Table 41).

13.3.4 Effects of walking training on BIA

Regarding the BIA parameters, resistance presented a significant decrease after the period of training (pre-579.98±66.29, post 534.84±73.98).

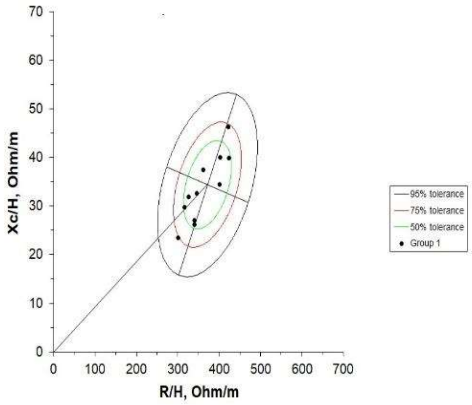


Figure 13. R-Xc graph of participants at baseline

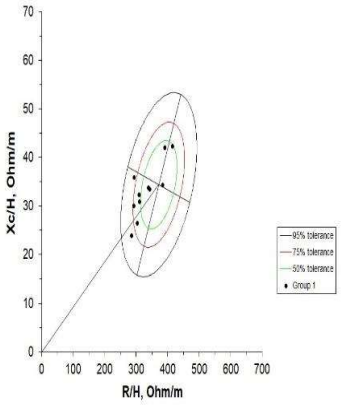


Figure 14. R-Xc graph of participants after the period of training

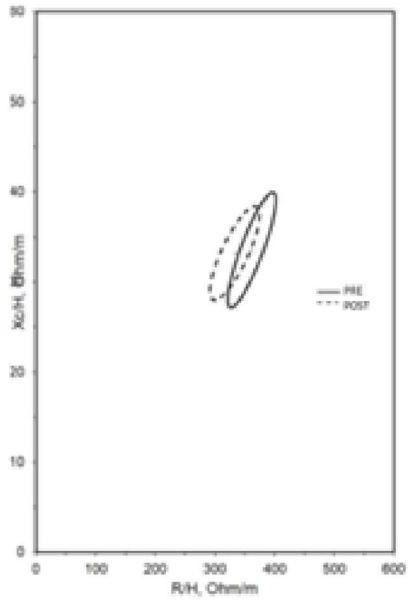


Figure 14. Mean impedance vectors with confidence ellipses for baseline and follow-up, T=6.5, F=3.1, P=0.06, Mahalanobis D=1.09

Figure 12 and Figure 13 showed the BIVA position before and after the period of training. It is possible to notice that, in mean, after the period of training there was a a reduction in vector length, which indicates an increase in hydration. In addition, there was also a displacement in the left part of the graph, which indicates an increase in cellularity.

13.4 Discussion

Walking is the major focus of PA promotion initiatives for old people because it is a universal form of physical activity which is appropriate regardless of sex, ethnic group, age, education, or income level. It does not require expensive equipment, special skill, or special facilities, so it is easily acceptable for a high proportion of the population [133,463]. In addition, walking emerges as the safest kind of physical activity. Some studies found that the injury rate of walking (1.9) was lower than that of other kinds of activities (swimming, tennis, lifestyle activity, etc) [400,413,441]. In a systematic review by Hanson and Jones (2014), which included 42 articles, emerged the absence of accidents or adverse events during the activity [464]. This could be an important aspect especially for encourage old and elderly people to practice this kind of activity [441].

The main aims of the present study were to evaluate the effectiveness of a period of outdoor walking training in a healthy elderly population on anthropometric parameters, body composition, and functional parameters. Participants were measured twice, at the baseline and after three months of walking.

At the follow-up, participants showed a significant decrease in weight and BMI and a significant increase in FFM. These results are important because an excess of fat mass is correlated with a higher cardiometabolic risk [457,462]. In addition, the age-related loss of muscle quantity and strength results in a geriatric syndrome called sarcopenia [465]. So, the decrease in weight and the increase in FFM could represent a protective factor against sarcopenia. In addition, muscle quantity and strength were proposed as important factors to be considered to identify sarcopenia [457]. Participants also showed an increase in lower body strength, even if not significant This could be linked to the duration of the interventions that could be too short to observe significant changes. Previous studies have analyzed the efficacy of the group-based walking program and a review

provides evidence that walking has health benefits over and above making people more physically active [464]. Significant improvements were found in several measures of health: systolic and diastolic blood pressure, resting heart rate, total cholesterol, VO2max, and quality of life for physical functioning [212,214,466–468]. In addition, some studies found a significant decrease in body fat and BMI, which is in line with the results of the present study [464]. The majority of the interventions, included in the systematic review, were below international moderate activity guidelines [469]. Also, mental health has several positive connections with walking. In fact, some studies found a positive relationship between walking and a decrease in depressive symptoms, or with perceived happiness, restorativeness, and naturalness [206,468].

As regards BIA parameters, the resistance presented a significant decrease after the period of training, followed by an increase in the phase angle, even if it was not significant. Usually, for middle-aged people, the more common kind of activity proposed is walking and resistance training, because they reverse the adverse effects of aging on cellular integrity and function [110,428,461]. Resistance training improves bioimpedance parameters and induces changes in cellular volume and cellular potential [419,446]. These results are partially in line with the results of the present study. Several studies have taken into account the importance of phase angle and its relationship with health status [48,49]; in this case, the increase of this parameter was associated with a decrease in body fluid. Consequently, participants presented increased cellularity [447,456].

Although these changes were important, perhaps it would have taken a longer period of training to have results on the other parameters. Walking could be considered a" protective" kind of activity for the aging process. Future research could be interesting to include a control group, to understand better the positive effects of PA on elderly people.

14. Summarizing

Table 42 shows the main results of the studies included in the present thesis.

Study 42. In summary, the results of the studies.

Study	Main goal	Main results
Study 1.	To explore the most popular kind of PA in GUS	Walking and the use of OFE were the most popular kind of activity
Study 2.	To evaluate the knowledge about the effects of PA done in green and blue Spaces	People aware of PA interventions in green and blue environments had positive influence on health status
Study 3.	To explore the motivations that drive people to use the GUS during their leisure time	There were regional and age differences in the motivations of people, several factors should be considered when counseling on PA selections is made
Study 4.	To understand the relationship between the type of activities done in GUS and the mental health status	People with poorer mental health more frequently chose activities performed in the green urban space.
Study 5.	To evaluate the effectiveness of the project “The moving park projects” in Italy	The study confirmed the positive effect of GUS, parks on health status
Study 6.	To evaluate the effectiveness of the project “The moving park projects” in Italy	The study confirmed the positive effect of GUS, parks on health status, also during the COVID pandemic
Study 7.	To explore the main motivations of Italian people to visit the GUS and to understand if	Two main motivations were identified to visit the parks: to relax and to practice PA,

	PA performed in the park is enough to achieve the WHO goal	and urban inhabitants' PA level did not reach the minimum levels recommended by the WHO inside the park
Study 8.	To analyze the effectiveness of NW performed in GUS	NW could be an important kind of outdoor PA to increase the muscle mass for the nonclinical population.
Study 9.	To compare the effects of Nordic walking and indoor resistance training on body structural parameters and physical performance	Both activities had positive effects on biological status of people, but Nordic walking revealed more positive effects
Study 10.	To analyze the effectiveness of walking in GUS for elderly people	Walking had several positive effects for elderly people

15. Conclusion and implication for future studies

The present Ph.D presentation had two main goals. The first was to evaluate the relationship between the use of Green Urban Space (GUS) and mental and physical health, through questionnaires. The second goal was to analyze the effectiveness of PA performed in GUS on mental and physical health and to compare these results with the effectiveness of PA done in an indoor space. First of all, a systematic review of the literature was performed to investigate the current wealth of knowledge about the most popular kind of PA carried out in GUS (study 1), and about the effects of PA done in green and blue spaces (study 2). From study 1 emerged that walking and the use of OFE were the type of activities most frequently practiced. Walking is an easy activity, performed every day by people to move so it does not require special skills or training to be performed. Walking is also an activity without cost and people can perform it in a city's park or anywhere they want for free since they do not have to pay a subscription. In addition, this kind of activity does not require particular equipment, people can wear what they prefer, and walking can be considered as a workout or a recreational activity, such as walking with the dog, but in any case, it is a good way to maintain a healthy lifestyle and to reduce sedentary behavior. There is an increase in OFE installations all over the world, and this could promote PA. Both activities can be performed when is better to the population because there is usually no time restriction for park use. From the second review emerged that PA interventions in green and blue environments can have a positive impact on a healthy population, both after a few weeks of intervention or after several weeks. In addition, it can be an effective strategy to enhance and promote a healthy lifestyle. It was not possible to draw an exhaustive conclusion based on the available evidence, so, this systematic review highlighted the need to extend and improve this kind of intervention. Both the reviews highlighted the need to improve the quality of study regarding the topic and to extend this kind of intervention that might stimulate a change in adults' lifestyles.

Linked to this point, another aim was to understand the motivations that drive people to use the GUS during their leisure time, since this aspect is still unclear (study 3 and study 6). It is a complex topic, especially due to its multifactorial nature. The questionnaire of study 3 was composed of fifteen items and participants had to evaluate with a Likert scale if they agreed or disagreed with the sentences (1= absolutely disagree, 5= absolutely agree). The data collected were analyzed by comparing people living in two Italian regions, Emilia-Romagna and Veneto. The results suggested that people from Emilia-Romagna had a higher score regarding attitude toward green urban space. This suggests that territorial policies appeared more effective than national policies. In fact, in Emilia-Romagna, there were more projects and initiatives to promote and to sensibilize citizens to the use of green urban spaces, such as the project "The moving park project" carried out in Bologna's Park during the spring-summer time. In addition, some variables seemed to be more important than others, in both regions. For example, the attitude score grew with increases age. Therefore, local politicians could create events or projects to engage specifically with the subjects belonging to the younger age groups (18-30 years). These might be cultural, or sports events aimed to change the perception that young people have about parks. Another possibility could be to increase the quality of the parks, by adding outdoor fitness equipment, wellness paths, or other facilities (such as toilets or benches). Therefore, awareness must be promoted at all ages. In addition, the type of work seems to be an important predictor of the use of parks, and this is an aspect to consider in future studies. The creation of restorative workplace environments could be also an important aspect to meet the needs of workers. A better understanding of the relationship between the creation of attitude and the kind of profession or the number of hours spent at work is needed. Finally, understanding people's attitudes will help to improve the quality of life in cities by creating affordable parks and green spaces for the entire population. Study 7 found two main motivations to visit the park: to relax and to practice PA. These are important aspects they represent

important information for planning park design actions and/or proposing activities or events to encourage the use of green urban space. People showed that they were influenced by the restorative effects of the park.

Based on these findings study 4 was conducted to understand the relationship between the type of activities done in GUS and restoration in people with different levels of mental health living in four different cities (Barcelona, Doetichem, Stoke-on-Trent, and Kaunas). Through a questionnaire, the frequency of six types of activities carried out in green urban spaces was collected and related to the feeling of restoration, and mental health. The activities were: doing sports, picnics, meeting family or friends, walking and playing with children, tranquility, and personal relaxation. A significant association between restoration and activities linked to the reduction of stress (tranquility and personal relaxation) was found. People from the four considered cities presented different associations for different frequency indicators, but they showed a similar trend: people with poorer mental health showed more statistically significant associations with the kind of activity performed in the green urban space. So, people with poorer mental health seemed to be more sensitive to the positive effect of visiting a green environment. On the contrary, people with better mental health seem to be less influenced by visiting GUS, maybe due to their mental health situation. Therefore, the green prescription will be important for all people, especially those with poorer mental health. These analyses support the evidence that green urban spaces have an important influence on the creation and maintenance of mental health.

Study 5 and study 6 dealt with the effectiveness of the project “The moving park projects”, which provided the administration of free supervised PA by qualified trainers to citizens within Bologna’s Park during the spring-summer time. The project aimed to introduce dwellers to the physical activity practice, and to improve their physical and mental health. These two studies confirmed the relationship between the use of the park and its positive effects on health. In fact, the project has

brought benefits in terms of stress reduction and increased psychological well-being of participants. In study 6 the impact of COVID-19 was analyzed. In this study, the effects of the project "The moving park project" were considered during the COVID-19 period, in which the possibility to perform PA in a safe context was important, and the project appears to have been able to improve citizens' psychological well-being, particularly in women. Engaging in regular PA performed in nature or GUS has been indeed invocated as a promising strategy to improve well-being in urban settings, especially when indoor physical activity was not allowed. Outdoor PA is an appropriate intervention to improve the health, well-being, and quality of life of the population Therefore, the government, health authorities, healthcare professionals, and other key decision-makers should consider these types of programs and initiatives that capitalize on nature-based opportunities. The promotion of adequate health habits is essential to cope with the global health challenge of non-communicable diseases.

Regarding the second goal of the present Ph.D dissertation, study 7 showed that urban dwellers are usually inactive. In particular, participants in the present study did not reach the minimum levels recommended by the WHO inside the park. Only when active commuting was added to the amount of PA, more people achieved the goal. This indicates the great importance of active transportation in an urban environment and the need to improve the possibility to perform the right amount of physical activity in green urban space. Active methods of transport could be an important helper to be included in their daily life habits. This represents an important point of reflection and may suggest the need to promote active commuting to raise awareness of the population about this important topic. In addition, it could be helpful to create a type of program for urban park users, such as putting signs inside the park, with tips and information about different kinds of outdoor exercise or examples of possible exercises (with explanatory drawings), facilitating the practice of more intensive PA.

Linked to this, study 8 and study 10 analyzed the effectiveness of PA performed in GUS. In particular, study 8 evaluates the benefits of a period of NW training in the general population. NW could answer two human needs: the importance of the use of green urban space and the possibility to easily perform physical activity. It is an easy kind of physical activity that could be done by anyone and everywhere in the green urban space. Even if it is usually used for a specific kind of population or rehabilitation in chronic disease, NW also has a lot of potential benefits for the general population. From the results of our study, we can see that NW increases resistance and lower body strength and also influences the changes in body composition. The popularity of this sport is increasing, probably due to the COVID-19 pandemic situation, because outdoor physical activity is recommended. It would be important to encourage its practice not only for older people but also for younger people because it is an easy sport that anyone could practice anywhere they want. Study 10 evaluated the benefits of a period of walking in women population of women over 65 years. From the results of the study emerged that walking influence the changes in body composition, which decrease weight and BMI, and increase FFM and resistance. It would be important to encourage its practices for the elderly population, to remain active, and to help them age healthily.

Finally, study 9 evaluated the comparison between a period of NW and indoor resistance training, to understand the effectiveness of the two types of PA. Both NW and indoor training has positive effects on the participants, but NW seemed to be more effective, in particular for men. However, it would be important to encourage the practice of any type of PA for the population to promote the decrease of sedentary behavior.

15.1 Implications for Future Studies

- Several figures which could analyze and study the GUS are needed, so a multidisciplinary approach is necessary to increase the evidence regarding this type of environment.
- Evaluating the effectiveness of policies regarding green urban space could be a good strategy to understand the attitude and perception of the population.
- More information about the motivations that drive people to use GUS is still needed.
- It could be interesting to understand why people decide to not use/visit this type of environment.
- Studies of higher quality are needed.
- A more specific definition of GUS could help to also improve the quality of the studies.
- The effects of PA performed outdoors and indoors could be examined for a longer period.
- Adherence to PA performed in green spaces could be analyzed.
- The creation of a specific PA protocol in green space could a good strategy to increase the use of this environment.
- Improving the walkability of a city could help to integrate active commuting into all-day life.
- General population could be more observed in GUS because there is increasing literature regarding people with chronic diseases or specific populations (such as children or the elderly).

Acknowledgments

I would like to express all my gratitude to my supervisor Professor Stefania Toselli, for encouraging my research experience and to take care of me and patiently instilled some of her knowledge into me.

I would also to thank all the Professors with I had the pleasure of working together: Daniele Torreggiani, Maria Pia Fantini, Pasqualino Maietta Latessa, Laura Dallolio, Laura Bragonzoni.

Thanks to all the Professors and colleagues from the Global Institute of Health in Barcelona who hosted me during my period abroad.

Gratitude is also expressed to all my colleagues, especially Sofia Marini and Mario Mauro who made everything lighter.

Finally, my special thank is for my family and my boyfriend Mattia, thank you to support and encourage me in this long path, I love you all.

Reference

1. World Urbanization Prospects - Population Division - United Nations Available online: https://population.un.org/wup/ (accessed on 13 July 2022).
2. Jim, C.Y. Green-Space Preservation and Allocation for Sustainable Greening of Compact Cities. *Cities* **2004**, *21*, 311–320, doi:10.1016/j.cities.2004.04.004.
3. Grey, G.W. *The Urban Forest: Comprehensive Management*; 3. edizione.; New Publisher: New York, 2021; ISBN 978-0-471-12275-3.
4. Bradshaw, T.; Brabdshaw, A.; Hunt, B.; Hunt, B.; Walmsley, T.J. Trees in the Urban Landscape: Principles and Practice - .: 0419201009 - AbeBooks Available online: https://www.abebooks.com/9780419201007/Trees-Urban-Landscape-Principles-practice-0419201009/plp (accessed on 2 December 2022).
5. Jim, C.Y.; Liu, H.T. Species Diversity of Three Major Urban Forest Types in Guangzhou City, China. *Forest Ecology and Management* **2001**, *146*, 99–114, doi:10.1016/S0378-1127(00)00449-7.
6. *The Compact City: A Sustainable Urban Form?*; Burton, E., Jenks, M., Williams, K., Eds.; Routledge: London, 1996; ISBN 978-0-203-36237-2.
7. Gidlöf-Gunnarsson, A.; Öhrström, E. Noise and Well-Being in Urban Residential Environments: The Potential Role of Perceived Availability to Nearby Green Areas. *Landscape and Urban Planning* **2007**, *83*, 115–126, doi:10.1016/j.landurbplan.2007.03.003.
8. Morris, N. Health, Well-Being and Open Space Literature Review. 40.
9. Peschardt, K.K.; Schipperijn, J.; Stigsdotter, U.K. Use of Small Public Urban Green Spaces (SPUGS). *Urban Forestry & Urban Greening* **2012**, *11*, 235–244, doi:10.1016/j.ufug.2012.04.002.
10. Pickard, B.R.; Daniel, J.; Mehaffey, M.; Jackson, L.E.; Neale, A. EnviroAtlas: A New Geospatial Tool to Foster Ecosystem Services Science and Resource Management. *Ecosystem Services* **2015**, *14*, 45–55, doi:10.1016/j.ecoser.2015.04.005.
11. EUROPEAN UNION Mapping Guide for a European Urban Atlas — European Environment Agency Available online: https://www.eea.europa.eu/data-and-maps/data/urban-atlas/mapping-guide (accessed on 1 December 2022).
12. de Vries, S.; van Dillen, S.M.E.; Groenewegen, P.P.; Spreeuwenberg, P. Streetscape Greenery and Health: Stress, Social Cohesion and Physical Activity as Mediators. *Social Science & Medicine* **2013**, *94*, 26–33, doi:10.1016/j.socscimed.2013.06.030.
13. Gascon, M.; Triguero-Mas, M.; Martínez, D.; Dadvand, P.; Forns, J.; Plasència, A.; Nieuwenhuijsen, M.J. Mental Health Benefits of Long-Term Exposure to Residential Green and Blue Spaces: A Systematic Review. *Int J Environ Res Public Health* **2015**, *12*, 4354–4379, doi:10.3390/ijerph120404354.
14. Sugiyama, T.; Ward Thompson, C. Associations between Characteristics of Neighbourhood Open Space and Older People's Walking. *Urban Forestry & Urban Greening* **2008**, *7*, 41–51, doi:10.1016/j.ufug.2007.12.002.
15. Triguero-Mas, M.; Dadvand, P.; Cirach, M.; Martínez, D.; Medina, A.; Mompart, A.; Basagaña, X.; Gražulevičienė, R.; Nieuwenhuijsen, M.J. Natural Outdoor Environments and Mental and Physical Health: Relationships and Mechanisms. *Environment International* **2015**, *77*, 35–41, doi:10.1016/j.envint.2015.01.012.
16. White, M.P.; Pahl, S.; Ashbullby, K.; Herbert, S.; Depledge, M.H. Feelings of Restoration from Recent Nature Visits. *Journal of Environmental Psychology* **2013**, *35*, 40–51, doi:10.1016/j.jenvp.2013.04.002.
17. Alcock, I.; White, M.P.; Wheeler, B.W.; Fleming, L.E.; Depledge, M.H. Longitudinal Effects on Mental Health of Moving to Greener and Less Green Urban Areas. *Environ. Sci. Technol.* **2014**, *48*, 1247–1255, doi:10.1021/es403688w.
18. Reklaitiene, R.; Grazuleviciene, R.; Dedele, A.; Virviciute, D.; Vensloviene, J.; Tamosiunas, A.; Baceviciene, M.; Luksiene, D.; Sapranaviciute-Zabazlajeva, L.; Radisauskas, R.; et al. The Relationship of Green Space, Depressive Symptoms and Perceived General Health in Urban Population. *Scand J Public Health* **2014**, *42*, 669–676, doi:10.1177/1403494814544494.
19. van den Berg, M.; van Poppel, M.; van Kamp, I.; Andrusaityte, S.; Balseviciene, B.; Cirach, M.; Danileviciute, A.; Ellis, N.; Hurst, G.; Masterson, D.; et al. Visiting Green Space Is Associated with Mental

Health and Vitality: A Cross-Sectional Study in Four European Cities. *Health Place* **2016**, *38*, 8–15, doi:10.1016/j.healthplace.2016.01.003.
20. Mitchell, R.; Popham, F. Effect of Exposure to Natural Environment on Health Inequalities: An Observational Population Study. *Lancet* **2008**, *372*, 1655–1660, doi:10.1016/S0140-6736(08)61689-X.
21. Tamosiunas, A.; Grazuleviciene, R.; Luksiene, D.; Dedele, A.; Reklaitiene, R.; Baceviciene, M.; Vencloviene, J.; Bernotiene, G.; Radisauskas, R.; Malinauskiene, V.; et al. Accessibility and Use of Urban Green Spaces, and Cardiovascular Health: Findings from a Kaunas Cohort Study. *Environ Health* **2014**, *13*, 20, doi:10.1186/1476-069X-13-20.
22. Grazuleviciene, R.; Vencloviene, J.; Kubilius, R.; Grizas, V.; Dedele, A.; Grazulevicius, T.; Ceponiene, I.; Tamuleviciute-Prasciene, E.; Nieuwenhuijsen, M.J.; Jones, M.; et al. The Effect of Park and Urban Environments on Coronary Artery Disease Patients: A Randomized Trial. *BioMed Research International* **2015**, *2015*, e403012, doi:10.1155/2015/403012.
23. Pereira, G.; Foster, S.; Martin, K.; Christian, H.; Boruff, B.J.; Knuiman, M.; Giles-Corti, B. The Association between Neighborhood Greenness and Cardiovascular Disease: An Observational Study. *BMC Public Health* **2012**, *12*, 466, doi:10.1186/1471-2458-12-466.
24. World Health Organization. Regional Office for Europe *Urban Green Spaces and Health*; World Health Organization. Regional Office for Europe, 2016;
25. Astell-Burt, T.; Mitchell, R.; Hartig, T. The Association between Green Space and Mental Health Varies across the Lifecourse. A Longitudinal Study. *J Epidemiol Community Health* **2014**, *68*, 578–583, doi:10.1136/jech-2013-203767.
26. Maas, J.; van Dillen, S.M.E.; Verheij, R.A.; Groenewegen, P.P. Social Contacts as a Possible Mechanism behind the Relation between Green Space and Health. *Health Place* **2009**, *15*, 586–595, doi:10.1016/j.healthplace.2008.09.006.
27. Bodicoat, D.H.; O'Donovan, G.; Dalton, A.M.; Gray, L.J.; Yates, T.; Edwardson, C.; Hill, S.; Webb, D.R.; Khunti, K.; Davies, M.J.; et al. The Association between Neighbourhood Greenspace and Type 2 Diabetes in a Large Cross-Sectional Study. *BMJ Open* **2014**, *4*, e006076, doi:10.1136/bmjopen-2014-006076.
28. Thiering, E.; Markevych, I.; Brüske, I.; Fuertes, E.; Kratzsch, J.; Sugiri, D.; Hoffmann, B.; von Berg, A.; Bauer, C.-P.; Koletzko, S.; et al. Associations of Residential Long-Term Air Pollution Exposures and Satellite-Derived Greenness with Insulin Resistance in German Adolescents. *Environ Health Perspect* **2016**, *124*, 1291–1298, doi:10.1289/ehp.1509967.
29. Gascon, M.; Triguero-Mas, M.; Martínez, D.; Dadvand, P.; Rojas-Rueda, D.; Plasència, A.; Nieuwenhuijsen, M.J. Residential Green Spaces and Mortality: A Systematic Review. *Environ Int* **2016**, *86*, 60–67, doi:10.1016/j.envint.2015.10.013.
30. 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, doi:10.1136/jech.56.12.913.
31. Villeneuve, P.J.; Jerrett, M.; Su, J.G.; Burnett, R.T.; Chen, H.; Wheeler, A.J.; Goldberg, M.S. A Cohort Study Relating Urban Green Space with Mortality in Ontario, Canada. *Environ Res* **2012**, *115*, 51–58, doi:10.1016/j.envres.2012.03.003.
32. Hartig, T.; Mitchell, R.; de Vries, S.; Frumkin, H. Nature and Health. *Annu Rev Public Health* **2014**, *35*, 207–228, doi:10.1146/annurev-publhealth-032013-182443.
33. Selander, J.; Nilsson, M.E.; Bluhm, G.; Rosenlund, M.; Lindqvist, M.; Nise, G.; Pershagen, G. Long-Term Exposure to Road Traffic Noise and Myocardial Infarction. *Epidemiology* **2009**, *20*, 272–279, doi:10.1097/EDE.0b013e31819463bd.
34. Shanahan, D.F.; Fuller, R.A.; Bush, R.; Lin, B.B.; Gaston, K.J. The Health Benefits of Urban Nature: How Much Do We Need? *BioScience* **2015**, *65*, 476–485, doi:10.1093/biosci/biv032.
35. Villanueva, K.; Badland, H.; Hooper, P.; Koohsari, M.J.; Mavoa, S.; Davern, M.; Roberts, R.; Goldfeld, S.; Giles-Corti, B. Developing Indicators of Public Open Space to Promote Health and Wellbeing in Communities. *Applied Geography* **2015**, *57*, 112–119, doi:10.1016/j.apgeog.2014.12.003.
36. Kuo, M. How Might Contact with Nature Promote Human Health? Promising Mechanisms and a Possible Central Pathway. *Frontiers in Psychology* **2015**, *6*.

37. Lachowycz, K.; Jones, A.P. Towards a Better Understanding of the Relationship between Greenspace and Health: Development of a Theoretical Framework. *Landscape and Urban Planning* **2013**, *118*, 62–69, doi:10.1016/j.landurbplan.2012.10.012.
38. Basagaña, X.; Sartini, C.; Barrera-Gómez, J.; Dadvand, P.; Cunillera, J.; Ostro, B.; Sunyer, J.; Medina-Ramón, M. Heat Waves and Cause-Specific Mortality at All Ages. *Epidemiology* **2011**, *22*, 765–772, doi:10.1097/EDE.0b013e31823031c5.
39. Hoek, G.; Krishnan, R.M.; Beelen, R.; Peters, A.; Ostro, B.; Brunekreef, B.; Kaufman, J.D. Long-Term Air Pollution Exposure and Cardio- Respiratory Mortality: A Review. *Environmental Health* **2013**, *12*, 43, doi:10.1186/1476-069X-12-43.
40. Dahmann, N.; Wolch, J.; Joassart-Marcelli, P.; Reynolds, K.; Jerrett, M. The Active City? Disparities in Provision of Urban Public Recreation Resources. *Health Place* **2010**, *16*, 431–445, doi:10.1016/j.healthplace.2009.11.005.
41. Uejio, C.K.; Wilhelmi, O.V.; Golden, J.S.; Mills, D.M.; Gulino, S.P.; Samenow, J.P. Intra-Urban Societal Vulnerability to Extreme Heat: The Role of Heat Exposure and the Built Environment, Socioeconomics, and Neighborhood Stability. *Health & Place* **2011**, *17*, 498–507, doi:10.1016/j.healthplace.2010.12.005.
42. Dadvand, P.; de Nazelle, A.; Triguero-Mas, M.; Schembari, A.; Cirach, M.; Amoly, E.; Figueras, F.; Basagaña, X.; Ostro, B.; Nieuwenhuijsen, M. Surrounding Greenness and Exposure to Air Pollution during Pregnancy: An Analysis of Personal Monitoring Data. *Environ Health Perspect* **2012**, *120*, 1286–1290, doi:10.1289/ehp.1104609.
43. Rook, G.A. Regulation of the Immune System by Biodiversity from the Natural Environment: An Ecosystem Service Essential to Health. *Proc Natl Acad Sci U S A* **2013**, *110*, 18360–18367, doi:10.1073/pnas.1313731110.
44. Dzhambov, A.M.; Dimitrova, D.D. Urban Green Spaces' Effectiveness as a Psychological Buffer for the Negative Health Impact of Noise Pollution: A Systematic Review. *Noise Health* **2014**, *16*, 157–165, doi:10.4103/1463-1741.134916.
45. Li, Q.; Morimoto, K.; Kobayashi, M.; Inagaki, H.; Katsumata, M.; Hirata, Y.; Hirata, K.; Suzuki, H.; Li, Y.J.; Wakayama, Y.; et al. Visiting a Forest, but Not a City, Increases Human Natural Killer Activity and Expression of Anti-Cancer Proteins. *Int J Immunopathol Pharmacol* **2008**, *21*, 117–127, doi:10.1177/039463200802100113.
46. Lynch, S.V.; Wood, R.A.; Boushey, H.; Bacharier, L.B.; Bloomberg, G.R.; Kattan, M.; O'Connor, G.T.; Sandel, M.T.; Calatroni, A.; Matsui, E.; et al. Effects of Early-Life Exposure to Allergens and Bacteria on Recurrent Wheeze and Atopy in Urban Children. *J Allergy Clin Immunol* **2014**, *134*, 593-601.e12, doi:10.1016/j.jaci.2014.04.018.
47. González-Oreja, J.A.; Bonache-Regidor, C. Far from the Noisy World? Modelling the Relationships between Park Size, Tree Cover and Noise Levels in Urban Green Spaces of the City of Puebla, MExico. **2010**, *35*.
48. Irvine, K.N.; Devine-Wright, P.; Payne, S.R.; Fuller, R.A.; Painter, B.; Gaston, K.J. Green Space, Soundscape and Urban Sustainability: An Interdisciplinary, Empirical Study. *Local Environment* **2009**, *14*, 155–172, doi:10.1080/13549830802522061.
49. Huddart, L. THE USE OF VEGETATION FOR TRAFFIC NOISE SCREENING. *Publication of: Transport and Road Research Laboratory* **1990**.
50. Yang, F.; Bao, Z.Y.; Zhu, Z.J. An Assessment of Psychological Noise Reduction by Landscape Plants. *Int J Environ Res Public Health* **2011**, *8*, 1032–1048, doi:10.3390/ijerph8041032.
51. Pathak, V.; Tripathi, B.D.; Mishra, V.K. Dynamics of Traffic Noise in a Tropical City Varanasi and Its Abatement through Vegetation. *Environ Monit Assess* **2008**, *146*, 67–75, doi:10.1007/s10661-007-0060-1.
52. Liu, C.; Li, X. Carbon Storage and Sequestration by Urban Forests in Shenyang, China. *Urban Forestry & Urban Greening* **2012**, *11*, 121–128, doi:10.1016/j.ufug.2011.03.002.
53. Nowak, D.J.; Crane, D.E.; Stevens, J.C. Air Pollution Removal by Urban Trees and Shrubs in the United States. *Urban Forestry & Urban Greening* **2006**, *4*, 115–123, doi:10.1016/j.ufug.2006.01.007.

54. Vailshery, L.S.; Jaganmohan, M.; Nagendra, H. Effect of Street Trees on Microclimate and Air Pollution in a Tropical City. *Urban Forestry & Urban Greening* **2013**, *12*, 408–415, doi:10.1016/j.ufug.2013.03.002.
55. Baró, F.; Chaparro, L.; Gómez-Baggethun, E.; Langemeyer, J.; Nowak, D.J.; Terradas, J. Contribution of Ecosystem Services to Air Quality and Climate Change Mitigation Policies: The Case of Urban Forests in Barcelona, Spain. *Ambio* **2014**, *43*, 466–479, doi:10.1007/s13280-014-0507-x.
56. Calfapietra, C.; Morani, A.; Sgrigna, G.; Di Giovanni, S.; Muzzini, V.; Pallozzi, E.; Guidolotti, G.; Nowak, D.; Fares, S. Removal of Ozone by Urban and Peri-Urban Forests: Evidence from Laboratory, Field, and Modeling Approaches. *J Environ Qual* **2016**, *45*, 224–233, doi:10.2134/jeq2015.01.0061.
57. Manes, F.; Incerti, G.; Salvatori, E.; Vitale, M.; Ricotta, C.; Costanza, R. Urban Ecosystem Services: Tree Diversity and Stability of Tropospheric Ozone Removal. *Ecol Appl* **2012**, *22*, 349–360, doi:10.1890/11-0561.1.
58. Smargiassi, A.; Goldberg, M.S.; Plante, C.; Fournier, M.; Baudouin, Y.; Kosatsky, T. Variation of Daily Warm Season Mortality as a Function of Micro-Urban Heat Islands. *J Epidemiol Community Health* **2009**, *63*, 659–664, doi:10.1136/jech.2008.078147.
59. Bowler, D.E.; Buyung-Ali, L.M.; Knight, T.M.; Pullin, A.S. A Systematic Review of Evidence for the Added Benefits to Health of Exposure to Natural Environments. *BMC Public Health* **2010**, *10*, 456, doi:10.1186/1471-2458-10-456.
60. Bowler, D.E.; Buyung-Ali, L.; Knight, T.M.; Pullin, A.S. Urban Greening to Cool Towns and Cities: A Systematic Review of the Empirical Evidence. *Landscape and Urban Planning* **2010**, *97*, 147–155, doi:10.1016/j.landurbplan.2010.05.006.
61. Harlan, S.L.; Brazel, A.J.; Prashad, L.; Stefanov, W.L.; Larsen, L. Neighborhood Microclimates and Vulnerability to Heat Stress. *Social Science & Medicine* **2006**, *63*, 2847–2863, doi:10.1016/j.socscimed.2006.07.030.
62. The Impact of Green Areas on Mitigating Urban Heat Island Effect: A Review. *Geoplast*.
63. Lafortezza, R.; Carrus, G.; Sanesi, G.; Davies, C. Benefits and Well-Being Perceived by People Visiting Green Spaces in Periods of Heat Stress. *Urban Forestry & Urban Greening* **2009**, *8*, 97–108, doi:10.1016/j.ufug.2009.02.003.
64. Nieminen, T.; Martelin, T.; Koskinen, S.; Aro, H.; Alanen, E.; Hyyppä, M.T. Social Capital as a Determinant of Self-Rated Health and Psychological Well-Being. *Int J Public Health* **2010**, *55*, 531–542, doi:10.1007/s00038-010-0138-3.
65. Pantell, M.; Rehkopf, D.; Jutte, D.; Syme, S.L.; Balmes, J.; Adler, N. Social Isolation: A Predictor of Mortality Comparable to Traditional Clinical Risk Factors. *Am J Public Health* **2013**, *103*, 2056–2062, doi:10.2105/AJPH.2013.301261.
66. Yang, Y.C.; Boen, C.; Gerken, K.; Li, T.; Schorpp, K.; Harris, K.M. Social Relationships and Physiological Determinants of Longevity across the Human Life Span. *Proceedings of the National Academy of Sciences* **2016**, *113*, 578–583, doi:10.1073/pnas.1511085112.
67. Kim, J.; Kaplan, R. Physical and Psychological Factors in Sense of Community: New Urbanist Kentlands and Nearby Orchard Village. *Environment and Behavior* **2004**, *36*, 313–340, doi:10.1177/0013916503260236.
68. de Vries, S.; van Dillen, S.M.E.; Groenewegen, P.P.; Spreeuwenberg, P. Streetscape Greenery and Health: Stress, Social Cohesion and Physical Activity as Mediators. *Social Science & Medicine* **2013**, *94*, 26–33, doi:10.1016/j.socscimed.2013.06.030.
69. Seeland, K.; Dübendorfer, S.; Hansmann, R. Making Friends in Zurich's Urban Forests and Parks: The Role of Public Green Space for Social Inclusion of Youths from Different Cultures. *Forest Policy and Economics* **2009**, *11*, 10–17, doi:10.1016/j.forpol.2008.07.005.
70. Branas, C.C.; Cheney, R.A.; MacDonald, J.M.; Tam, V.W.; Jackson, T.D.; Ten Have, T.R. A Difference-in-Differences Analysis of Health, Safety, and Greening Vacant Urban Space. *Am J Epidemiol* **2011**, *174*, 1296–1306, doi:10.1093/aje/kwr273.
71. Chong, S.; Lobb, E.; Khan, R.; Abu-Rayya, H.; Byun, R.; Jalaludin, B. Neighbourhood Safety and Area Deprivation Modify the Associations between Parkland and Psychological Distress in Sydney, Australia. *BMC Public Health* **2013**, *13*, 422, doi:10.1186/1471-2458-13-422.

72. Hartig, T.; Mang, M.; Evans, G.W. Restorative Effects of Natural Environment Experiences. *Environment and Behavior* **1991**, *23*, 3–26, doi:10.1177/0013916591231001.
73. *Three Steps to Understanding Restorative Environments as Health Resources*; Taylor & Francis, 2007; pp. 183–200; ISBN 978-0-203-96182-7.
74. Shanahan, D.F.; Fuller, R.A.; Bush, R.; Lin, B.B.; Gaston, K.J. The Health Benefits of Urban Nature: How Much Do We Need? *BioScience* **2015**, *65*, 476–485, doi:10.1093/biosci/biv032.
75. Gong, Y.; Palmer, S.; Gallacher, J.; Marsden, T.; Fone, D. A Systematic Review of the Relationship between Objective Measurements of the Urban Environment and Psychological Distress. *Environ Int* **2016**, *96*, 48–57, doi:10.1016/j.envint.2016.08.019.
76. Kaplan, S. The Restorative Benefits of Nature: Toward an Integrative Framework. *Journal of Environmental Psychology* **1995**, *15*, 169–182, doi:10.1016/0272-4944(95)90001-2.
77. Kaplan, S. Meditation, Restoration, and the Management of Mental Fatigue. *Environment and Behavior* **2001**, *33*, 480–506, doi:10.1177/00139160121973106.
78. Kaplan, R.; Kaplan, S. Well-being, Reasonableness, and the Natural Environment. *Applied Psychology: Health and Well-Being* **2011**, *3*, 304–321, doi:10.1111/j.1758-0854.2011.01055.x.
79. Ulrich, R.S.; Simons, R.F.; Losito, B.D.; Fiorito, E.; Miles, M.A.; Zelson, M. Stress Recovery during Exposure to Natural and Urban Environments. *Journal of Environmental Psychology* **1991**, *11*, 201–230, doi:10.1016/S0272-4944(05)80184-7.
80. Ulrich, R.S. Aesthetic and Affective Response to Natural Environment. In *Behavior and the Natural Environment*; Altman, I., Wohlwill, J.F., Eds.; Human Behavior and Environment; Springer US: Boston, MA, 1983; pp. 85–125 ISBN 978-1-4613-3539-9.
81. Clatworthy, J.; Hinds, J.; M. Camic, P. Gardening as a Mental Health Intervention: A Review. *Mental Health Review Journal* **2013**, *18*, 214–225, doi:10.1108/MHRJ-02-2013-0007.
82. Hartig, T.; Evans, G.W.; Jamner, L.D.; Davis, D.S.; Gärling, T. Tracking Restoration in Natural and Urban Field Settings. *Journal of Environmental Psychology* **2003**, *23*, 109–123, doi:10.1016/S0272-4944(02)00109-3.
83. Ottosson, J.; Grahn, P. A Comparison of Leisure Time Spent in a Garden with Leisure Time Spent Indoors: On Measures of Restoration in Residents in Geriatric Care. *Landscape Research* **2005**, *30*, 23–55, doi:10.1080/0142639042000324758.
84. Lee, A.C.K.; Maheswaran, R. The Health Benefits of Urban Green Spaces: A Review of the Evidence. *Journal of Public Health* **2011**, *33*, 212–222, doi:10.1093/pubmed/fdq068.
85. Park, B.-J.; Tsunetsugu, Y.; Kasetani, T.; Hirano, H.; Kagawa, T.; Sato, M.; Miyazaki, Y. Physiological Effects of Shinrin-Yoku (Taking in the Atmosphere of the Forest)--Using Salivary Cortisol and Cerebral Activity as Indicators. *J Physiol Anthropol* **2007**, *26*, 123–128, doi:10.2114/jpa2.26.123.
86. Gidlow, C.J.; Jones, M.V.; Hurst, G.; Masterson, D.; Clark-Carter, D.; Tarvainen, M.P.; Smith, G.; Nieuwenhuijsen, M. Where to Put Your Best Foot Forward: Psycho-Physiological Responses to Walking in Natural and Urban Environments. *Journal of Environmental Psychology* **2016**, *45*, 22–29, doi:10.1016/j.jenvp.2015.11.003.
87. Roe, J.J.; Thompson, C.W.; Aspinall, P.A.; Brewer, M.J.; Duff, E.I.; Miller, D.; Mitchell, R.; Clow, A. Green Space and Stress: Evidence from Cortisol Measures in Deprived Urban Communities. *Int J Environ Res Public Health* **2013**, *10*, 4086–4103, doi:10.3390/ijerph10094086.
88. Ward Thompson, C.; Roe, J.; Aspinall, P.; Mitchell, R.; Clow, A.; Miller, D. More Green Space Is Linked to Less Stress in Deprived Communities: Evidence from Salivary Cortisol Patterns. *Landscape and Urban Planning* **2012**, *105*, 221–229, doi:10.1016/j.landurbplan.2011.12.015.
89. Beil, K.; Hanes, D. The Influence of Urban Natural and Built Environments on Physiological and Psychological Measures of Stress--a Pilot Study. *Int J Environ Res Public Health* **2013**, *10*, 1250–1267, doi:10.3390/ijerph10041250.
90. Honold, J.; Lakes, T.; Beyer, R.; van der Meer, E. Restoration in Urban Spaces: Nature Views From Home, Greenways, and Public Parks. *Environment and Behavior* **2016**, *48*, 796–825, doi:10.1177/0013916514568556.

91. Gidlow, C.J.; Randall, J.; Gillman, J.; Smith, G.R.; Jones, M.V. Natural Environments and Chronic Stress Measured by Hair Cortisol. *Landscape and Urban Planning* **2016**, *148*, 61–67, doi:10.1016/j.landurbplan.2015.12.009.
92. World Health Organization Global Recommendations on Physical Activity for Health. *Recommandations mondiales sur l'activité physique pour la santé* **2010**, 58.
93. Hong, A.; Sallis, J.F.; King, A.C.; Conway, T.L.; Saelens, B.; Cain, K.L.; Fox, E.H.; Frank, L.D. Linking Green Space to Neighborhood Social Capital in Older Adults: The Role of Perceived Safety. *Soc Sci Med* **2018**, *207*, 38–45, doi:10.1016/j.socscimed.2018.04.051.
94. Lachowycz, K.; Jones, A.P. Does Walking Explain Associations between Access to Greenspace and Lower Mortality? *Soc Sci Med* **2014**, *107*, 9–17, doi:10.1016/j.socscimed.2014.02.023.
95. Bosch, M. van den Natural Environments, Health, and Well-Being Available online: https://oxfordre.com/environmentalscience/view/10.1093/acrefore/9780199389414.001.0001/acrefore-9780199389414-e-333 (accessed on 13 July 2022).
96. Bird, D.W. *Natural Fit: Can Green Space and Biodiversity Increase Levels of Physical Activity?*; RSPB, 2004;
97. Newton, J. Wellbeing and the Natural Environment: A Brief Overview of the Evidence. *undefined* **2007**.
98. Wendel-Vos, G.C.W.; Schuit, A.J.; de Niet, R.; Boshuizen, H.C.; Saris, W.H.M.; Kromhout, D. Factors of the Physical Environment Associated with Walking and Bicycling. *Med Sci Sports Exerc* **2004**, *36*, 725–730, doi:10.1249/01.mss.0000121955.03461.0a.
99. Epstein, L.H.; Raja, S.; Gold, S.S.; Paluch, R.A.; Pak, Y.; Roemmich, J.N. Reducing Sedentary Behavior: The Relationship between Park Area and the Physical Activity of Youth. *Psychol Sci* **2006**, *17*, 654–659, doi:10.1111/j.1467-9280.2006.01761.x.
100. Sugiyama, T.; Thompson, C.W.; Alves, S. Associations Between Neighborhood Open Space Attributes and Quality of Life for Older People in Britain. *Environment and Behavior* **2009**, *41*, 3–21, doi:10.1177/0013916507311688.
101. Kaczynski, A.T.; Henderson, K.A. Environmental Correlates of Physical Activity: A Review of Evidence about Parks and Recreation. *Leisure Sciences* **2007**, *29*, 315–354, doi:10.1080/01490400701394865.
102. Kaczynski, A.T.; Henderson, K.A. Parks and Recreation Settings and Active Living: A Review of Associations with Physical Activity Function and Intensity. *J Phys Act Health* **2008**, *5*, 619–632, doi:10.1123/jpah.5.4.619.
103. Cochrane, T.; Davey, R.C.; Gidlow, C.; Smith, G.R.; Fairburn, J.; Armitage, C.J.; Stephansen, H.; Speight, S. Small Area and Individual Level Predictors of Physical Activity in Urban Communities: A Multi-Level Study in Stoke on Trent, England. *Int J Environ Res Public Health* **2009**, *6*, 654–677, doi:10.3390/ijerph6020654.
104. Schipperijn, J.; Bentsen, P.; Troelsen, J.; Toftager, M.; Stigsdotter, U.K. Associations between Physical Activity and Characteristics of Urban Green Space. *Urban Forestry & Urban Greening* **2013**, *12*, 109–116, doi:10.1016/j.ufug.2012.12.002.
105. Gardsjord, H.S.; Tveit, M.S.; Nordh, H. Promoting Youth's Physical Activity through Park Design: Linking Theory and Practice in a Public Health Perspective. *Landscape Research* **2014**, *39*, 70–81, doi:10.1080/01426397.2013.793764.
106. Björk, J.; Albin, M.; Grahn, P.; Jacobsson, H.; Ardö, J.; Wadbro, J.; Ostergren, P.-O. Recreational Values of the Natural Environment in Relation to Neighbourhood Satisfaction, Physical Activity, Obesity and Wellbeing. *J Epidemiol Community Health* **2008**, *62*, e2, doi:10.1136/jech.2007.062414.
107. de Jong, K.; Albin, M.; Skärbäck, E.; Grahn, P.; Björk, J. Perceived Green Qualities Were Associated with Neighborhood Satisfaction, Physical Activity, and General Health: Results from a Cross-Sectional Study in Suburban and Rural Scania, Southern Sweden. *Health Place* **2012**, *18*, 1374–1380, doi:10.1016/j.healthplace.2012.07.001.
108. Lachowycz, K.; Jones, A.P.; Page, A.S.; Wheeler, B.W.; Cooper, A.R. What Can Global Positioning Systems Tell Us about the Contribution of Different Types of Urban Greenspace to Children's Physical Activity? *Health Place* **2012**, *18*, 586–594, doi:10.1016/j.healthplace.2012.01.006.
109. Barton, J.; Pretty, J. What Is the Best Dose of Nature and Green Exercise for Improving Mental Health? A Multi-Study Analysis. *Environ. Sci. Technol.* **2010**, *44*, 3947–3955, doi:10.1021/es903183r.

110. Marselle, M.R.; Irvine, K.N.; Lorenzo-Arribas, A.; Warber, S.L. Moving beyond Green: Exploring the Relationship of Environment Type and Indicators of Perceived Environmental Quality on Emotional Well-Being Following Group Walks. *Int J Environ Res Public Health* **2015**, *12*, 106–130, doi:10.3390/ijerph120100106.
111. Bodin, M.; Hartig, T. Does the Outdoor Environment Matter for Psychological Restoration Gained through Running? *Psychology of Sport and Exercise* **2003**, *4*, 141–153, doi:10.1016/S1469-0292(01)00038-3.
112. Mitchell, R. Is Physical Activity in Natural Environments Better for Mental Health than Physical Activity in Other Environments? *Soc Sci Med* **2013**, *91*, 130–134, doi:10.1016/j.socscimed.2012.04.012.
113. Lachowycz, K.; Jones, A.P. Greenspace and Obesity: A Systematic Review of the Evidence. *Obes Rev* **2011**, *12*, e183-189, doi:10.1111/j.1467-789X.2010.00827.x.
114. Owen, N.; Healy, G.N.; Matthews, C.E.; Dunstan, D.W. Too Much Sitting: The Population-Health Science of Sedentary Behavior. *Exerc Sport Sci Rev* **2010**, *38*, 105–113, doi:10.1097/JES.0b013e3181e373a2.
115. Evenson, K.R.; Wen, F.; Hillier, A.; Cohen, D.A. Assessing the Contribution of Parks to Physical Activity Using Global Positioning System and Accelerometry. *Med Sci Sports Exerc* **2013**, *45*, 1981–1987, doi:10.1249/MSS.0b013e318293330e.
116. Veitch, J.; Carver, A.; Abbott, G.; Giles-Corti, B.; Timperio, A.; Salmon, J. How Active Are People in Metropolitan Parks? An Observational Study of Park Visitation in Australia. *BMC Public Health* **2015**, *15*, 610, doi:10.1186/s12889-015-1960-6.
117. Bedimo-Rung, A.L.; Mowen, A.J.; Cohen, D.A. The Significance of Parks to Physical Activity and Public Health: A Conceptual Model. *Am J Prev Med* **2005**, *28*, 159–168, doi:10.1016/j.amepre.2004.10.024.
118. Aspinall, P.A.; Thompson, C.W.; Alves, S.; Sugiyama, T.; Brice, R.; Vickers, A. Preference and Relative Importance for Environmental Attributes of Neighbourhood Open Space in Older People. *Environ Plann B Plann Des* **2010**, *37*, 1022–1039, doi:10.1068/b36024.
119. Jin, S.; Guo, J.; Wheeler, S.; Kan, L.; Che, S. Evaluation of Impacts of Trees on PM2.5 Dispersion in Urban Streets. *Atmospheric Environment* **2014**, *99*, 277–287, doi:10.1016/j.atmosenv.2014.10.002.
120. Carlisle, A.; Sharp, N. Exercise and Outdoor Ambient Air Pollution. *Br J Sports Med* **2001**, *35*, 214–222, doi:10.1136/bjsm.35.4.214.
121. Foster, C.; Hillsdon, M.; Thorogood, M. Environmental Perceptions and Walking in English Adults. *J Epidemiol Community Health* **2004**, *58*, 924–928, doi:10.1136/jech.2003.014068.
122. Andersen, Z.J.; de Nazelle, A.; Mendez, M.A.; Garcia-Aymerich, J.; Hertel, O.; Tjønneland, A.; Overvad, K.; Raaschou-Nielsen, O.; Nieuwenhuijsen, M.J. A Study of the Combined Effects of Physical Activity and Air Pollution on Mortality in Elderly Urban Residents: The Danish Diet, Cancer, and Health Cohort. *Environ Health Perspect* **2015**, *123*, 557–563, doi:10.1289/ehp.1408698.
123. Lovasi, G.S.; Quinn, J.W.; Neckerman, K.M.; Perzanowski, M.S.; Rundle, A. Children Living in Areas with More Street Trees Have Lower Prevalence of Asthma. *J Epidemiol Community Health* **2008**, *62*, 647–649, doi:10.1136/jech.2007.071894.
124. Lovasi, G.S.; O'Neil-Dunne, J.P.M.; Lu, J.W.T.; Sheehan, D.; Perzanowski, M.S.; Macfaden, S.W.; King, K.L.; Matte, T.; Miller, R.L.; Hoepner, L.A.; et al. Urban Tree Canopy and Asthma, Wheeze, Rhinitis, and Allergic Sensitization to Tree Pollen in a New York City Birth Cohort. *Environ Health Perspect* **2013**, *121*, 494–500, doi:10.1289/ehp.1205513.
125. Dadvand, P.; Villanueva, C.M.; Font-Ribera, L.; Martinez, D.; Basagaña, X.; Belmonte, J.; Vrijheid, M.; Gražulevičienė, R.; Kogevinas, M.; Nieuwenhuijsen, M.J. Risks and Benefits of Green Spaces for Children: A Cross-Sectional Study of Associations with Sedentary Behavior, Obesity, Asthma, and Allergy. *Environ Health Perspect* **2014**, *122*, 1329–1335, doi:10.1289/ehp.1308038.
126. Fuertes, E.; Markevych, I.; von Berg, A.; Bauer, C.-P.; Berdel, D.; Koletzko, S.; Sugiri, D.; Heinrich, J. Greenness and Allergies: Evidence of Differential Associations in Two Areas in Germany. *J Epidemiol Community Health* **2014**, *68*, 787–790, doi:10.1136/jech-2014-203903.

127. Boldemann, C.; Blennow, M.; Dal, H.; Mårtensson, F.; Raustorp, A.; Yuen, K.; Wester, U. Impact of Preschool Environment upon Children's Physical Activity and Sun Exposure. *Prev Med* **2006**, *42*, 301–308, doi:10.1016/j.ypmed.2005.12.006.
128. Boldemann, C.; Dal, H.; Mårtensson, F.; Cosco, N.; Moore, R.; Bieber, B.; Blennow, M.; Pagels, P.; Raustorp, A.; Wester, U.; et al. Preschool Outdoor Play Environment May Combine Promotion of Children's Physical Activity and Sun Protection. Further Evidence from Southern Sweden and North Carolina. *Science & Sports* **2011**, *26*, 72–82, doi:10.1016/j.scispo.2011.01.007.
129. Bogar, S.; Beyer, K.M. Green Space, Violence, and Crime: A Systematic Review. *Trauma Violence Abuse* **2016**, *17*, 160–171, doi:10.1177/1524838015576412.
130. Marmot, M.; Bell, R. Social Determinants and Non-Communicable Diseases: Time for Integrated Action. *BMJ* **2019**, *364*, l251, doi:10.1136/bmj.l251.
131. Sallis, R. Exercise Is Medicine: A Call to Action for Physicians to Assess and Prescribe Exercise. *Phys Sportsmed* **2015**, *43*, 22–26, doi:10.1080/00913847.2015.1001938.
132. Caspersen, C.J.; Powell, K.E.; Christenson, G.M. Physical Activity, Exercise, and Physical Fitness: Definitions and Distinctions for Health-Related Research. *Public Health Rep* **1985**, *100*, 126–131.
133. Grigoletto, A.; Mauro, M.; Maietta Latessa, P.; Iannuzzi, V.; Gori, D.; Campa, F.; Greco, G.; Toselli, S. Impact of Different Types of Physical Activity in Green Urban Space on Adult Health and Behaviors: A Systematic Review. *Eur J Investig Health Psychol Educ* **2021**, *11*, 263–275, doi:10.3390/ejihpe11010020.
134. WHO-NMH-PND-18.5-Eng.Pdf.
135. Longmuir, P.E.; Colley, R.C.; Wherley, V.A.; Tremblay, M.S. Canadian Society for Exercise Physiology Position Stand: Benefit and Risk for Promoting Childhood Physical Activity. *Appl Physiol Nutr Metab* **2014**, *39*, 1271–1279, doi:10.1139/apnm-2014-0074.
136. López-Valenciano, A.; Mayo, X.; Liguori, G.; Copeland, R.J.; Lamb, M.; Jimenez, A. Changes in Sedentary Behaviour in European Union Adults between 2002 and 2017. *BMC Public Health* **2020**, *20*, 1206, doi:10.1186/s12889-020-09293-1.
137. DiPietro, L.; Al-Ansari, S.S.; Biddle, S.J.H.; Borodulin, K.; Bull, F.C.; Buman, M.P.; Cardon, G.; Carty, C.; Chaput, J.-P.; Chastin, S.; et al. Advancing the Global Physical Activity Agenda: Recommendations for Future Research by the 2020 WHO Physical Activity and Sedentary Behavior Guidelines Development Group. *Int J Behav Nutr Phys Act* **2020**, *17*, 143, doi:10.1186/s12966-020-01042-2.
138. Tomlinson, D.J.; Erskine, R.M.; Morse, C.I.; Winwood, K.; Onambélé-Pearson, G. The Impact of Obesity on Skeletal Muscle Strength and Structure through Adolescence to Old Age. *Biogerontology* **2016**, *17*, 467–483, doi:10.1007/s10522-015-9626-4.
139. de Rezende, L.F.M.; Rodrigues Lopes, M.; Rey-López, J.P.; Matsudo, V.K.R.; Luiz, O. do C. Sedentary Behavior and Health Outcomes: An Overview of Systematic Reviews. *PLoS One* **2014**, *9*, e105620, doi:10.1371/journal.pone.0105620.
140. Non Communicable Diseases Available online: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases (accessed on 2 January 2023).
141. Anderson, E.; Durstine, J.L. Physical Activity, Exercise, and Chronic Diseases: A Brief Review. *Sports Medicine and Health Science* **2019**, *1*, 3–10, doi:10.1016/j.smhs.2019.08.006.
142. Physical Activity Factsheets for the 28 European Union Member States of the WHO European Region Available online: https://www.who.int/europe/publications/i/item/EUR-RC71-R14 (accessed on 2 January 2023).
143. 2018 Physical Activity Guidelines Advisory Committee Scientific Report.
144. Noordzij, J.M.; Beenackers, M.A.; Oude Groeniger, J.; Timmermans, E.; Chaix, B.; Doiron, D.; Huisman, M.; Motoc, I.; Ruiz, M.; Wissa, R.; et al. Green Spaces, Subjective Health and Depressed Affect in Middle-Aged and Older Adults: A Cross-Country Comparison of Four European Cohorts. *J Epidemiol Community Health* **2021**, *75*, 470–476, doi:10.1136/jech-2020-214257.
145. Engemann, K.; Pedersen, C.B.; Arge, L.; Tsirogiannis, C.; Mortensen, P.B.; Svenning, J.-C. Residential Green Space in Childhood Is Associated with Lower Risk of Psychiatric Disorders from Adolescence into Adulthood. *Proceedings of the National Academy of Sciences* **2019**, *116*, 5188–5193, doi:10.1073/pnas.1807504116.
146. Physical Activity Guidelines for Americans, 2nd Edition.

147. Bull, F.C.; Al-Ansari, S.S.; Biddle, S.; Borodulin, K.; Buman, M.P.; Cardon, G.; Carty, C.; Chaput, J.-P.; Chastin, S.; Chou, R.; et al. World Health Organization 2020 Guidelines on Physical Activity and Sedentary Behaviour. *Br J Sports Med* **2020**, *54*, 1451–1462, doi:10.1136/bjsports-2020-102955.
148. Howley, E.T. Type of Activity: Resistance, Aerobic and Leisure versus Occupational Physical Activity. *Med Sci Sports Exerc* **2001**, *33*, S364-369; discussion S419-420, doi:10.1097/00005768-200106001-00005.
149. Murphy, S.L.; Xu, J.; Kochanek, K.D.; Curtin, S.C.; Arias, E. Deaths: Final Data for 2015. *Natl Vital Stat Rep* **2017**, *66*, 1–75.
150. Olshansky, S.J.; Passaro, D.J.; Hershow, R.C.; Layden, J.; Carnes, B.A.; Brody, J.; Hayflick, L.; Butler, R.N.; Allison, D.B.; Ludwig, D.S. A Potential Decline in Life Expectancy in the United States in the 21st Century. *New England Journal of Medicine* **2005**, *352*, 1138–1145, doi:10.1056/NEJMsr043743.
151. Wang, H.; Naghavi, M.; Allen, C.; Barber, R.M.; Bhutta, Z.A.; Carter, A.; Casey, D.C.; Charlson, F.J.; Chen, A.Z.; Coates, M.M.; et al. Global, Regional, and National Life Expectancy, All-Cause Mortality, and Cause-Specific Mortality for 249 Causes of Death, 1980–2015: A Systematic Analysis for the Global Burden of Disease Study 2015. *The Lancet* **2016**, *388*, 1459–1544, doi:10.1016/S0140-6736(16)31012-1.
152. Murray, C.J.; Lopez, A.D. Alternative Projections of Mortality and Disability by Cause 1990-2020: Global Burden of Disease Study. *Lancet* **1997**, *349*, 1498–1504, doi:10.1016/S0140-6736(96)07492-2.
153. Naghavi, M.; Abajobir, A.A.; Abbafati, C.; Abbas, K.M.; Abd-Allah, F.; Abera, S.F.; Aboyans, V.; Adetokunboh, O.; Afshin, A.; Agrawal, A.; et al. Global, Regional, and National Age-Sex Specific Mortality for 264 Causes of Death, 1980–2016: A Systematic Analysis for the Global Burden of Disease Study 2016. *The Lancet* **2017**, *390*, 1151–1210, doi:10.1016/S0140-6736(17)32152-9.
154. World Health Organization *Global status report on noncommunicable diseases 2010*; World Health Organization, 2011;
155. Lear, S.A.; Hu, W.; Rangarajan, S.; Gasevic, D.; Leong, D.; Iqbal, R.; Casanova, A.; Swaminathan, S.; Anjana, R.M.; Kumar, R.; et al. The Effect of Physical Activity on Mortality and Cardiovascular Disease in 130 000 People from 17 High-Income, Middle-Income, and Low-Income Countries: The PURE Study. *Lancet* **2017**, *390*, 2643–2654, doi:10.1016/S0140-6736(17)31634-3.
156. Pedersen, B.K.; Saltin, B. Exercise as Medicine - Evidence for Prescribing Exercise as Therapy in 26 Different Chronic Diseases. *Scand J Med Sci Sports* **2015**, *25 Suppl 3*, 1–72, doi:10.1111/sms.12581.
157. Global Health Risks : Mortality and Burden of Disease Attributable to Selected Major Risks Available online: https://apps.who.int/iris/handle/10665/44203 (accessed on 2 May 2022).
158. Biswas, A.; Oh, P.I.; Faulkner, G.E.; Bajaj, R.R.; Silver, M.A.; Mitchell, M.S.; Alter, D.A. Sedentary Time and Its Association with Risk for Disease Incidence, Mortality, and Hospitalization in Adults: A Systematic Review and Meta-Analysis. *Ann Intern Med* **2015**, *162*, 123–132, doi:10.7326/M14-1651.
159. Thivel, D.; Tremblay, A.; Genin, P.M.; Panahi, S.; Rivière, D.; Duclos, M. Physical Activity, Inactivity, and Sedentary Behaviors: Definitions and Implications in Occupational Health. *Front Public Health* **2018**, *6*, 288, doi:10.3389/fpubh.2018.00288.
160. Kohl, H.W.; Craig, C.L.; Lambert, E.V.; Inoue, S.; Alkandari, J.R.; Leetongin, G.; Kahlmeier, S.; Lancet Physical Activity Series Working Group The Pandemic of Physical Inactivity: Global Action for Public Health. *Lancet* **2012**, *380*, 294–305, doi:10.1016/S0140-6736(12)60898-8.
161. Katzmarzyk, P.T.; Friedenreich, C.; Shiroma, E.J.; Lee, I.-M. Physical Inactivity and Non-Communicable Disease Burden in Low-Income, Middle-Income and High-Income Countries. *Br J Sports Med* **2022**, *56*, 101–106, doi:10.1136/bjsports-2020-103640.
162. Ding, D.; Lawson, K.D.; Kolbe-Alexander, T.L.; Finkelstein, E.A.; Katzmarzyk, P.T.; van Mechelen, W.; Pratt, M.; Lancet Physical Activity Series 2 Executive Committee The Economic Burden of Physical Inactivity: A Global Analysis of Major Non-Communicable Diseases. *Lancet* **2016**, *388*, 1311–1324, doi:10.1016/S0140-6736(16)30383-X.
163. Toselli, S.; Bragonzoni, L.; Dallolio, L.; Alessia, G.; Masini, A.; Marini, S.; Barone, G.; Pinelli, E.; Zinno, R.; Mauro, M.; et al. The Effects of Park Based Interventions on Health: The Italian Project "Moving Parks." *Int J Environ Res Public Health* **2022**, *19*, 2130, doi:10.3390/ijerph19042130.
164. World Health Organization *Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World*; World Health Organization, 2018; ISBN 978-92-4-151418-7.

165. Zijlema, W.L.; Avila-Palencia, I.; Triguero-Mas, M.; Gidlow, C.; Maas, J.; Kruize, H.; Andrusaityte, S.; Grazuleviciene, R.; Nieuwenhuijsen, M.J. Active Commuting through Natural Environments Is Associated with Better Mental Health: Results from the PHENOTYPE Project. *Environ Int* **2018**, *121*, 721–727, doi:10.1016/j.envint.2018.10.002.
166. Mytton, O.T.; Townsend, N.; Rutter, H.; Foster, C. Green Space and Physical Activity: An Observational Study Using Health Survey for England Data. *Health & Place* **2012**, *18*, 1034–1041, doi:10.1016/j.healthplace.2012.06.003.
167. Sallis, J.F.; Cerin, E.; Conway, T.L.; Adams, M.A.; Frank, L.D.; Pratt, M.; Salvo, D.; Schipperijn, J.; Smith, G.; Cain, K.L.; et al. Physical Activity in Relation to Urban Environments in 14 Cities Worldwide: A Cross-Sectional Study. *The Lancet* **2016**, *387*, 2207–2217, doi:10.1016/S0140-6736(15)01284-2.
168. Lovell, R.; Depledge, M.; Maxwell, S. *Health and the Natural Environment: A Review of Evidence, Policy, Practice and Opportunities for the Future*; Department for Environment, Food and Rural Affairs, 2018;
169. Lin, W.; Chen, Q.; Jiang, M.; Tao, J.; Liu, Z.; Zhang, X.; Wu, L.; Xu, S.; Kang, Y.; Zeng, Q. Sitting or Walking? Analyzing the Neural Emotional Indicators of Urban Green Space Behavior with Mobile EEG. *J Urban Health* **2020**, *97*, 191–203, doi:10.1007/s11524-019-00407-8.
170. Han, K.-T. The Effect of Nature and Physical Activity on Emotions and Attention While Engaging in Green Exercise. *Urban Forestry & Urban Greening* **2017**, *24*, 5–13, doi:10.1016/j.ufug.2017.03.012.
171. Remme, R.P.; Frumkin, H.; Guerry, A.D.; King, A.C.; Mandle, L.; Sarabu, C.; Bratman, G.N.; Giles-Corti, B.; Hamel, P.; Han, B.; et al. An Ecosystem Service Perspective on Urban Nature, Physical Activity, and Health. *Proceedings of the National Academy of Sciences* **2021**, *118*, e2018472118, doi:10.1073/pnas.2018472118.
172. Lahart, I.; Darcy, P.; Gidlow, C.; Calogiuri, G. The Effects of Green Exercise on Physical and Mental Wellbeing: A Systematic Review. *International Journal of Environmental Research and Public Health* **2019**, *16*, 1352, doi:10.3390/ijerph16081352.
173. Gladwell, V.F.; Brown, D.K.; Wood, C.; Sandercock, G.R.; Barton, J.L. The Great Outdoors: How a Green Exercise Environment Can Benefit All. *Extreme Physiology & Medicine* **2013**, *2*, 3, doi:10.1186/2046-7648-2-3.
174. Lachowycz, K.; Jones, A.P. Towards a Better Understanding of the Relationship between Greenspace and Health: Development of a Theoretical Framework. *Landscape and Urban Planning* **2013**, *118*, 62–69, doi:10.1016/j.landurbplan.2012.10.012.
175. Moore, H.J.; Nixon, C.A.; Lake, A.A.; Douthwaite, W.; O'Malley, C.L.; Pedley, C.L.; Summerbell, C.D.; Routen, A.C. The Environment Can Explain Differences in Adolescents' Daily Physical Activity Levels Living in a Deprived Urban Area: Cross-Sectional Study Using Accelerometry, GPS, and Focus Groups. *Journal of Physical Activity and Health* **2014**, *11*, 1517–1524, doi:10.1123/jpah.2012-0420.
176. Klinker, C.D.; Schipperijn, J.; Christian, H.; Kerr, J.; Ersbøll, A.K.; Troelsen, J. Using Accelerometers and Global Positioning System Devices to Assess Gender and Age Differences in Children's School, Transport, Leisure and Home Based Physical Activity. *International Journal of Behavioral Nutrition and Physical Activity* **2014**, *11*, 8, doi:10.1186/1479-5868-11-8.
177. Thompson Coon, J.; Boddy, K.; Stein, K.; Whear, R.; Barton, J.; Depledge, M.H. Does Participating in Physical Activity in Outdoor Natural Environments Have a Greater Effect on Physical and Mental Wellbeing than Physical Activity Indoors? A Systematic Review. *Environ Sci Technol* **2011**, *45*, 1761–1772, doi:10.1021/es102947t.
178. Dadvand, P.; Bartoll, X.; Basagaña, X.; Dalmau-Bueno, A.; Martinez, D.; Ambros, A.; Cirach, M.; Triguero-Mas, M.; Gascon, M.; Borrell, C.; et al. Green Spaces and General Health: Roles of Mental Health Status, Social Support, and Physical Activity. *Environment International* **2016**, *91*, 161–167, doi:10.1016/j.envint.2016.02.029.
179. Fong, K.C.; Hart, J.E.; James, P. A Review of Epidemiologic Studies on Greenness and Health: Updated Literature Through 2017. *Curr Environ Health Rep* **2018**, *5*, 77–87, doi:10.1007/s40572-018-0179-y.
180. Nieuwenhuijsen, M.J.; Khreis, H.; Triguero-Mas, M.; Gascon, M.; Dadvand, P. Fifty Shades of Green: Pathway to Healthy Urban Living. *Epidemiology* **2017**, *28*, 63–71, doi:10.1097/EDE.0000000000000549.

181. Hallal, P.C.; Andersen, L.B.; Bull, F.C.; Guthold, R.; Haskell, W.; Ekelund, U.; Lancet Physical Activity Series Working Group Global Physical Activity Levels: Surveillance Progress, Pitfalls, and Prospects. *Lancet* **2012**, *380*, 247–257, doi:10.1016/S0140-6736(12)60646-1.
182. Warburton, D.E.R.; Bredin, S.S.D. Health Benefits of Physical Activity: A Systematic Review of Current Systematic Reviews. *Curr Opin Cardiol* **2017**, *32*, 541–556, doi:10.1097/HCO.0000000000000437.
183. Löllgen, H.; Böckenhoff, A.; Knapp, G. Physical Activity and All-Cause Mortality: An Updated Meta-Analysis with Different Intensity Categories. *Int J Sports Med* **2009**, *30*, 213–224, doi:10.1055/s-0028-1128150.
184. Annerstedt, M.; Ostergren, P.-O.; Björk, J.; Grahn, P.; Skärbäck, E.; Währborg, P. Green Qualities in the Neighbourhood and Mental Health - Results from a Longitudinal Cohort Study in Southern Sweden. *BMC Public Health* **2012**, *12*, 337, doi:10.1186/1471-2458-12-337.
185. Wolf, K.L.; Robbins, A.S.T. Metro Nature, Environmental Health, and Economic Value. *Environ Health Perspect* **2015**, *123*, 390–398, doi:10.1289/ehp.1408216.
186. Shanahan, D.F.; Lin, B.B.; Bush, R.; Gaston, K.J.; Dean, J.H.; Barber, E.; Fuller, R.A. Toward Improved Public Health Outcomes from Urban Nature. *Am J Public Health* **2015**, *105*, 470–477, doi:10.2105/AJPH.2014.302324.
187. Tester, J.; Baker, R. Making the Playfields Even: Evaluating the Impact of an Environmental Intervention on Park Use and Physical Activity. *Prev Med* **2009**, *48*, 316–320, doi:10.1016/j.ypmed.2009.01.010.
188. Sallis, J.F.; Floyd, M.F.; Rodríguez, D.A.; Saelens, B.E. Role of Built Environments in Physical Activity, Obesity, and Cardiovascular Disease. *Circulation* **2012**, *125*, 729–737, doi:10.1161/CIRCULATIONAHA.110.969022.
189. Berke, E.M.; Koepsell, T.D.; Moudon, A.V.; Hoskins, R.E.; Larson, E.B. Association of the Built Environment with Physical Activity and Obesity in Older Persons. *Am J Public Health* **2007**, *97*, 486–492, doi:10.2105/AJPH.2006.085837.
190. Atkinson, J.L.; Sallis, J.F.; Saelens, B.E.; Cain, K.L.; Black, J.B. The Association of Neighborhood Design and Recreational Environments with Physical Activity. *Am J Health Promot* **2005**, *19*, 304–309, doi:10.4278/0890-1171-19.4.304.
191. Cunningham, G.O.; Michael, Y.L. Concepts Guiding the Study of the Impact of the Built Environment on Physical Activity for Older Adults: A Review of the Literature. *Am J Health Promot* **2004**, *18*, 435–443, doi:10.4278/0890-1171-18.6.435.
192. Brownson, R.C.; Hoehner, C.M.; Day, K.; Forsyth, A.; Sallis, J.F. Measuring the Built Environment for Physical Activity: State of the Science. *Am J Prev Med* **2009**, *36*, S99-123.e12, doi:10.1016/j.amepre.2009.01.005.
193. Li, F.; Harmer, P.A.; Cardinal, B.J.; Bosworth, M.; Acock, A.; Johnson-Shelton, D.; Moore, J.M. Built Environment, Adiposity, and Physical Activity in Adults Aged 50-75. *Am J Prev Med* **2008**, *35*, 38–46, doi:10.1016/j.amepre.2008.03.021.
194. Powell, K.E. Land Use, the Built Environment, and Physical Activity: A Public Health Mixture; a Public Health Solution. *Am J Prev Med* **2005**, *28*, 216–217, doi:10.1016/j.amepre.2004.10.031.
195. Sallis, J.F. Measuring Physical Activity Environments: A Brief History. *Am J Prev Med* **2009**, *36*, S86-92, doi:10.1016/j.amepre.2009.01.002.
196. Carlin, A.; Perchoux, C.; Puggina, A.; Aleksovska, K.; Buck, C.; Burns, C.; Cardon, G.; Chantal, S.; Ciarapica, D.; Condello, G.; et al. A Life Course Examination of the Physical Environmental Determinants of Physical Activity Behaviour: A "Determinants of Diet and Physical Activity" (DEDIPAC) Umbrella Systematic Literature Review. *PLoS One* **2017**, *12*, e0182083, doi:10.1371/journal.pone.0182083.
197. Brug, J.; van der Ploeg, H.P.; Loyen, A.; Ahrens, W.; Allais, O.; Andersen, L.F.; Cardon, G.; Capranica, L.; Chastin, S.; De Bourdeaudhuij, I.; et al. Determinants of Diet and Physical Activity (DEDIPAC): A Summary of Findings. *Int J Behav Nutr Phys Act* **2017**, *14*, 150, doi:10.1186/s12966-017-0609-5.
198. Liu, H.; Li, F.; Li, J.; Zhang, Y. The Relationships between Urban Parks, Residents' Physical Activity, and Mental Health Benefits: A Case Study from Beijing, China. *J Environ Manage* **2017**, *190*, 223–230, doi:10.1016/j.jenvman.2016.12.058.

199. Liberati, A.; Altman, D.G.; Tetzlaff, J.; Mulrow, C.; Gøtzsche, P.C.; Ioannidis, J.P.A.; Clarke, M.; Devereaux, P.J.; Kleijnen, J.; Moher, D. The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. *PLoS Med* **2009**, *6*, e1000100, doi:10.1371/journal.pmed.1000100.
200. Cochrane Handbook for Systematic Reviews of Interventions Available online: https://training.cochrane.org/handbook (accessed on 9 August 2022).
201. *Statistical Power Analysis for the Behavioral Sciences*; Routledge, 2013; ISBN 978-0-203-77158-7.
202. How a Meta-Analysis Works. In *Introduction to Meta-Analysis*; John Wiley & Sons, Ltd, 2009; pp. 1–7 ISBN 978-0-470-74338-6.
203. Johnson, U.; Ivarsson, A.; Parker, J.; Andersen, M.B.; Svetoft, I. Connection in the Fresh Air: A Study on the Benefits of Participation in an Electronic Tracking Outdoor Gym Exercise Programme. *Montenegrin Journal of Sports Science and Medicine 8*, 61–67.
204. Astell-Burt, T.; Feng, X.; Kolt, G.S. Green Space Is Associated with Walking and Moderate-to-Vigorous Physical Activity (MVPA) in Middle-to-Older-Aged Adults: Findings from 203 883 Australians in the 45 and Up Study. *Br J Sports Med* **2014**, *48*, 404–406, doi:10.1136/bjsports-2012-092006.
205. Cranney, L.; Phongsavan, P.; Kariuki, M.; Stride, V.; Scott, A.; Hua, M.; Bauman, A. Impact of an Outdoor Gym on Park Users' Physical Activity: A Natural Experiment. *Health Place* **2016**, *37*, 26–34, doi:10.1016/j.healthplace.2015.11.002.
206. Schoffman, D.E.; Kaczynski, A.T.; Forthofer, M.; Wilcox, S.; Hutto, B.; Child, S.T.; Hughey, S.M. Longitudinal Associations with Changes in Outdoor Recreation Area Use for Physical Activity during a Community-Based Intervention. *Prev Med* **2015**, *78*, 29–32, doi:10.1016/j.ypmed.2015.06.005.
207. Veitch, J.; Ball, K.; Crawford, D.; Abbott, G.R.; Salmon, J. Park Improvements and Park Activity: A Natural Experiment. *Am J Prev Med* **2012**, *42*, 616–619, doi:10.1016/j.amepre.2012.02.015.
208. Fitness correction of men using an "outdoor activity" - ProQuest Available online: https://www.proquest.com/openview/7a00f737ba72d359dca7179552c345ba/1?pq-origsite=gscholar&cbl=1006394 (accessed on 15 January 2023).
209. Wu, L.-L.; Wang, K.-M.; Liao, P.-I.; Kao, Y.-H.; Huang, Y.-C. Effects of an 8-Week Outdoor Brisk Walking Program on Fatigue in Hi-Tech Industry Employees: A Randomized Control Trial. *Workplace Health Saf* **2015**, *63*, 436–445, doi:10.1177/2165079915589685.
210. Kim, D.-I.; Lee, D.H.; Hong, S.; Jo, S.-W.; Won, Y.-S.; Jeon, J.Y. Six Weeks of Combined Aerobic and Resistance Exercise Using Outdoor Exercise Machines Improves Fitness, Insulin Resistance, and Chemerin in the Korean Elderly: A Pilot Randomized Controlled Trial. *Arch Gerontol Geriatr* **2018**, *75*, 59–64, doi:10.1016/j.archger.2017.11.006.
211. Cohen, D.; Marsh, T.; Williamson, S.; Golinelli, D.; McKenzie, T.L. Impact and Cost-Effectiveness of Family Fitness Zones: A Natural Experiment in Urban Public Parks. *Health Place* **2012**, *18*, 39–45, doi:10.1016/j.healthplace.2011.09.008.
212. Aparicio, E.H.; Rodríguez, E.F.; Marbán, R.M.; Minguet, J.L.C. Análisis de los Circuitos Biosaludables para la Tercera Edad en la provincia de Málaga (España) (Analysis of the Public Geriatric Parks for Elderly People in Málaga (Spain)). *Retos* **2010**, *17*, 99–102, doi:10.47197/retos.v0i17.34684.
213. Society, A.G.; Society, G.; Of, A.A.; On Falls Prevention, O.S.P. Guideline for the Prevention of Falls in Older Persons. *Journal of the American Geriatrics Society* **2001**, *49*, 664–672, doi:10.1046/j.1532-5415.2001.49115.x.
214. Robertson, M.C.; Campbell, A.J.; Gardner, M.M.; Devlin, N. Preventing Injuries in Older People by Preventing Falls: A Meta-Analysis of Individual-Level Data. *J Am Geriatr Soc* **2002**, *50*, 905–911, doi:10.1046/j.1532-5415.2002.50218.x.
215. Pratt, M.; Macera, C.A.; Wang, G. Higher Direct Medical Costs Associated with Physical Inactivity. *Phys Sportsmed* **2000**, *28*, 63–70, doi:10.3810/psm.2000.10.1237.
216. Playgrounds for Seniors Popular in Europe, Asia and North America Available online: https://www.athleticbusiness.com/facilities/fitness/article/15142404/playgrounds-for-seniors-popular-in-europe-asia-and-north-america (accessed on 3 May 2022).
217. Scott, A.; Stride, V.; Neville, L.; Hua, M. Design and Promotion of an Outdoor Gym for Older Adults: A Collaborative Project. *Health Promot J Austr* **2014**, *25*, 212–214, doi:10.1071/HE14037.

218. Fujita, K.; Fujiwara, Y.; Chaves, P.H.M.; Motohashi, Y.; Shinkai, S. Frequency of Going Outdoors as a Good Predictors for Incident Disability of Physical Function as Well as Disability Recovery in Community-Dwelling Older Adults in Rural Japan. *J Epidemiol* **2006**, *16*, 261–270, doi:10.2188/jea.16.261.
219. Lee, I.-M.; Buchner, D.M. The Importance of Walking to Public Health. *Medicine & Science in Sports & Exercise* **2008**, *40*, S512, doi:10.1249/MSS.0b013e31817c65d0.
220. Lee, I.M.; Rexrode, K.M.; Cook, N.R.; Manson, J.E.; Buring, J.E. Physical Activity and Coronary Heart Disease in Women: Is "No Pain, No Gain" Passé? *JAMA* **2001**, *285*, 1447–1454, doi:10.1001/jama.285.11.1447.
221. Simpson, M.E.; Serdula, M.; Galuska, D.A.; Gillespie, C.; Donehoo, R.; Macera, C.; Mack, K. Walking Trends among U.S. Adults: The Behavioral Risk Factor Surveillance System, 1987-2000. *Am J Prev Med* **2003**, *25*, 95–100, doi:10.1016/s0749-3797(03)00112-0.
222. Greyling, G.A. THE USAGE OF OUTDOOR GYMS IN SOUTH AFRICA. 109.
223. Seattle Fitness Zone® Areas - Our Work in WA. *Trust for Public Land*.
224. Mora, R. Moving Bodies: Open Gyms and Physical Activity in Santiago. *Journal of Urban Design* **2012**, *17*, 485–497, doi:10.1080/13574809.2012.706367.
225. Chow, H.-W.; Ho, C.-H. Does the Use of Outdoor Fitness Equipment by Older Adults Qualify as Moderate to Vigorous Physical Activity? *PLoS One* **2018**, *13*, e0196507, doi:10.1371/journal.pone.0196507.
226. Chow, H. Outdoor Fitness Equipment in Parks: A Qualitative Study from Older Adults' Perceptions. *BMC Public Health* **2013**, *13*, 1216, doi:10.1186/1471-2458-13-1216.
227. Chow, H.-W.; Wu, D.-R. Outdoor Fitness Equipment Usage Behaviors in Natural Settings. *Int J Environ Res Public Health* **2019**, *16*, 391, doi:10.3390/ijerph16030391.
228. Copeland, J.L.; Currie, C.; Walker, A.; Mason, E.; Willoughby, T.N.; Amson, A. Fitness Equipment in Public Parks: Frequency of Use and Community Perceptions in a Small Urban Centre. *J Phys Act Health* **2017**, *14*, 344–352, doi:10.1123/jpah.2016-0277.
229. Pretty, J.; Griffin, M.; Sellens, M.; Pretty, C. Green Exercise: Complementary Roles of Nature, Exercise and Diet in Physical and Emotional Well-Being and Implications for Public Health Policy. *undefined* **2003**.
230. Hartig, T.; Mang, M.; Evans, G.W. Restorative Effects of Natural Environment Experiences. *Environment and Behavior* **1991**, *23*, 3–26, doi:10.1177/0013916591231001.
231. Mizen, A.; Song, J.; Fry, R.; Akbari, A.; Berridge, D.; Parker, S.C.; Johnson, R.; Lovell, R.; Lyons, R.A.; Nieuwenhuijsen, M.; et al. Longitudinal Access and Exposure to Green-Blue Spaces and Individual-Level Mental Health and Well-Being: Protocol for a Longitudinal, Population-Wide Record-Linked Natural Experiment. *BMJ Open* **2019**, *9*, e027289, doi:10.1136/bmjopen-2018-027289.
232. Lynch, M.; Spencer, L.H.; Tudor Edwards, R. A Systematic Review Exploring the Economic Valuation of Accessing and Using Green and Blue Spaces to Improve Public Health. *Int J Environ Res Public Health* **2020**, *17*, 4142, doi:10.3390/ijerph17114142.
233. Markevych, I.; Schoierer, J.; Hartig, T.; Chudnovsky, A.; Hystad, P.; Dzhambov, A.M.; de Vries, S.; Triguero-Mas, M.; Brauer, M.; Nieuwenhuijsen, M.J.; et al. Exploring Pathways Linking Greenspace to Health: Theoretical and Methodological Guidance. *Environmental Research* **2017**, *158*, 301–317, doi:10.1016/j.envres.2017.06.028.
234. Dadvand, P.; de Nazelle, A.; Figueras, F.; Basagaña, X.; Su, J.; Amoly, E.; Jerrett, M.; Vrijheid, M.; Sunyer, J.; Nieuwenhuijsen, M.J. Green Space, Health Inequality and Pregnancy. *Environment International* **2012**, *40*, 110–115, doi:10.1016/j.envint.2011.07.004.
235. Sallis, J.F.; Cerin, E.; Conway, T.L.; Adams, M.A.; Frank, L.D.; Pratt, M.; Salvo, D.; Schipperijn, J.; Smith, G.; Cain, K.L.; et al. Physical Activity in Relation to Urban Environments in 14 Cities Worldwide: A Cross-Sectional Study. *The Lancet* **2016**, *387*, 2207–2217, doi:10.1016/S0140-6736(15)01284-2.
236. Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D.G. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *BMJ* **2009**, *339*, b2535, doi:10.1136/bmj.b2535.

237. Sterne, J.A.C.; Savović, J.; Page, M.J.; Elbers, R.G.; Blencowe, N.S.; Boutron, I.; Cates, C.J.; Cheng, H.-Y.; Corbett, M.S.; Eldridge, S.M.; et al. RoB 2: A Revised Tool for Assessing Risk of Bias in Randomised Trials. *BMJ* **2019**, *366*, l4898, doi:10.1136/bmj.l4898.
238. Sterne, J.A.; Hernán, M.A.; Reeves, B.C.; Savović, J.; Berkman, N.D.; Viswanathan, M.; Henry, D.; Altman, D.G.; Ansari, M.T.; Boutron, I.; et al. ROBINS-I: A Tool for Assessing Risk of Bias in Non-Randomised Studies of Interventions. *BMJ* **2016**, *355*, i4919, doi:10.1136/bmj.i4919.
239. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. *BMJ* **2021**, *372*, n71, doi:10.1136/bmj.n71.
240. 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, doi:10.3390/ijerph121114216.
241. Sales, M.; Polman, R.; Hill, K.D.; Levinger, P. A Novel Exercise Initiative for Seniors to Improve Balance and Physical Function. *J Aging Health* **2017**, *29*, 1424–1443, doi:10.1177/0898264316662359.
242. Plotnikoff, R.C.; Wilczynska, M.; Cohen, K.E.; Smith, J.J.; Lubans, D.R. Integrating Smartphone Technology, Social Support and the Outdoor Physical Environment to Improve Fitness among Adults at Risk of, or Diagnosed with, Type 2 Diabetes: Findings from the 'ECoFit' Randomized Controlled Trial. *Preventive Medicine* **2017**, *105*, 404–411, doi:10.1016/j.ypmed.2017.08.027.
243. Müller-Riemenschneider, F.; Petrunoff, N.; Yao, J.; Ng, A.; Sia, A.; Ramiah, A.; Wong, M.; Han, J.; Tai, B.C.; Uijtdewilligen, L. Effectiveness of Prescribing Physical Activity in Parks to Improve Health and Wellbeing - the Park Prescription Randomized Controlled Trial. *International Journal of Behavioral Nutrition and Physical Activity* **2020**, *17*, 42, doi:10.1186/s12966-020-00941-8.
244. Vert, C.; Gascon, M.; Ranzani, O.; Márquez, S.; Triguero-Mas, M.; Carrasco-Turigas, G.; Arjona, L.; Koch, S.; Llopis, M.; Donaire-Gonzalez, D.; et al. Physical and Mental Health Effects of Repeated Short Walks in a Blue Space Environment: A Randomised Crossover Study. *Environ Res* **2020**, *188*, 109812, doi:10.1016/j.envres.2020.109812.
245. Burnet, K.; Kelsch, E.; Zieff, G.; Moore, J.B.; Stoner, L. How Fitting Is F.I.T.T.?: A Perspective on a Transition from the Sole Use of Frequency, Intensity, Time, and Type in Exercise Prescription. *Physiology & Behavior* **2019**, *199*, 33–34, doi:10.1016/j.physbeh.2018.11.007.
246. Brown, D.K.; Barton, J.L.; Pretty, J.; Gladwell, V.F. Walks4Work: Assessing the Role of the Natural Environment in a Workplace Physical Activity Intervention. *Scand J Work Environ Health* **2014**, *40*, 390–399, doi:10.5271/sjweh.3421.
247. Furber, S.; Pomroy, H.; Grego, S.; Tavener-Smith, K. People's Experiences of Using Outdoor Gym Equipment in Parks. *Health Promot J Austr* **2014**, *25*, 211, doi:10.1071/HE14038.
248. McEachan, R.R.C.; Prady, S.L.; Smith, G.; Fairley, L.; Cabieses, B.; Gidlow, C.; Wright, J.; Dadvand, P.; van Gent, D.; Nieuwenhuijsen, M.J. The Association between Green Space and Depressive Symptoms in Pregnant Women: Moderating Roles of Socioeconomic Status and Physical Activity. *J Epidemiol Community Health* **2016**, *70*, 253–259, doi:10.1136/jech-2015-205954.
249. Bos, E.H.; van der Meulen, L.; Wichers, M.; Jeronimus, B.F. A Primrose Path? Moderating Effects of Age and Gender in the Association between Green Space and Mental Health. *Int J Environ Res Public Health* **2016**, *13*, 492, doi:10.3390/ijerph13050492.
250. Richardson, E.A.; Mitchell, R. Gender Differences in Relationships between Urban Green Space and Health in the United Kingdom. *Soc Sci Med* **2010**, *71*, 568–575, doi:10.1016/j.socscimed.2010.04.015.
251. de Vries, S.; Verheij, R.A.; Groenewegen, P.P.; Spreeuwenberg, P. Natural Environments—Healthy Environments? An Exploratory Analysis of the Relationship between Greenspace and Health. *Environ Plan A* **2003**, *35*, 1717–1731, doi:10.1068/a35111.
252. Bojorquez, I.; Ojeda-Revah, L. Urban Public Parks and Mental Health in Adult Women: Mediating and Moderating Factors. *Int J Soc Psychiatry* **2018**, *64*, 637–646, doi:10.1177/0020764018795198.
253. Opić, S.; Đuranović, M. Leisure Time of Young Due to Some Socio-Demographic Characteristics. *Procedia - Social and Behavioral Sciences* **2014**, *159*, 546–551, doi:10.1016/j.sbspro.2014.12.422.
254. Ajzen, I. The Theory of Planned Behaviour: Reactions and Reflections. *Psychol Health* **2011**, *26*, 1113–1127, doi:10.1080/08870446.2011.613995.

255. Mukhopadhyay, A.; Sengupta, J.; Ramanathan, S. Recalling Past Temptations: An Information-Processing Perspective on the Dynamics of Self-Control. *Journal of Consumer Research* **2008**, *35*, 586–599, doi:10.1086/591105.
256. Cos'è Veneto 2050? – Veneto 2050.
257. Nuovo Patto per il Lavoro e per il Clima, l'Emilia-Romagna firma l'intesa per rilancio e sviluppo fondati sulla sostenibilità Available online: https://formazionelavoro.regione.emilia-romagna.it/notizie-in-evidenza/nuovo-patto-per-il-lavoro-e-per-il-clima-lemilia-romagna-firma-lintesa-per-rilancio-e-sviluppo-fondati-sulla-sostenibilita (accessed on 15 January 2023).
258. 05_Veneto_Scheda.Pdf.
259. 08_Emilia-Romagna_Scheda_DEF.Pdf.
260. Parchi e Aree Protette - Regione Del Veneto Available online: https://www.regione.veneto.it/web/agricoltura-e-foreste/parchi-e-aree-protette (accessed on 15 January 2023).
261. Nuovi finanziamenti per sostenere la rete delle aree protette: 5 milioni di euro a beneficio degli Enti di gestione per i parchi e la biodiversità dell'Emilia-Romagna Available online: https://ambiente.regione.emilia-romagna.it/it/notizie/attualita/2022/giugno/parchi-dalla-regione-5-milioni-di-euro-per-le-aree-protette-risorse-che-s2019inseriscono-nel-programma-triennale-da-oltre-15-milioni-di-euro (accessed on 15 January 2023).
262. Forum di avvio della Fase 2 della Carta Europea per il Turismo Sostenibile nei Parchi dell'Emilia Centrale Available online: https://ambiente.regione.emilia-romagna.it/it/parchi-natura2000/notizie/notizie-2021/forum-di-avvio-della-fase-2-della-carta-europea-per-il-turismo-sostenibile-nei-parchi-dell2019emilia-centrale (accessed on 15 January 2023).
263. S.R.L, e-ntRA-C. per siti accessibili-http://www internetwork it/-I. La Giornata Nazionale degli Alberi (21 novembre) con convegni e iniziative online Available online: https://www.bolognametropolitana.it/Home_Page/Archivio_news/001/21_Novembre_Giornata_Nazionale_degli_Alberi (accessed on 15 January 2023).
264. S.R.L, e-ntRA-C. per siti accessibili-http://www internetwork it/-I. "Parchi in Movimento": 11 associazioni sportive propongono attività gratuite in sei parchi della città Available online: https://www.cittametropolitana.bo.it/portale/Home/Archivio_news/u201CParchi_in_Movimento_u201D_11_associazioni_sportive_propongono_attivita_gratuite_in_sei_parchi_della_citta (accessed on 15 January 2023).
265. Home Page - Circoscrizione 2^ Available online: https://circ2.comune.verona.it/nqcontent.cfm?a_id=10012 (accessed on 15 January 2023).
266. Piano Del Verde Comunale - Comune Di Padova Available online: https://www.padovanet.it/informazione/piano-del-verde-comunale (accessed on 15 January 2023).
267. L'Emilia-Romagna "corridoio verde" d'Italia: 4,5 milioni di nuovi alberi in 5 anni, uno per ogni abitante Available online: https://ambiente.regione.emilia-romagna.it/it/parchi-natura2000/notizie/notizie-2020/emilia-romagna-corridoio-verde-4-5-milioni-di-nuovi-alberi (accessed on 15 January 2023).
268. Smith, W.G. *Does Gender Influence Online Survey Participation? A Record-Linkage Analysis of University Faculty Online Survey Response Behavior*; 2008;
269. van Praag, L.; Bracke, P.; Christiaens, W.; Levecque, K.; Pattyn, E. Mental Health in a Gendered Context: Gendered Community Effect on Depression and Problem Drinking. *Health Place* **2009**, *15*, 990–998, doi:10.1016/j.healthplace.2009.04.003.
270. Pattyn, E.; Van Praag, L.; Verhaeghe, M.; Levecque, K.; Bracke, P. The Association between Residential Area Characteristics and Mental Health Outcomes among Men and Women in Belgium. *Archives of Public Health* **2011**, *69*, 3, doi:10.1186/0778-7367-69-3.
271. Floyd, M.F.; Bocarro, J.N.; Smith, W.R.; Baran, P.K.; Moore, R.C.; Cosco, N.G.; Edwards, M.B.; Suau, L.J.; Fang, K. Park-Based Physical Activity among Children and Adolescents. *Am J Prev Med* **2011**, *41*, 258–265, doi:10.1016/j.amepre.2011.04.013.

272. Payne, L.L.; Mowen, A.J.; Orsega-Smith, E. An Examination of Park Preferences and Behaviors Among Urban Residents: The Role of Residential Location, Race, and Age. *Leisure Sciences* **2002**, *24*, 181–198, doi:10.1080/01490400252900149.
273. Chen, W.Y.; Jim, C.Y. Cost–Benefit Analysis of the Leisure Value of Urban Greening in the New Chinese City of Zhuhai. *Cities* **2008**, *25*, 298–309, doi:10.1016/j.cities.2008.06.002.
274. Xu, Y.; Qi, J.; Yang, Y.; Wen, X. The Contribution of Lifestyle Factors to Depressive Symptoms: A Cross-Sectional Study in Chinese College Students. *Psychiatry Res* **2016**, *245*, 243–249, doi:10.1016/j.psychres.2016.03.009.
275. Damon, W.; Lerner, R.M.; Kuhn, D.; Siegler, R.S.; Eisenberg, N. *Child and Adolescent Development: An Advanced Course*; John Wiley & Sons, 2012; ISBN 978-1-118-42873-3.
276. Chen, C.; Luo, W.; Li, H.; Zhang, D.; Kang, N.; Yang, X.; Xia, Y. Impact of Perception of Green Space for Health Promotion on Willingness to Use Parks and Actual Use among Young Urban Residents. *Int J Environ Res Public Health* **2020**, *17*, 5560, doi:10.3390/ijerph17155560.
277. Schipperijn, J.; Ekholm, O.; Stigsdotter, U.K.; Toftager, M.; Bentsen, P.; Kamper-Jørgensen, F.; Randrup, T.B. Factors Influencing the Use of Green Space: Results from a Danish National Representative Survey. *Landscape and Urban Planning* **2010**, *95*, 130–137, doi:10.1016/j.landurbplan.2009.12.010.
278. Lachowycz, K.; Jones, A.P. Does Walking Explain Associations between Access to Greenspace and Lower Mortality? *Social Science & Medicine* **2014**, *107*, 9–17, doi:10.1016/j.socscimed.2014.02.023.
279. de Hollander, E.L.; Scheepers, E.; van Wijnen, H.J.; van Wesemael, P.J.; Schuit, A.J.; Wendel-Vos, W.; van Kempen, E.E. Transport Choice When Travelling to a Sports Facility: The Role of Perceived Route Features - Results from a Cross-Sectional Study in the Netherlands. *BMC Sports Sci Med Rehabil* **2015**, *7*, 15, doi:10.1186/s13102-015-0009-6.
280. Stigsdotter, U.K.; Ekholm, O.; Schipperijn, J.; Toftager, M.; Kamper-Jørgensen, F.; Randrup, T.B. Health Promoting Outdoor Environments--Associations between Green Space, and Health, Health-Related Quality of Life and Stress Based on a Danish National Representative Survey. *Scand J Public Health* **2010**, *38*, 411–417, doi:10.1177/1403494810367468.
281. Lin, B.B.; Fuller, R.A.; Bush, R.; Gaston, K.J.; Shanahan, D.F. Opportunity or Orientation? Who Uses Urban Parks and Why. *PLOS ONE* **2014**, *9*, e87422, doi:10.1371/journal.pone.0087422.
282. Eden in a Vacant Lot: Special Places, Species, and Kids in the Neighborhood of Life. **2002**, doi:10.7551/mitpress/1807.003.0013.
283. Dunn, R.R.; Gavin, M.C.; Sanchez, M.C.; Solomon, J.N. The Pigeon Paradox: Dependence of Global Conservation on Urban Nature. *Conserv Biol* **2006**, *20*, 1814–1816, doi:10.1111/j.1523-1739.2006.00533.x.
284. Cole Wright, J.; Cullum, J.; Schwab, N. The Cognitive and Affective Dimensions of Moral Conviction: Implications for Attitudinal and Behavioral Measures of Interpersonal Tolerance. *Pers Soc Psychol Bull* **2008**, *34*, 1461–1476, doi:10.1177/0146167208322557.
285. Baur, J.W.R.; Tynon, J.F.; Gómez, E. Attitudes about Urban Nature Parks: A Case Study of Users and Nonusers in Portland, Oregon. *Landscape and Urban Planning* **2013**, *117*, 100–111, doi:10.1016/j.landurbplan.2013.04.015.
286. Kaplan, R.; Kaplan, S. A Psychological Perspective. 6.
287. Korpela, K.M.; Ylén, M.P. Effectiveness of Favorite-Place Prescriptions: A Field Experiment. *Am J Prev Med 36*.
288. Hartig, T.; Lindblom, K.; Ovefelt, K. The Home and Near-home Area Offer Restoration Opportunities Differentiated by Gender. *Scandinavian Housing and Planning Research* **1998**, *15*, 283–296, doi:10.1080/02815739808730463.
289. Staats, H.; Kieviet, A.; Hartig, T. Where to Recover from Attentional Fatigue: An Expectancy-Value Analysis of Environmental Preference. *Journal of Environmental Psychology* **2003**, *23*, 147–157, doi:10.1016/S0272-4944(02)00112-3.
290. Nieuwenhuijsen, M.J.; Kruize, H.; Gidlow, C.; Andrusaityte, S.; Antó, J.M.; Basagaña, X.; Cirach, M.; Dadvand, P.; Danileviciute, A.; Donaire-Gonzalez, D.; et al. Positive Health Effects of the Natural

Outdoor Environment in Typical Populations in Different Regions in Europe (PHENOTYPE): A Study Programme Protocol. *BMJ Open* **2014**, *4*, e004951, doi:10.1136/bmjopen-2014-004951.
291. Smith, G.; Cirach, M.; Swart, W.; Dėdelė, A.; Gidlow, C.; van Kempen, E.; Kruize, H.; Gražulevičienė, R.; Nieuwenhuijsen, M.J. Characterisation of the Natural Environment: Quantitative Indicators across Europe. *Int J Health Geogr* **2017**, *16*, 16, doi:10.1186/s12942-017-0090-z.
292. van den Berg, M.; van Poppel, M.; van Kamp, I.; Andrusaityte, S.; Balseviciene, B.; Cirach, M.; Danileviciute, A.; Ellis, N.; Hurst, G.; Masterson, D.; et al. Visiting Green Space Is Associated with Mental Health and Vitality: A Cross-Sectional Study in Four European Cities. *Health Place* **2016**, *38*, 8–15, doi:10.1016/j.healthplace.2016.01.003.
293. Ware, J.E.J.; Sherbourne, C.D. The MOS 36-Ltem Short-Form Health Survey (SF-36): I. Conceptual Framework and Item Selection. *Medical Care* **1992**, *30*, 473–483.
294. SF-36 Health Survey Update : Spine Available online: https://journals.lww.com/spinejournal/Citation/2000/12150/SF_36_Health_Survey_Update.8.aspx (accessed on 6 October 2021).
295. The MOS 36-Ltem Short-Form Health Survey (SF-36): I. Concept... : Medical Care Available online: https://journals.lww.com/lww-medicalcare/Abstract/1992/06000/The_MOS_36_ltem_Short_Form_Health_Survey__SF_36__.2.aspx (accessed on 6 October 2021).
296. Rossi, S.D.; Byrne, J.A.; Pickering, C.M. The Role of Distance in Peri-Urban National Park Use: Who Visits Them and How Far Do They Travel? *Applied Geography* **2015**, *63*, 77–88, doi:10.1016/j.apgeog.2015.06.008.
297. Sallis, J.F.; Cerin, E.; Conway, T.L.; Adams, M.A.; Frank, L.D.; Pratt, M.; Salvo, D.; Schipperijn, J.; Smith, G.; Cain, K.L.; et al. Physical Activity in Relation to Urban Environments in 14 Cities Worldwide: A Cross-Sectional Study. *Lancet* **2016**, *387*, 2207–2217, doi:10.1016/S0140-6736(15)01284-2.
298. Toohey, A.M.; McCormack, G.R.; Doyle-Baker, P.K.; Adams, C.L.; Rock, M.J. Dog-Walking and Sense of Community in Neighborhoods: Implications for Promoting Regular Physical Activity in Adults 50 Years and Older. *Health Place* **2013**, *22*, 75–81, doi:10.1016/j.healthplace.2013.03.007.
299. Kuo, F.E.; Sullivan, W.C.; Coley, R.L.; Brunson, L. Fertile Ground for Community: Inner-City Neighborhood Common Spaces. *American Journal of Community Psychology* **1998**, *26*, 823–851, doi:10.1023/A:1022294028903.
300. Maas, J.; van Dillen, S.M.E.; Verheij, R.A.; Groenewegen, P.P. Social Contacts as a Possible Mechanism behind the Relation between Green Space and Health. *Health Place* **2009**, *15*, 586–595, doi:10.1016/j.healthplace.2008.09.006.
301. Koohsari, M.J.; Mavoa, S.; Villanueva, K.; Sugiyama, T.; Badland, H.; Kaczynski, A.T.; Owen, N.; Giles-Corti, B. Public Open Space, Physical Activity, Urban Design and Public Health: Concepts, Methods and Research Agenda. *Health & Place* **2015**, *33*, 75–82, doi:10.1016/j.healthplace.2015.02.009.
302. de la Barrera, F.; Reyes-Paecke, S.; Harris, J.; Bascuñán, D.; Farías, J.M. People's Perception Influences on the Use of Green Spaces in Socio-Economically Differentiated Neighborhoods. *Urban Forestry & Urban Greening* **2016**, *20*, 254–264, doi:10.1016/j.ufug.2016.09.007.
303. Hong, A.; Sallis, J.F.; King, A.C.; Conway, T.L.; Saelens, B.; Cain, K.L.; Fox, E.H.; Frank, L.D. Linking Green Space to Neighborhood Social Capital in Older Adults: The Role of Perceived Safety. *Social Science & Medicine* **2018**, *207*, 38–45, doi:10.1016/j.socscimed.2018.04.051.
304. White, M.P.; Pahl, S.; Ashbullby, K.; Herbert, S.; Depledge, M.H. Feelings of Restoration from Recent Nature Visits. *Journal of Environmental Psychology* **2013**, *35*, 40–51, doi:10.1016/j.jenvp.2013.04.002.
305. Aerts, R.; Honnay, O.; Van Nieuwenhuyse, A. Biodiversity and Human Health: Mechanisms and Evidence of the Positive Health Effects of Diversity in Nature and Green Spaces. *Br Med Bull* **2018**, *127*, 5–22, doi:10.1093/bmb/ldy021.
306. Chen, W.Y.; Jim, C.Y. Cost–Benefit Analysis of the Leisure Value of Urban Greening in the New Chinese City of Zhuhai. *Cities* **2008**, *25*, 298–309, doi:10.1016/j.cities.2008.06.002.
307. Lee, I.; Choi, H.; Bang, K.-S.; Kim, S.; Song, M.; Lee, B. Effects of Forest Therapy on Depressive Symptoms among Adults: A Systematic Review. *Int J Environ Res Public Health* **2017**, *14*, 321, doi:10.3390/ijerph14030321.

308. Bosch, M. van den Natural Environments, Health, and Well-Being Available online: https://oxfordre.com/environmentalscience/view/10.1093/acrefore/9780199389414.001.0001/acrefore-9780199389414-e-333 (accessed on 26 May 2021).
309. White, M.P.; Dolan, P. Accounting for the Richness of Daily Activities. *Psychol Sci* **2009**, *20*, 1000–1008, doi:10.1111/j.1467-9280.2009.02392.x.
310. Korpela, K.M.; Ylén, M.; Tyrväinen, L.; Silvennoinen, H. Determinants of Restorative Experiences in Everyday Favorite Places. *Health Place* **2008**, *14*, 636–652, doi:10.1016/j.healthplace.2007.10.008.
311. Korpela, K.; Borodulin, K.; Neuvonen, M.; Paronen, O.; Tyrväinen, L. Analyzing the Mediators between Nature-Based Outdoor Recreation and Emotional Well-Being. *Journal of Environmental Psychology* **2014**, *37*, 1–7, doi:10.1016/j.jenvp.2013.11.003.
312. Kruize, H.; van Kamp, I.; van den Berg, M.; van Kempen, E.; Wendel-Vos, W.; Ruijsbroek, A.; Swart, W.; Maas, J.; Gidlow, C.; Smith, G.; et al. Exploring Mechanisms Underlying the Relationship between the Natural Outdoor Environment and Health and Well-Being - Results from the PHENOTYPE Project. *Environ Int* **2020**, *134*, 105173, doi:10.1016/j.envint.2019.105173.
313. Chen, C.; Luo, W.; Li, H.; Zhang, D.; Kang, N.; Yang, X.; Xia, Y. Impact of Perception of Green Space for Health Promotion on Willingness to Use Parks and Actual Use among Young Urban Residents. *Int J Environ Res Public Health* **2020**, *17*, doi:10.3390/ijerph17155560.
314. Schipperijn, J.; Ekholm, O.; Stigsdotter, U.K.; Toftager, M.; Bentsen, P.; Kamper-Jørgensen, F.; Randrup, T.B. Factors Influencing the Use of Green Space: Results from a Danish National Representative Survey. *Landscape and Urban Planning* **2010**, *95*, 130–137, doi:10.1016/j.landurbplan.2009.12.010.
315. Carter, M.; Horwitz, P. Beyond Proximity: The Importance of Green Space Useability to Self-Reported Health. *Ecohealth* **2014**, *11*, 322–332, doi:10.1007/s10393-014-0952-9.
316. van Dillen, S.M.E.; de Vries, S.; Groenewegen, P.P.; Spreeuwenberg, P. Greenspace in Urban Neighbourhoods and Residents' Health: Adding Quality to Quantity. *J Epidemiol Community Health* **2012**, *66*, e8–e8, doi:10.1136/jech.2009.104695.
317. Triguero-Mas, M.; Donaire-Gonzalez, D.; Seto, E.; Valentín, A.; Martínez, D.; Smith, G.; Hurst, G.; Carrasco-Turigas, G.; Masterson, D.; van den Berg, M.; et al. Natural Outdoor Environments and Mental Health: Stress as a Possible Mechanism. *Environmental Research* **2017**, *159*, 629–638, doi:10.1016/j.envres.2017.08.048.
318. Bixby, H.; Bentham, J.; Zhou, B.; Di Cesare, M.; Paciorek, C.J.; Bennett, J.E.; Taddei, C.; Stevens, G.A.; Rodriguez-Martinez, A.; Carrillo-Larco, R.M.; et al. Rising Rural Body-Mass Index Is the Main Driver of the Global Obesity Epidemic in Adults. *Nature* **2019**, *569*, 260–264, doi:10.1038/s41586-019-1171-x.
319. DiBonaventura, M.; Nicolucci, A.; Meincke, H.; Le Lay, A.; Fournier, J. Obesity in Germany and Italy: Prevalence, Comorbidities, and Associations with Patient Outcomes. *Clinicoecon Outcomes Res* **2018**, *10*, 457–475, doi:10.2147/CEOR.S157673.
320. Pi-Sunyer, X. The Medical Risks of Obesity. *Postgrad Med* **2009**, *121*, 21–33, doi:10.3810/pgm.2009.11.2074.
321. Purnell, J.Q. Definitions, Classification, and Epidemiology of Obesity. In *Endotext*; Feingold, K.R., Anawalt, B., Boyce, A., Chrousos, G., de Herder, W.W., Dhatariya, K., Dungan, K., Hershman, J.M., Hofland, J., Kalra, S., Kaltsas, G., Koch, C., Kopp, P., Korbonits, M., Kovacs, C.S., Kuohung, W., Laferrère, B., Levy, M., McGee, E.A., McLachlan, R., Morley, J.E., New, M., Purnell, J., Sahay, R., Singer, F., Sperling, M.A., Stratakis, C.A., Trence, D.L., Wilson, D.P., Eds.; MDText.com, Inc.: South Dartmouth (MA), 2000.
322. Guh, D.P.; Zhang, W.; Bansback, N.; Amarsi, Z.; Birmingham, C.L.; Anis, A.H. The Incidence of Co-Morbidities Related to Obesity and Overweight: A Systematic Review and Meta-Analysis. *BMC Public Health* **2009**, *9*, 88, doi:10.1186/1471-2458-9-88.
323. Nyberg, S.T.; Batty, G.D.; Pentti, J.; Virtanen, M.; Alfredsson, L.; Fransson, E.I.; Goldberg, M.; Heikkilä, K.; Jokela, M.; Knutsson, A.; et al. Obesity and Loss of Disease-Free Years Owing to Major Non-Communicable Diseases: A Multicohort Study. *Lancet Public Health* **2018**, *3*, e490–e497, doi:10.1016/S2468-2667(18)30139-7.

324. Jehan, F.; Nisar, I.; Kerai, S.; Balouch, B.; Brown, N.; Rahman, N.; Rizvi, A.; Shafiq, Y.; Zaidi, A.K.M. Randomized Trial of Amoxicillin for Pneumonia in Pakistan. *N Engl J Med* **2020**, *383*, 24–34, doi:10.1056/NEJMoa1911998.
325. Tremblay, M.S.; Aubert, S.; Barnes, J.D.; Saunders, T.J.; Carson, V.; Latimer-Cheung, A.E.; Chastin, S.F.M.; Altenburg, T.M.; Chinapaw, M.J.M.; Altenburg, T.M.; et al. Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project Process and Outcome. *International Journal of Behavioral Nutrition and Physical Activity* **2017**, *14*, 75, doi:10.1186/s12966-017-0525-8.
326. GHO Available online: https://www.who.int/data/gho (accessed on 15 January 2023).
327. ITALY Physical Activity Factsheet. 6.
328. Kandola, A.; Vancampfort, D.; Herring, M.; Rebar, A.; Hallgren, M.; Firth, J.; Stubbs, B. Moving to Beat Anxiety: Epidemiology and Therapeutic Issues with Physical Activity for Anxiety. *Curr Psychiatry Rep* **2018**, *20*, 63, doi:10.1007/s11920-018-0923-x.
329. Wallace, D.D.; Derose, K.P.; Han, B.; Cohen, D.A. The Effects of Park-Based Interventions on Health: A Systematic Review Protocol. *Syst Rev* **2020**, *9*, 135, doi:10.1186/s13643-020-01396-5.
330. Derose, K.P.; Wallace, D.D.; Han, B.; Cohen, D.A. Effects of Park-Based Interventions on Health-Related Outcomes: A Systematic Review. *Preventive Medicine* **2021**, *147*, 106528, doi:10.1016/j.ypmed.2021.106528.
331. Petrunoff, N.; Yao, J.; Sia, A.; Ng, A.; Ramiah, A.; Wong, M.; Han, J.; Tai, B.C.; Uijtdewilligen, L.; Müller-Riemenschneider, F. Activity in Nature Mediates a Park Prescription Intervention's Effects on Physical Activity, Park Use and Quality of Life: A Mixed-Methods Process Evaluation. *BMC Public Health* **2021**, *21*, 204, doi:10.1186/s12889-021-10177-1.
332. Sellers, C.E.; Grant, P.M.; Ryan, C.G.; O'Kane, C.; Raw, K.; Conn, D. Take a Walk in the Park? A Cross-over Pilot Trial Comparing Brisk Walking in Two Different Environments: Park and Urban. *Prev Med* **2012**, *55*, 438–443, doi:10.1016/j.ypmed.2012.09.005.
333. de Bloom, J.; Sianoja, M.; Korpela, K.; Tuomisto, M.; Lilja, A.; Geurts, S.; Kinnunen, U. Effects of Park Walks and Relaxation Exercises during Lunch Breaks on Recovery from Job Stress: Two Randomized Controlled Trials. *Journal of Environmental Psychology* **2017**, *51*, 14–30, doi:10.1016/j.jenvp.2017.03.006.
334. https://plus.google.com/+UNESCO UNESCO Available online: https://en.unesco.org/ (accessed on 17 January 2023).
335. Benvenuto Su Urbanistica e Edilizia - Comune Di Bologna Available online: http://dru.iperbole.bologna.it/pianificazione?filter=Piano%20Urbanistico%20Generale%20(PUG) (accessed on 17 January 2023).
336. Grossi, E.; Groth, N.; Mosconi, P.; Cerutti, R.; Pace, F.; Compare, A.; Apolone, G. Development and Validation of the Short Version of the Psychological General Well-Being Index (PGWB-S). *Health Qual Life Outcomes* **2006**, *4*, 88, doi:10.1186/1477-7525-4-88.
337. Gualdi-Russo, E.; Rinaldo, N.; Pasini, A.; Zaccagni, L. Hand Preference and Performance in Basketball Tasks. *International Journal of Environmental Research and Public Health* **2019**, *16*, 4336, doi:10.3390/ijerph16224336.
338. Schermelleh-Engel, K.; Moosbrugger, H.; Müller, H. Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness-of-Fit Measures. *Methods of Psychological Research* **2003**, *8*, 23–74.
339. Wunsch, K.; Kienberger, K.; Niessner, C. Changes in Physical Activity Patterns Due to the Covid-19 Pandemic: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health* **2022**, *19*, 2250, doi:10.3390/ijerph19042250.
340. Hall, G.; Laddu, D.R.; Phillips, S.A.; Lavie, C.J.; Arena, R. A Tale of Two Pandemics: How Will COVID-19 and Global Trends in Physical Inactivity and Sedentary Behavior Affect One Another? *Prog Cardiovasc Dis* **2021**, *64*, 108–110, doi:10.1016/j.pcad.2020.04.005.
341. Caputo, E.L.; Reichert, F.F. Studies of Physical Activity and COVID-19 During the Pandemic: A Scoping Review. *Journal of Physical Activity and Health* **2020**, *17*, 1275–1284, doi:10.1123/jpah.2020-0406.

342. Xiong, J.; Lipsitz, O.; Nasri, F.; Lui, L.M.W.; Gill, H.; Phan, L.; Chen-Li, D.; Iacobucci, M.; Ho, R.; Majeed, A.; et al. Impact of COVID-19 Pandemic on Mental Health in the General Population: A Systematic Review. *Journal of Affective Disorders* **2020**, *277*, 55–64, doi:10.1016/j.jad.2020.08.001.
343. Zaccagni, L.; Toselli, S.; Barbieri, D. Physical Activity during COVID-19 Lockdown in Italy: A Systematic Review. *Int J Environ Res Public Health* **2021**, *18*, 6416, doi:10.3390/ijerph18126416.
344. Bakaloudi, D.R.; Barazzoni, R.; Bischoff, S.C.; Breda, J.; Wickramasinghe, K.; Chourdakis, M. Impact of the First COVID-19 Lockdown on Body Weight: A Combined Systematic Review and a Meta-Analysis. *Clinical Nutrition* **2022**, *41*, 3046–3054, doi:10.1016/j.clnu.2021.04.015.
345. Bonati, M.; Campi, R.; Segre, G. Psychological Impact of the Quarantine during the COVID-19 Pandemic on the General European Adult Population: A Systematic Review of the Evidence. *Epidemiology and Psychiatric Sciences* **2022**, *31*, e27, doi:10.1017/S2045796022000051.
346. Petrunoff, N.A.; Yi, N.X.; Dickens, B.; Sia, A.; Koo, J.; Cook, A.R.; Lin, W.H.; Ying, L.; Hsing, A.W.; van Dam, R.M.; et al. Associations of Park Access, Park Use and Physical Activity in Parks with Wellbeing in an Asian Urban Environment: A Cross-Sectional Study. *International Journal of Behavioral Nutrition and Physical Activity* **2021**, *18*, 87, doi:10.1186/s12966-021-01147-2.
347. Heckert, M.; Bristowe, A. Parks and the Pandemic: A Scoping Review of Research on Green Infrastructure Use and Health Outcomes during COVID-19. *International Journal of Environmental Research and Public Health* **2021**, *18*, 13096, doi:10.3390/ijerph182413096.
348. Stata | FAQ: Citing Stata Software, Documentation, and FAQs Available online: https://www.stata.com/support/faqs/resources/citing-software-documentation-faqs/ (accessed on 17 January 2023).
349. Cronin, C.J.; Evans, W.N. Total Shutdowns, Targeted Restrictions, or Individual Responsibility: How to Promote Social Distancing in the COVID-19 Era? *J Health Econ* **2021**, *79*, 102497, doi:10.1016/j.jhealeco.2021.102497.
350. Slater, S.J. Recommendations for Keeping Parks and Green Space Accessible for Mental and Physical Health During COVID-19 and Other Pandemics. *Prev. Chronic Dis.* **2020**, *17*, doi:10.5888/pcd17.200204.
351. The Impact of COVID-19 on Sport, Physical Activity and Well-Being and Its Effects on Social Development | DISD Available online: https://www.un.org/development/desa/dspd/2020/05/covid-19-sport/ (accessed on 17 January 2023).
352. Cooper, S.L. PROMOTING PHYSICAL ACTIVITY FOR MENTAL WELL-BEING. *ACSM's Health & Fitness Journal* **2020**, *24*, 12, doi:10.1249/FIT.0000000000000569.
353. Abreu, J.M. de; Souza, R.A. de; Viana-Meireles, L.G.; Landeira-Fernandez, J.; Filgueiras, A. Effects of Physical Activity and Exercise on Well-Being in the Context of the Covid-19 Pandemic. *PLOS ONE* **2022**, *17*, e0260465, doi:10.1371/journal.pone.0260465.
354. Khosravi, M. COVID-19 Quarantine: Two-Way Interaction between Physical Activity and Mental Health. *European Journal of Translational Myology* **2020**, *30*, doi:10.4081/ejtm.2020.9509.
355. Mutz, M.; Gerke, M. Sport and Exercise in Times of Self-Quarantine: How Germans Changed Their Behaviour at the Beginning of the Covid-19 Pandemic. *International Review for the Sociology of Sport* **2021**, *56*, 305–316, doi:10.1177/1012690220934335.
356. van Uffelen, J.G.Z.; Khan, A.; Burton, N.W. Gender Differences in Physical Activity Motivators and Context Preferences: A Population-Based Study in People in Their Sixties. *BMC Public Health* **2017**, *17*, 624, doi:10.1186/s12889-017-4540-0.
357. Waters, L.A.; Galichet, B.; Owen, N.; Eakin, E. Who Participates in Physical Activity Intervention Trials? *Journal of Physical Activity and Health* **2011**, *8*, 85–103, doi:10.1123/jpah.8.1.85.
358. Becker, R.; Glauser, D. Are Prepaid Monetary Incentives Sufficient for Reducing Panel Attrition and Optimizing the Response Rate? An Experiment in the Context of a Multi-Wave Panel with a Sequential Mixed-Mode Design. *Bulletin of Sociological Methodology/Bulletin de Méthodologie Sociologique* **2018**, *139*, 74–95, doi:10.1177/0759106318762456.
359. Grigoletto, A.; Mauro, M.; Campa, F.; Loi, A.; Zambon, M.C.; Bettocchi, M.; Nieuwenhuijsen, M.; Bragonzoni, L.; Maietta Latessa, P.; Toselli, S. Attitudes towards Green Urban Space: A Case Study of Two Italian Regions. *Int J Environ Res Public Health* **2021**, *18*, 6442, doi:10.3390/ijerph18126442.

360. Yoshida, M.; James, J.D. Customer Satisfaction With Game and Service Experiences: Antecedents and Consequences. *Journal of Sport Management* **2010**, *24*, 338–361, doi:10.1123/jsm.24.3.338.
361. Yu, H.S.; Zhang, J.J.; Kim, D.H.; Chen, K.K.; Henderson, C.; Min, S.D.; Huang, H. Service Quality, Perceived Value, Customer Satisfaction, and Behavioral Intention Among Fitness Center Members Aged 60 Years and Over. *Social Behavior and Personality: an international journal* **2014**, *42*, 757–767, doi:10.2224/sbp.2014.42.5.757.
362. Guthold, R.; Stevens, G.A.; Riley, L.M.; Bull, F.C. Global Trends in Insufficient Physical Activity among Adolescents: A Pooled Analysis of 298 Population-Based Surveys with 1·6 Million Participants. *Lancet Child Adolesc Health* **2020**, *4*, 23–35, doi:10.1016/S2352-4642(19)30323-2.
363. Kalajas-Tilga, H.; Koka, A.; Hein, V.; Tilga, H.; Raudsepp, L. Motivational Processes in Physical Education and Objectively Measured Physical Activity among Adolescents. *Journal of Sport and Health Science* **2020**, *9*, 462–471, doi:10.1016/j.jshs.2019.06.001.
364. Butt, J.; Weinberg, R.S.; Breckon, J.D.; Claytor, R.P. Adolescent Physical Activity Participation and Motivational Determinants Across Gender, Age, and Race. *Journal of Physical Activity and Health* **2011**, *8*, 1074–1083, doi:10.1123/jpah.8.8.1074.
365. André, N.; Dishman, R.K. Evidence for the Construct Validity of Self-Motivation as a Correlate of Exercise Adherence in French Older Adults. *Journal of Aging and Physical Activity* **2012**, *20*, 231–245, doi:10.1123/japa.20.2.231.
366. Penedo, F.J.; Dahn, J.R. Exercise and Well-Being: A Review of Mental and Physical Health Benefits Associated with Physical Activity. *Current Opinion in Psychiatry* **2005**, *18*, 189.
367. Marquez, D.X.; Aguiñaga, S.; Vásquez, P.M.; Conroy, D.E.; Erickson, K.I.; Hillman, C.; Stillman, C.M.; Ballard, R.M.; Sheppard, B.B.; Petruzzello, S.J.; et al. A Systematic Review of Physical Activity and Quality of Life and Well-Being. *Transl Behav Med* **2020**, *10*, 1098–1109, doi:10.1093/tbm/ibz198.
368. Larson, L.R.; Hipp, J.A. Nature-Based Pathways to Health Promotion: The Value of Parks and Greenspace. *N C Med J* **2022**, *83*, 99–102, doi:10.18043/ncm.83.2.99.
369. Roschel, H.; Artioli, G.G.; Gualano, B. Risk of Increased Physical Inactivity During COVID-19 Outbreak in Older People: A Call for Actions. *J Am Geriatr Soc* **2020**, *68*, 1126–1128, doi:10.1111/jgs.16550.
370. Anwari, N.; Tawkir Ahmed, Md.; Rakibul Islam, Md.; Hadiuzzaman, Md.; Amin, S. Exploring the Travel Behavior Changes Caused by the COVID-19 Crisis: A Case Study for a Developing Country. *Transportation Research Interdisciplinary Perspectives* **2021**, *9*, 100334, doi:10.1016/j.trip.2021.100334.
371. Yao, W.; Yu, J.; Yang, Y.; Chen, N.; Jin, S.; Hu, Y.; Bai, C. Understanding Travel Behavior Adjustment under COVID-19. *Communications in Transportation Research* **2022**, *2*, 100068, doi:10.1016/j.commtr.2022.100068.
372. Hansson, E.; Mattisson, K.; Björk, J.; Östergren, P.-O.; Jakobsson, K. Relationship between Commuting and Health Outcomes in a Cross-Sectional Population Survey in Southern Sweden. *BMC Public Health* **2011**, *11*, 834, doi:10.1186/1471-2458-11-834.
373. Mueller, N.; Rojas-Rueda, D.; Cole-Hunter, T.; de Nazelle, A.; Dons, E.; Gerike, R.; Götschi, T.; Int Panis, L.; Kahlmeier, S.; Nieuwenhuijsen, M. Health Impact Assessment of Active Transportation: A Systematic Review. *Prev Med* **2015**, *76*, 103–114, doi:10.1016/j.ypmed.2015.04.010.
374. Flint, E.; Webb, E.; Cummins, S. Change in Commute Mode and Body-Mass Index: Prospective, Longitudinal Evidence from UK Biobank. *Lancet Public Health* **2016**, *1*, e46–e55, doi:10.1016/S2468-2667(16)30006-8.
375. Avila-Palencia, I.; Int Panis, L.; Dons, E.; Gaupp-Berghausen, M.; Raser, E.; Götschi, T.; Gerike, R.; Brand, C.; de Nazelle, A.; Orjuela, J.P.; et al. The Effects of Transport Mode Use on Self-Perceived Health, Mental Health, and Social Contact Measures: A Cross-Sectional and Longitudinal Study. *Environ Int* **2018**, *120*, 199–206, doi:10.1016/j.envint.2018.08.002.
376. Avila-Palencia, I.; Nazelle, A. de; Cole-Hunter, T.; Donaire-Gonzalez, D.; Jerrett, M.; Rodriguez, D.A.; Nieuwenhuijsen, M.J. The Relationship between Bicycle Commuting and Perceived Stress: A Cross-Sectional Study. *BMJ Open* **2017**, *7*, e013542, doi:10.1136/bmjopen-2016-013542.
377. Althoff, T.; Sosič, R.; Hicks, J.L.; King, A.C.; Delp, S.L.; Leskovec, J. Large-Scale Physical Activity Data Reveal Worldwide Activity Inequality. *Nature* **2017**, *547*, 336–339, doi:10.1038/nature23018.

378. England, N. A Rapid Scoping Review of Health and Wellbeing Evidence for the Framework of Green Infrastructure Standards - NEER015 Available online: http://publications.naturalengland.org.uk/publication/4799558023643136 (accessed on 31 May 2022).
379. Barton, J.; Hine, R.; Pretty, J. The Health Benefits of Walking in Greenspaces of High Natural and Heritage Value. *Journal of Integrative Environmental Sciences* **2009**, *6*, 261–278, doi:10.1080/19438150903378425.
380. Bortolini, L.; Cividino, S.R.S.; Gubiani, R.; Cecchini, M.; Delfanti, L.M.P.; Colantoni, A. Urban Green Spaces Activities: A Preparatory Groundwork for a Safety Management System. *Journal of Safety Research* **2016**, *56*, 75–82, doi:10.1016/j.jsr.2015.12.004.
381. Body Mass Index - BMI Available online: https://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi (accessed on 31 May 2022).
382. I Quartieri Available online: http://www.comune.bologna.it/iperbole/piancont/schede/quartieri/quartieri.htm (accessed on 31 May 2022).
383. Art 49.Pdf.
384. World Health Organization *Global Health Risks : Mortality and Burden of Disease Attributable to Selected Major Risks*; World Health Organization, 2009;
385. Hemmingsson, E.; Ekelund, U. Is the Association between Physical Activity and Body Mass Index Obesity Dependent? *Int J Obes (Lond)* **2007**, *31*, 663–668, doi:10.1038/sj.ijo.0803458.
386. Hammond, M.M.; Zhang, Y.; Pathiravasan, C.H.; Lin, H.; Sardana, M.; Trinquart, L.; Benjamin, E.J.; Borrelli, B.; Manders, E.S.; Fusco, K.; et al. Relations Between BMI Trajectories and Habitual Physical Activity Measured by a Smartwatch in the Electronic Cohort of the Framingham Heart Study: Cohort Study. *JMIR Cardio* **2022**, *6*, e32348, doi:10.2196/32348.
387. Tittlbach, S.A.; Jekauc, D.; Schmidt, S.C.E.; Woll, A.; Bös, K. The Relationship between Physical Activity, Fitness, Physical Complaints and BMI in German Adults - Results of a Longitudinal Study. *Eur J Sport Sci* **2017**, *17*, 1090–1099, doi:10.1080/17461391.2017.1347963.
388. Relationship Between Sitting Time, Physical Activity, and Metabolic Syndrome Among Adults Depending on Body Mass Index (BMI) - PMC Available online: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6215384/ (accessed on 20 July 2022).
389. van den Bosch, M.; Ode Sang, Å. Urban Natural Environments as Nature-Based Solutions for Improved Public Health – A Systematic Review of Reviews. *Environmental Research* **2017**, *158*, 373–384, doi:10.1016/j.envres.2017.05.040.
390. Lee, I.; Choi, H.; Bang, K.-S.; Kim, S.; Song, M.; Lee, B. Effects of Forest Therapy on Depressive Symptoms among Adults: A Systematic Review. *Int J Environ Res Public Health* **2017**, *14*, 321, doi:10.3390/ijerph14030321.
391. Chen, X.; de Vries, S.; Assmuth, T.; Dick, J.; Hermans, T.; Hertel, O.; Jensen, A.; Jones, L.; Kabisch, S.; Lanki, T.; et al. Research Challenges for Cultural Ecosystem Services and Public Health in (Peri-)Urban Environments. *Science of The Total Environment* **2019**, *651*, 2118–2129, doi:10.1016/j.scitotenv.2018.09.030.
392. Aerts, R.; Honnay, O.; Van Nieuwenhuyse, A. Biodiversity and Human Health: Mechanisms and Evidence of the Positive Health Effects of Diversity in Nature and Green Spaces. *British Medical Bulletin* **2018**, *127*, 5–22, doi:10.1093/bmb/ldy021.
393. Barton, J.; Pretty, J. What Is the Best Dose of Nature and Green Exercise for Improving Mental Health? A Multi-Study Analysis. *Environ. Sci. Technol.* **2010**, *44*, 3947–3955, doi:10.1021/es903183r.
394. Astell-Burt, T.; Feng, X.; Kolt, G.S. Does Access to Neighbourhood Green Space Promote a Healthy Duration of Sleep? Novel Findings from a Cross-Sectional Study of 259 319 Australians. *BMJ Open* **2013**, *3*, e003094, doi:10.1136/bmjopen-2013-003094.
395. Richardson, E.A.; Pearce, J.; Mitchell, R.; Kingham, S. Role of Physical Activity in the Relationship between Urban Green Space and Health. *Public Health* **2013**, *127*, 318–324, doi:10.1016/j.puhe.2013.01.004.

396. Stathopoulos, A.; Hess, S. Revisiting Reference Point Formation, Gains–Losses Asymmetry and Non-Linear Sensitivities with an Emphasis on Attribute Specific Treatment. *Transportation Research Part A: Policy and Practice* **ortu**, *46*, 1673–1689, doi:10.1016/j.tra.2012.08.005.
397. Ortuzar, J. de D. Future Transportation: Sustainability, Complexity and Individualization of Choices. *Communications in transportation research* **2021**, *1*, e100010, doi:10.1016/j.commtr.2021.100010.
398. Tschentscher, M.; Niederseer, D.; Niebauer, J. Health Benefits of Nordic Walking: A Systematic Review. *American Journal of Preventive Medicine* **2013**, *44*, 76–84, doi:10.1016/j.amepre.2012.09.043.
399. Hartvigsen, J.; Morsø, L.; Bendix, T.; Manniche, C. Supervised and Non-Supervised Nordic Walking in the Treatment of Chronic Low Back Pain: A Single Blind Randomized Clinical Trial. *BMC Musculoskelet Disord* **2010**, *11*, 30, doi:10.1186/1471-2474-11-30.
400. Figard-Fabre, H.; Fabre, N.; Leonardi, A.; Schena, F. Physiological and Perceptual Responses to Nordic Walking in Obese Middle-Aged Women in Comparison with the Normal Walk. *Eur J Appl Physiol* **2010**, *108*, 1141–1151, doi:10.1007/s00421-009-1315-z.
401. Shim, J.; Kwon, H.; Kim, H.; Kim, B.; Jung, J. Comparison of the Effects of Walking with and without Nordic Pole on Upper Extremity and Lower Extremity Muscle Activation. *Journal of Physical Therapy Science* **2013**, *25*, 1553, doi:10.1589/jpts.25.1553.
402. Fritschi, J.O.; Brown, W.J.; Laukkanen, R.; van Uffelen, J.G.Z. The Effects of Pole Walking on Health in Adults: A Systematic Review. *Scandinavian Journal of Medicine & Science in Sports* **2012**, *22*, e70–e78, doi:10.1111/j.1600-0838.2012.01495.x.
403. Rodgers, C.D.; VanHeest, J.L.; Schachter, C.L. Energy Expenditure during Submaximal Walking with Exerstriders. *Med Sci Sports Exerc* **1995**, *27*, 607–611.
404. Langbein, W.E.; Collins, E.G.; Orebaugh, C.; Maloney, C.; Williams, K.J.; Littooy, F.N.; Edwards, L.C. Increasing Exercise Tolerance of Persons Limited by Claudication Pain Using Polestriding. *Journal of Vascular Surgery* **2002**, *35*, 887–893, doi:10.1067/mva.2002.123756.
405. Kocur, P.; Deskur-Śmielecka, E.; Wilk, M.; Dylewicz, P. Effects of Nordic Walking Training on Exercise Capacity and Fitness in Men Participating in Early, Short-Term Inpatient Cardiac Rehabilitation after an Acute Coronary Syndrome — a Controlled Trial. *Clin Rehabil* **2009**, *23*, 995–1004, doi:10.1177/0269215509337464.
406. Cardiovascular Training Effect Associated With Polestriding... : Journal of Cardiovascular Nursing Available online: https://journals.lww.com/jcnjournal/Abstract/2005/05000/Cardiovascular_Training_Effect_Associated_With.9.aspx (accessed on 2 May 2022).
407. Mannerkorpi, K.; Nordeman, L.; Cider, Å.; Jonsson, G. Does Moderate-to-High Intensity Nordic Walking Improve Functional Capacity and Pain in Fibromyalgia? A Prospective Randomized Controlled Trial. *Arthritis Res Ther* **2010**, *12*, R189, doi:10.1186/ar3159.
408. Ebersbach, G.; Ebersbach, A.; Edler, D.; Kaufhold, O.; Kusch, M.; Kupsch, A.; Wissel, J. Comparing Exercise in Parkinson's Disease—the Berlin BIG Study. *Movement Disorders* **2010**, *25*, 1902–1908, doi:10.1002/mds.23212.
409. Reuter, I.; Mehnert, S.; Leone, P.; Kaps, M.; Oechsner, M.; Engelhardt, M. Effects of a Flexibility and Relaxation Programme, Walking, and Nordic Walking on Parkinson's Disease. *J Aging Res* **2011**, *2011*, 232473, doi:10.4061/2011/232473.
410. Strömbeck, B.E.; Theander, E.; Jacobsson, L.T.H. Effects of Exercise on Aerobic Capacity and Fatigue in Women with Primary Sjögren's Syndrome. *Rheumatology* **2007**, *46*, 868–871, doi:10.1093/rheumatology/kem004.
411. Sprod, L.K.; Drum, S.N.; Bentz, A.T.; Carter, S.D.; Schneider, C.M. The Effects of Walking Poles on Shoulder Function in Breast Cancer Survivors. *Integr Cancer Ther* **2005**, *4*, 287–293, doi:10.1177/1534735405282212.
412. Breyer, M.-K.; Breyer-Kohansal, R.; Funk, G.-C.; Dornhofer, N.; Spruit, M.A.; Wouters, E.F.; Burghuber, O.C.; Hartl, S. Nordic Walking Improves Daily Physical Activities in COPD: A Randomised Controlled Trial. *Respir Res* **2010**, *11*, 112, doi:10.1186/1465-9921-11-112.
413. Kukkonen-Harjula, K.; Hiilloskorpi, H.; Mänttäri, A.; Pasanen, M.; Parkkari, J.; Suni, J.; Fogelholm, M.; Laukkanen, R. Self-Guided Brisk Walking Training with or without Poles: A Randomized-Controlled Trial

in Middle-Aged Women. *Scandinavian Journal of Medicine & Science in Sports* **2007**, *17*, 316–323, doi:10.1111/j.1600-0838.2006.00585.x.
414. Lukaski, H.C.; Vega Diaz, N.; Talluri, A.; Nescolarde, L. Classification of Hydration in Clinical Conditions: Indirect and Direct Approaches Using Bioimpedance. *Nutrients* **2019**, *11*, 809, doi:10.3390/nu11040809.
415. Campa, F.; Matias, C.; Gatterer, H.; Toselli, S.; Koury, J.C.; Andreoli, A.; Melchiorri, G.; Sardinha, L.B.; Silva, A.M. Classic Bioelectrical Impedance Vector Reference Values for Assessing Body Composition in Male and Female Athletes. *International Journal of Environmental Research and Public Health* **2019**, *16*, 5066, doi:10.3390/ijerph16245066.
416. Gatterer, H.; Schenk, K.; Burtscher, M. Assessment of Human Body Composition Methods and Limitations. In *Body Composition*; CRC Press, 2017 ISBN 978-1-351-26000-8.
417. Ackland, T.R.; Lohman, T.G.; Sundgot-Borgen, J.; Maughan, R.J.; Meyer, N.L.; Stewart, A.D.; Müller, W. Current Status of Body Composition Assessment in Sport. *Sports Med* **2012**, *42*, 227–249, doi:10.2165/11597140-000000000-00000.
418. Lukaski, H.C. Methods for the Assessment of Human Body Composition: Traditional and New. *The American Journal of Clinical Nutrition* **1987**, *46*, 537–556, doi:10.1093/ajcn/46.4.537.
419. dos Santos, L.; Ribeiro, A.S.; Gobbo, L.A.; Nunes, J.P.; Cunha, P.M.; Campa, F.; Toselli, S.; Schoenfeld, B.J.; Sardinha, L.B.; Cyrino, E.S. Effects of Resistance Training with Different Pyramid Systems on Bioimpedance Vector Patterns, Body Composition, and Cellular Health in Older Women: A Randomized Controlled Trial. *Sustainability* **2020**, *12*, 6658, doi:10.3390/su12166658.
420. Campa, F.; Toselli, S. Bioimpedance Vector Analysis of Elite, Subelite, and Low-Level Male Volleyball Players. *Int J Sports Physiol Perform* **2018**, *13*, 1250–1253, doi:10.1123/ijspp.2018-0039.
421. Chertow, G.M. Estimates of Body Composition as Intermediate Outcome Variables: Are DEXA and BIA Ready for Prime Time? *J Ren Nutr* **1999**, *9*, 138–141, doi:10.1016/s1051-2276(99)90052-3.
422. Chula de Castro, J.A.; Lima, T.R. de; Silva, D.A.S. Body Composition Estimation in Children and Adolescents by Bioelectrical Impedance Analysis: A Systematic Review. *J Bodyw Mov Ther* **2018**, *22*, 134–146, doi:10.1016/j.jbmt.2017.04.010.
423. Chen, M.; Liu, J.; Ma, Y.; Li, Y.; Gao, D.; Chen, L.; Ma, T.; Dong, Y.; Ma, J. Association between Body Fat and Elevated Blood Pressure among Children and Adolescents Aged 7-17 Years: Using Dual-Energy X-Ray Absorptiometry (DEXA) and Bioelectrical Impedance Analysis (BIA) from a Cross-Sectional Study in China. *Int J Environ Res Public Health* **2021**, *18*, 9254, doi:10.3390/ijerph18179254.
424. Newton, R.L.; Alfonso, A.; White, M.A.; York-Crowe, E.; Walden, H.; Ryan, D.; Bray, G.A.; Williamson, D. Percent Body Fat Measured by BIA and DEXA in Obese, African-American Adolescent Girls. *Int J Obes (Lond)* **2005**, *29*, 594–602, doi:10.1038/sj.ijo.0802968.
425. Marini, E.; Campa, F.; Buffa, R.; Stagi, S.; Matias, C.N.; Toselli, S.; Sardinha, L.B.; Silva, A.M. Phase Angle and Bioelectrical Impedance Vector Analysis in the Evaluation of Body Composition in Athletes. *Clinical Nutrition* **2020**, *39*, 447–454, doi:10.1016/j.clnu.2019.02.016.
426. Tomeleri, C.M.; Cavaglieri, C.R.; de Souza, M.F.; Cavalcante, E.F.; Antunes, M.; Nabbuco, H.C.G.; Venturini, D.; Barbosa, D.S.; Silva, A.M.; Cyrino, E.S. Phase Angle Is Related with Inflammatory and Oxidative Stress Biomarkers in Older Women. *Experimental Gerontology* **2018**, *102*, 12–18, doi:10.1016/j.exger.2017.11.019.
427. Ribeiro, A.S.; Avelar, A.; Santos, L. dos; Silva, A.M.; Gobbo, L.A.; Schoenfeld, B.J.; Sardinha, L.B.; Cyrino, E.S. Hypertrophy-Type Resistance Training Improves Phase Angle in Young Adult Men and Women. *Int J Sports Med* **2017**, *38*, 35–40, doi:10.1055/s-0042-102788.
428. Souza, M.F.; Tomeleri, C.M.; Ribeiro, A.S.; Schoenfeld, B.J.; Silva, A.M.; Sardinha, L.B.; Cyrino, E.S. Effect of Resistance Training on Phase Angle in Older Women: A Randomized Controlled Trial. *Scandinavian Journal of Medicine & Science in Sports* **2017**, *27*, 1308–1316, doi:10.1111/sms.12745.
429. Obesity and Overweight Available online: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight (accessed on 2 May 2022).
430. Lohman, T.; Roache, A.; Martorell, R. Anthropometric Standardization Reference Manual.; 1988.

431. Anthropometric Stand Ref Manual | PDF Available online: https://www.scribd.com/document/336334654/Anthropometric-Stand-Ref-Manual (accessed on 4 April 2022).
432. Ulijaszek, S.J.; Kerr, D.A. Anthropometric Measurement Error and the Assessment of Nutritional Status. *Br J Nutr* **1999**, *82*, 165–177, doi:10.1017/S0007114599001348.
433. Sergi, G.; De Rui, M.; Veronese, N.; Bolzetta, F.; Berton, L.; Carraro, S.; Bano, G.; Coin, A.; Manzato, E.; Perissinotto, E. Assessing Appendicular Skeletal Muscle Mass with Bioelectrical Impedance Analysis in Free-Living Caucasian Older Adults. *Clinical Nutrition* **2015**, *34*, 667–673, doi:10.1016/j.clnu.2014.07.010.
434. Sun, S.S.; Chumlea, W.C.; Heymsfield, S.B.; Lukaski, H.C.; Schoeller, D.; Friedl, K.; Kuczmarski, R.J.; Flegal, K.M.; Johnson, C.L.; Hubbard, V.S. Development of Bioelectrical Impedance Analysis Prediction Equations for Body Composition with the Use of a Multicomponent Model for Use in Epidemiologic Surveys. *The American Journal of Clinical Nutrition* **2003**, *77*, 331–340, doi:10.1093/ajcn/77.2.331.
435. Piccoli, A.; Rossi, B.; Pillon, L.; Bucciante, G. A New Method for Monitoring Body Fluid Variation by Bioimpedance Analysis: The RXc Graph. *Kidney International* **1994**, *46*, 534–539, doi:10.1038/ki.1994.305.
436. Saragat, B.; Buffa, R.; Mereu, E.; De Rui, M.; Coin, A.; Sergi, G.; Marini, E. Specific Bioelectrical Impedance Vector Reference Values for Assessing Body Composition in the Italian Elderly. *Exp Gerontol* **2014**, *50*, 52–56, doi:10.1016/j.exger.2013.11.016.
437. Marini, E.; Sergi, G.; Succa, V.; Saragat, B.; Sarti, S.; Coin, A.; Manzato, E.; Buffa, R. Efficacy of Specific Bioelectrical Impedance Vector Analysis (BIVA) for Assessing Body Composition in the Elderly. *J Nutr Health Aging* **2013**, *17*, 515–521, doi:10.1007/s12603-012-0411-7.
438. Chtourou, H.; Engel, F.A.; Fakhfakh, H.; Fakhfakh, H.; Hammouda, O.; Ammar, A.; Trabelsi, K.; Souissi, N.; Sperlich, B. Diurnal Variation of Short-Term Repetitive Maximal Performance and Psychological Variables in Elite Judo Athletes. *Front Physiol* **2018**, *9*, 1499, doi:10.3389/fphys.2018.01499.
439. Senior Fitness Test Manual - Roberta E. Rikli - C. Jessie Jones - Libro in Lingua Inglese - Human Kinetics Publishers - | IBS Available online: https://www.ibs.it/senior-fitness-test-manual-libro-inglese-roberta-e-rikli-c-jessie-jones/e/9781450411189 (accessed on 2 May 2022).
440. Nolen-Doerr, E.; Crick, K.; Saha, C.; de Groot, M.; Pillay, Y.; Shubrook, J.H.; Donley, D.; Hornsby, W.G. Six-Minute Walk Test as a Predictive Measure of Exercise Capacity in Adults with Type 2 Diabetes. *Cardiopulm Phys Ther J* **2018**, *29*, 124–129, doi:10.1097/CPT.0000000000000080.
441. Parkkari, J.; Kannus, P.; Natri, A.; Lapinleimu, I.; Palvanen, M.; Heiskanen, M.; Vuori, I.; Järvinen, M. Active Living and Injury Risk. *Int J Sports Med* **2004**, *25*, 209–216, doi:10.1055/s-2004-819935.
442. Church, T.S.; Earnest, C.P.; Morss, G.M. Field Testing of Physiological Responses Associated with Nordic Walking. *Res Q Exerc Sport* **2002**, *73*, 296–300, doi:10.1080/02701367.2002.10609023.
443. Gomeñuka, N.A.; Oliveira, H.B.; Silva, E.S.; Costa, R.R.; Kanitz, A.C.; Liedtke, G.V.; Schuch, F.B.; Peyré-Tartaruga, L.A. Effects of Nordic Walking Training on Quality of Life, Balance and Functional Mobility in Elderly: A Randomized Clinical Trial. *PLoS One* **2019**, *14*, e0211472, doi:10.1371/journal.pone.0211472.
444. Pellegrini, B.; Peyré-Tartaruga, L.A.; Zoppirolli, C.; Bortolan, L.; Bacchi, E.; Figard-Fabre, H.; Schena, F. Exploring Muscle Activation during Nordic Walking: A Comparison between Conventional and Uphill Walking. *PLoS One* **2015**, *10*, e0138906, doi:10.1371/journal.pone.0138906.
445. Takeshima, N.; Rogers, N.L.; Rogers, M.E.; Islam, M.M.; Koizumi, D.; Lee, S. Functional Fitness Gain Varies in Older Adults Depending on Exercise Mode. *Medicine & Science in Sports & Exercise* **2007**, *39*, 2036–2043, doi:10.1249/mss.0b013e31814844b7.
446. Fukuda, D.H.; Stout, J.R.; Moon, J.R.; Smith-Ryan, A.E.; Kendall, K.L.; Hoffman, J.R. Effects of Resistance Training on Classic and Specific Bioelectrical Impedance Vector Analysis in Elderly Women. *Experimental Gerontology* **2016**, *74*, 9–12, doi:10.1016/j.exger.2015.12.002.
447. Barrea, L.; Muscogiuri, G.; Laudisio, D.; Di Somma, C.; Salzano, C.; Pugliese, G.; de Alteriis, G.; Colao, A.; Savastano, S. Phase Angle: A Possible Biomarker to Quantify Inflammation in Subjects with Obesity and 25(OH)D Deficiency. *Nutrients* **2019**, *11*, 1747, doi:10.3390/nu11081747.

448. Mattioli, A.V.; Ballerini Puviani, M.; Nasi, M.; Farinetti, A. COVID-19 Pandemic: The Effects of Quarantine on Cardiovascular Risk. *Eur J Clin Nutr* **2020**, *74*, 852–855, doi:10.1038/s41430-020-0646-z.
449. Grigoletto, A.; Mauro, M.; Campa, F.; Loi, A.; Zambon, M.C.; Bettocchi, M.; Nieuwenhuijsen, M.; Bragonzoni, L.; Maietta Latessa, P.; Toselli, S. Attitudes towards Green Urban Space: A Case Study of Two Italian Regions. *Int J Environ Res Public Health* **2021**, *18*, 6442, doi:10.3390/ijerph18126442.
450. Wang, H.; Dai, X.; Wu, J.; Wu, X.; Nie, X. Influence of Urban Green Open Space on Residents' Physical Activity in China. *BMC Public Health* **2019**, *19*, 1093, doi:10.1186/s12889-019-7416-7.
451. Lukaski, H.C.; Vega Diaz, N.; Talluri, A.; Nescolarde, L. Classification of Hydration in Clinical Conditions: Indirect and Direct Approaches Using Bioimpedance. *Nutrients* **2019**, *11*, 809, doi:10.3390/nu11040809.
452. Grigoletto, A.; Mauro, M.; Oppio, A.; Greco, G.; Fischetti, F.; Cataldi, S.; Toselli, S. Effects of Nordic Walking Training on Anthropometric, Body Composition and Functional Parameters in the Middle-Aged Population. *Int J Environ Res Public Health* **2022**, *19*, 7433, doi:10.3390/ijerph19127433.
453. Westcott, W.L. Resistance Training Is Medicine: Effects of Strength Training on Health. *Curr Sports Med Rep* **2012**, *11*, 209–216, doi:10.1249/JSR.0b013e31825dabb8.
454. Fragala, M.S.; Cadore, E.L.; Dorgo, S.; Izquierdo, M.; Kraemer, W.J.; Peterson, M.D.; Ryan, E.D. Resistance Training for Older Adults: Position Statement From the National Strength and Conditioning Association. *J Strength Cond Res* **2019**, *33*, 2019–2052, doi:10.1519/JSC.0000000000003230.
455. Toselli, S.; Badicu, G.; Bragonzoni, L.; Spiga, F.; Mazzuca, P.; Campa, F. Comparison of the Effect of Different Resistance Training Frequencies on Phase Angle and Handgrip Strength in Obese Women: A Randomized Controlled Trial. *Int J Environ Res Public Health* **2020**, *17*, 1163, doi:10.3390/ijerph17041163.
456. Tomeleri, C.M.; Ribeiro, A.S.; Cavaglieri, C.R.; Deminice, R.; Schoenfeld, B.J.; Schiavoni, D.; Dos Santos, L.; de Souza, M.F.; Antunes, M.; Venturini, D.; et al. Correlations between Resistance Training-Induced Changes on Phase Angle and Biochemical Markers in Older Women. *Scand J Med Sci Sports* **2018**, *28*, 2173–2182, doi:10.1111/sms.13232.
457. Cruz-Jentoft, A.J.; Bahat, G.; Bauer, J.; Boirie, Y.; Bruyère, O.; Cederholm, T.; Cooper, C.; Landi, F.; Rolland, Y.; Sayer, A.A.; et al. Sarcopenia: Revised European Consensus on Definition and Diagnosis. *Age Ageing* **2019**, *48*, 16–31, doi:10.1093/ageing/afy169.
458. Campa, F.; Silva, A.M.; Toselli, S. Changes in Phase Angle and Handgrip Strength Induced by Suspension Training in Older Women. *Int J Sports Med* **2018**, *39*, 442–449, doi:10.1055/a-0574-3166.
459. Ribeiro, A.S.; Schoenfeld, B.J.; Dos Santos, L.; Nunes, J.P.; Tomeleri, C.M.; Cunha, P.M.; Sardinha, L.B.; Cyrino, E.S. Resistance Training Improves a Cellular Health Parameter in Obese Older Women: A Randomized Controlled Trial. *J Strength Cond Res* **2020**, *34*, 2996–3002, doi:10.1519/JSC.0000000000002773.
460. Neves, R. Seniors' Playground and Physical Activity - Perceptions and Practices.
461. Campa, F.; Schoenfeld, B.J.; Marini, E.; Stagi, S.; Mauro, M.; Toselli, S. Effects of a 12-Week Suspension versus Traditional Resistance Training Program on Body Composition, Bioimpedance Vector Patterns, and Handgrip Strength in Older Men: A Randomized Controlled Trial. *Nutrients* **2021**, *13*, 2267, doi:10.3390/nu13072267.
462. Koopman, R.; van Loon, L.J.C. Aging, Exercise, and Muscle Protein Metabolism. *Journal of Applied Physiology* **2009**, *106*, 2040–2048, doi:10.1152/japplphysiol.91551.2008.
463. Murtagh, E.M.; Murphy, M.H.; Boone-Heinonen, J. Walking – the First Steps in Cardiovascular Disease Prevention. *Curr Opin Cardiol* **2010**, *25*, 490–496, doi:10.1097/HCO.0b013e32833ce972.
464. Hanson, S.; Jones, A. Is There Evidence That Walking Groups Have Health Benefits? A Systematic Review and Meta-Analysis. *Br J Sports Med* **2015**, *49*, 710–715, doi:10.1136/bjsports-2014-094157.
465. Brady, A.O.; Straight, C.R.; Evans, E.M. Body Composition, Muscle Capacity, and Physical Function in Older Adults: An Integrated Conceptual Model. *Journal of Aging and Physical Activity* **2014**, *22*, 441–452, doi:10.1123/JAPA.2013-0009.
466. Murphy, M.H.; Nevill, A.M.; Murtagh, E.M.; Holder, R.L. The Effect of Walking on Fitness, Fatness and Resting Blood Pressure: A Meta-Analysis of Randomised, Controlled Trials. *Preventive Medicine* **2007**, *44*, 377–385, doi:10.1016/j.ypmed.2006.12.008.

467. Robertson, R.; Robertson, A.; Jepson, R.; Maxwell, M. Walking for Depression or Depressive Symptoms: A Systematic Review and Meta-Analysis. *Mental Health and Physical Activity* **2012**, *5*, 66–75, doi:10.1016/j.mhpa.2012.03.002.
468. Hamer, M.; Chida, Y. Walking and Primary Prevention: A Meta-Analysis of Prospective Cohort Studies. *British Journal of Sports Medicine* **2008**, *42*, 238–243, doi:10.1136/bjsm.2007.039974.
469. Grigoletto, A.; Mauro, M.; Maietta Latessa, P.; Iannuzzi, V.; Gori, D.; Campa, F.; Greco, G.; Toselli, S. Impact of Different Types of Physical Activity in Green Urban Space on Adult Health and Behaviors: A Systematic Review. *Eur J Investig Health Psychol Educ* **2021**, *11*, 263–275, doi:10.3390/ejihpe11010020.