

Designing health into urban green and blue infrastructures – The need for action in planning, policies, and research

International Synthesis Report



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Utrecht University | City of Eindhoven
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Executive summary

A growing body of research shows the positive effects of green open spaces on people's health and well-being. However, there is still limited knowledge among local stakeholders, urban designers, and policy makers about how to plan, develop and maintain urban green and blue infrastructures to purposefully design more health and fitness into people's lives. It is for these reasons that the focus of this report is set on the potential of the built environment to foster and promote health-related behaviour on the different socio-economic and cultural profiles of populations in European urban areas. It addresses the following research questions:

1. What is the relation between health-related behaviour (i.e. active travel, active recreational use, and social interaction) and urban open spaces (e.g. green spaces, squares, street networks, blue infrastructure)?
2. How do socio-economic and cultural profiles relate to health-related usage of open spaces?

The following results are based on a systematic literature review of academic articles published in the last ten years. In addition, expert interviews were carried out in

order to obtain insight information about the partner countries and cities.

We lay out that there is a strong and vast documented relationship between health-related behaviours, particularly for physical activity (PA), and the built environment (i.e. urban open spaces). Most studies were carried out in the United States of America, Australia and United Kingdom.

Open spaces are ideal opportunities to be active and have been proven to provide various health benefits to citizens. They may act as determinants of health and support the promotion of a health-related behaviour of city dwellers. Attributes such as quantity (e.g. amount, proximity, accessibility) and quality (e.g. cleanliness, paved roads, short routes from A to B, good state of trees and green areas) have the potential to enhance active travel, social interaction and active recreation. These attributes, both quantitative and qualitative, affect diversely health-related behaviours of the different socio-economic groups.

There is scarce information about the relationship between the different socio-economic groups, urban open spaces, and



their usage. Nevertheless, it can be stated from the literature review that women in general, adults who work in sedentary jobs (office), pensioners, and minority ethnic groups are in risk of pursuing and developing less health-related behaviours than other population groups, since they use the urban open public spaces in average less actively.

The reviewed data shows significant variation of PA levels in the partner countries. In the Netherlands, around 50% of the population exercise or practice sports few times per week, followed by Germany with 41%, while in Greece and Hungary only 24% and 23% of the population engage in sports and exercise.

The question as to where people become active varies from country to country, revealing geographical and cultural differences across Europe. While active travel is important in The Netherlands (e.g. the world famous "bicycling culture"), people are more hesitant to exercise in open spaces. German population, in contrast, engages in sports and exercise in outdoor spaces, such as parks, in large numbers, while Hungarians do the same mostly at home. In Greece, people state they engage in sports or PA mainly on the way between home and school, work or shops,

but there is almost no active travel by bike or the like. Partner countries share similarities regarding the risk of sedentary activities, such as watching TV, listening to music, using the internet, social media, and talking on the phone during the free time.

We observed that policies and practices promoting and encouraging city dwellers to pursue more health-related behaviours, as well as in open spaces as elsewhere, are increasingly being implemented in different European countries. We could not evaluate whether they are effective or not, but we perceived that in many cities there is a lack of collaboration between institutions and administrative bodies. In fact, it is striking that local groups, dispersed across organisational units, do not work together although they have similar goals. These observations do underline the need for more efforts to put the aim of "health in all policies" in practice. We conclude that in order to achieve this goal, it is imperative to develop more holistic approaches to the problem, strengthen participatory efforts, especially with disadvantaged groups, and to increase the health literacy of the population, especially regarding the untapped potential of urban green and blue spaces.



Figure 1. Pokémon Go players at the Herrengarten in Darmstadt.

Acknowledgments

The present report was produced in the framework of the ERASMUS+ project "PREHealth: Promoting education and jobs to enhance the use of urban blue and green infrastructure for health and fitness", and aims at presenting the findings of a literature review and expert interviews on the connection between health-related behaviour and the use of open spaces in European countries with a focus on the four participant countries and cities: the Cities of Athens in Greece, Darmstadt in Germany, Győr in Hungary, and the associated city of Eindhoven in the Netherlands. The findings presented provide a conceptual framework for recognizing the important role of urban green and blue infrastructure in promoting and increasing health-related behaviours, addressing policy and decision makers, educational authorities, local civil society organizations and key persons in the fields of urban design and planning, lifelong learning and public health, as well as the general public.

We express our gratitude to the various representatives of the different cities for their time and support for the study.

Glossary

Active travel

Moving to a fixed destination with the help of your own muscle power, e.g. walking, cycling or skateboarding to work.

Active recreation

Activities engaged in for the purpose of relaxation, health and well-being or enjoyment (i.e. other than work) in which physical exertion is required, e.g. sports, dancing, gardening or play.

Blue infrastructure (in urban areas)

Comprises all surface waters within a city (e.g. lakes, rivers, coastal water) (Volker & Kistemann, 2015).

Green infrastructure

An interconnected network of green space that conserves natural ecosystem values and functions, and provides associated benefits to human populations (Coutts & Hahn, 2015).

Health-related behaviour

Any activity undertaken for the purpose of improving health and wellbeing or for preventing and detecting disease, e.g. exercising regularly, eating a balanced diet, and obtaining necessary vaccinations.

PREHealth focuses on the health-related behaviours active travel, active recreation and social interaction.

Urban open space

All areas not developed by buildings. Particularly important for PREHealth are green and blue open spaces such as parks, greened road and path networks, squares, bodies of water, etc.

Physical activity

According to the World Health Organization physical activity can be “defined as any bodily movement produced by skeletal muscles that requires energy expenditure” (WHO, 2018, p.14).

Social interaction

Action and communication related to fellow human beings/groups in everyday, public and private situations (Korte & Schäfers, 2010).



Figure 2. "Bootcamp bank" in Strijp-S, Eindhoven.

1. Introduction

In 2004, the World Health Organization (WHO) identified physical inactivity as the fourth leading risk factor for global mortality, accounting for 5.5% of deaths per year. This was preceded by high blood pressure as first leading factor (12.8%), tobacco use (8.7%), and high blood glucose (5.8%). In high-income countries (grouped by gross national income per capita), such as European countries, physical inactivity is as well the fourth leading risk factor of global mortality, but has a 7.7% impact on the cause of death. In this scenario, tobacco use is first (17.9%), high blood pressure second (16.8%), and overweight and obesity third (8.4%). Physical inactivity is a main predictor for the second and the third causes of death (see Table 1).

In the last decade studies analysing the role of urban planning and its impacts on city dwellers' health and behaviour have gained traction. Both theory and practice argue in favour of a health-oriented urban planning, which must be able to offer more health benefits than downsides (see Frumkin, 2003; Frank et al., 2003). While it is clear

that urbanization does have health impacts, it is still unclear what the concrete health benefits are when dealing with urban green and blue infrastructure. This highlights the need of an evidence-based approach when it comes to decision-making about our cities' landscapes. But the relationship between the built environment and health is a very complex one, and establishing causal relationships is very difficult.

One of the impacts of modern life on our behaviour is that it demands less physical activity (PA) than it used to before. The general trend on the European Region is towards decreasing PA levels (WHO Regional Office Europe, 2015a) and nowadays minimum standards of PA are seldom reached. Thus, the focus of the PREHealth project is on analysing, augmenting, and informing about the built environment's potentials to foster and promote health-related behaviour.

Fostering health-related behaviour on individuals is needed as a strategy due to the growing concerns physical inactivity give rise to. "Much of our behaviour acts in service of

Risk factor	Deaths (millions)	Percentage of total	Risk factor	Deaths (millions)	Percentage of total
World			Low-income countries^a		
1 High blood pressure	7.5	12.8	1 Childhood underweight	2.0	7.8
2 Tobacco use	5.1	8.7	2 High blood pressure	2.0	7.5
3 High blood glucose	3.4	5.8	3 Unsafe sex	1.7	6.6
4 Physical inactivity	3.2	5.5	4 Unsafe water, sanitation, hygiene	1.6	6.1
5 Overweight and obesity	2.8	4.8	5 High blood glucose	1.3	4.9
6 High cholesterol	2.6	4.5	6 Indoor smoke from solid fuels	1.3	4.8
7 Unsafe sex	2.4	4.0	7 Tobacco use	1.0	3.9
8 Alcohol use	2.3	3.8	8 Physical inactivity	1.0	3.8
9 Childhood underweight	2.2	3.8	9 Suboptimal breastfeeding	1.0	3.7
10 Indoor smoke from solid fuels	2.0	3.3	10 High cholesterol	0.9	3.4
Middle-income countries^a			High-income countries^a		
1 High blood pressure	4.2	17.2	1 Tobacco use	1.5	17.9
2 Tobacco use	2.6	10.8	2 High blood pressure	1.4	16.8
3 Overweight and obesity	1.6	6.7	3 Overweight and obesity	0.7	8.4
4 Physical inactivity	1.6	6.6	4 Physical inactivity	0.6	7.7
5 Alcohol use	1.6	6.4	5 High blood glucose	0.6	7.0
6 High blood glucose	1.5	6.3	6 High cholesterol	0.5	5.8
7 High cholesterol	1.3	5.2	7 Low fruit and vegetable intake	0.2	2.5
8 Low fruit and vegetable intake	0.9	3.9	8 Urban outdoor air pollution	0.2	2.5
9 Indoor smoke from solid fuels	0.7	2.8	9 Alcohol use	0.1	1.6
10 Urban outdoor air pollution	0.7	2.8	10 Occupational risks	0.1	1.1

^a Countries grouped by gross national income per capita – low income (US\$ 825 or less), high income (US\$ 10 066 or more).

Table 1. Ranking of selected risks factors: 10 leading risk factor causes of death by income group, 2004 (WHO, 2009).

pursuing our goals" (Carver & Scheier, 2001); as an example, people perform physical activity with different goals in mind (to lose weight, to keep themselves fit, to have fun, to interact with others, to commute in an inexpensive way, etc.). The PREHealth project will focus on three different health-related behaviours: active travel, active recreation, and social interaction. The study at hand focuses on these behaviours carried out in urban open spaces. Particularly important for PREHealth are green and blue open spaces such as parks,

greened road and path networks, squares, bodies of water, etc.

This international synthesis report is mainly a review of recent literature and data – published between 2007 and 2017 – taking in to account different socio-economic and cultural profiles of the population. It is focused on Europe and illustrates the diversity of the four partner countries: Greece, Germany, The Netherlands, and Hungary. The report also presents conclusions of interviews with policy makers and practitioners.

2. Challenges

"Physical activity is an important contributor to human health and well-being, and the full extent of its benefit is only now becoming realized." (Bailey, Hillman, Arent, & Petitpas, 2013).

Physical inactivity is considered a major public health challenge in the developed world and is recognized as a global epidemic (Allender, Cowburn & Foster, 2006). As urbanization increases, the minimum standards of PA are hardly reached by city dwellers. In the European Region, the general trend is towards decreasing levels of PA and the current stand is negative: "It is estimated that more than 70% of adolescents do not meet the PA recommendations and that one third of adults are not sufficiently active" (WHO Regional Office Europe, 2015a, p. 2).

Some of the conditions associated to physical inactivity include obesity, hypertension, diabetes, back pain, poor joint mobility and psychosocial problems. Therefore, it is necessary to promote and achieve higher levels of physical activity among citizens. The need for action is imperative for planners, policy makers, private organizations, and civil society in general.

One of the major challenges is the population's lack of awareness regarding PA. As mentioned before, PA is widely recognized to be important for health and well-being. Still, only a small percentage of the population is aware of the minimum standards of PA and some often consider themselves wrongly as "physically active". Studies have shown that around two thirds of adult Europeans are not physically active as recommended by the World Health Organization, evidencing the need of action (Cavill, Kahlmeier & Racioppi, 2006). One example is the study by Chaudhury and Shelton (2010), which analyses data from a representative sample of older people in England and their awareness of the recommended level of, and presents that most of the population sample lack of knowledge of what constitutes sufficient PA and even have unrealistic views of their activity levels.

A healthy population suggests social and economic development, since the residents are able to form part of the human capital and actively engage in civil activities. Part of this health status can be reached by performing PA. In 2013 it was found that 42% of Europeans never exercised or played any sport and around 30% never engaged in other forms of PA such as cycling, dancing, gardening, etc. (European Commission, 2014). These figures call for attention because of the possible diseases that physical inactivity is associated with (such as cardiovascular disease, obesity, depression, high blood pressure, musculoskeletal problems, among others), and the economic costs that these diseases bear.

An unhealthy population represents a considerable economic burden for a country; it is estimated that the cost for a population of 10 million people, with 50% insufficiently physically active, is 910 million Euros per year (WHO Regional Office Europe, 2015a).

A setting (i.e. field of action), which has been associated with a large number of healthy behaviours and beneficial health effects, such as increase PA and social contacts or interactions, and people's self-reported general health and mental health, are green spaces (Nieuwenhuijsen, 2016). This is an promising setting to analyse since urban green has been accepted in urban planning as a crucial component of the cityscape, and an element that municipalities tend to upkeep and maintain, even when there are small amounts of it. According to a study conducted by Fuller and Gaston (2009) in 386 European cities, the amount of green space in developed land is on average 18.6%, ranging from 1.9% to 46%. They state that green space coverage in Europe increases more rapidly than the city area, but that a decline in green space availability per capita accelerates with increasing population density, suggesting that access to green space could decline rapidly as cities grow, increasing the geographical isolation of people from

opportunities to experience nature. This is a fact that jeopardises the accessibility to green urban open spaces, and thereby decreases its potential to encourage healthy behaviours in city dwellers with less access.

A general limitation and one of the biggest difficulties while developing this review, was the lack of research on the topic in European countries, as reflected by the small numbers of studies and statistics. Even though there is scientific research about PA and urban open spaces in some European countries, the vast majority of research on the topic has been done in USA, England and Australia. The reason for this could be that negative health outcomes were recognized earlier because of the alarming monetary pressure of public health costs in these countries. Nevertheless, we have reviewed studies mainly from the European Region, with some exceptions of USA and Australia.

A further limitation while developing this review was the difference in the data collection and processing regarding health-related behaviours (especially PA). We analysed different sources and data banks, such as the WHO, Eurostat, and national sources for each partner country, all with different methods and measurements, and therefore, with different results or outcomes, which were often even contradictory among each other. Moreover, it was difficult to compare data (e.g. levels of PA among the population) between the four partner countries.

Conclusively, the challenges identified were: the lack of PA, the lack of awareness regarding the minimum standards of PA among the population, the increase of urbanization and the pressure open spaces, and therefore green and blue infrastructures, are facing. The limitations are the lack of research regarding the topic in European countries and the inconsistency in the available data.

3. Approach

The research is carried out in two steps in order to address and link the various topics that arise when analysing the relationship between health-related behaviour, open spaces, and different socio-economic and cultural profiles. First, we introduce a broad concept of health and its variables in order to have a general vision of health and where health-related behaviours take place. Second, we target specific assets of health (PA as an enabler of well-being and a measure for health-related behaviour), its determinants (the built environment and more specifically urban open spaces), and the individual and its social relationships, different socio-economic groups, as the centre of the research. In addition, a group of experts in planning and policy making were interviewed in order to assess the most current developments and collaborations to further health-related

behaviours in urban open spaces within some European cities.

The study is based on the social and ecological framework for measuring human flourishing by Little (2010) and the model for a new health urbanism for adolescents by Knöll and Roe (2017) (Fig.3). In the adaptation for PREHealth, Knöll distinguishes between individual factors (A1 and A2) and opportunity structures such as health equity (B1) and place attributes such as walkability (B2), which pay into the population's everyday practices (C) and eventually can be measured in health and well-being outcomes (E). In their model for adolescents, Knöll and Roe advocate for a responsive urban design process featuring more participatory research and co-design formats, which interacts with the opportunity structures, seeks to better understand users'

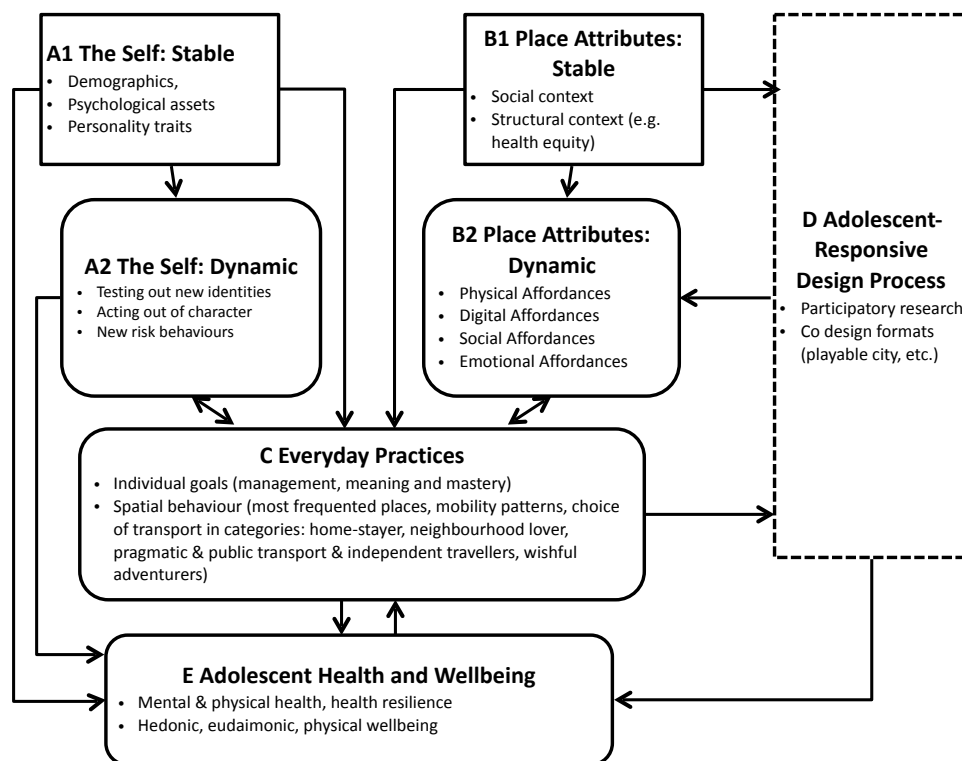


Figure 3. Shows the model of a new adolescent health urbanism by Knöll and Roe (2017), based on the social ecological framework to measure human flourishing by Little (2010). An adolescent-responsive design process (D) interacts with opportunity structures (B and B2) and peoples' everyday practices (C) and takes health outcomes and wellbeing (E) as evaluation criteria for urban design.

everyday practices, and support positive health outcomes. The PREHealth approach adapts this user-responsive framework and introduces its four main goals (D), i.e. raising awareness for health effects of urban open spaces, developing digital learning tools, implementing new formal and informal educational courses, and initiate local participatory planning processes in the four partner cities (Fig. 4).

The definitions on this review, rather than been extensive, are explanatory for this specific project. The following listing outlines the different concepts and definitions.

Health component: health-related behaviour

In this study we focus on three different health-related behaviours: active travel, active

recreation and social interaction.

The first behaviour is active travel, which can be defined as moving to a fixed destination with the help of your own muscle power for transport purposes, e.g. walking, cycling or skateboarding to work.

The second behaviour is active recreation, which is engaging in activities for the purpose of relaxation or enjoyment in which physical exertion is required. Active recreation includes activities such as sports, dancing, gardening or play, contributing to physical and mental health, and well-being.

The third behaviour is social interaction, which is beneficial to individuals' mental health. For this report we will be referring to action and communication related to fellow human beings/groups in everyday, public and private situations (Korte & Schäfers, 2010).

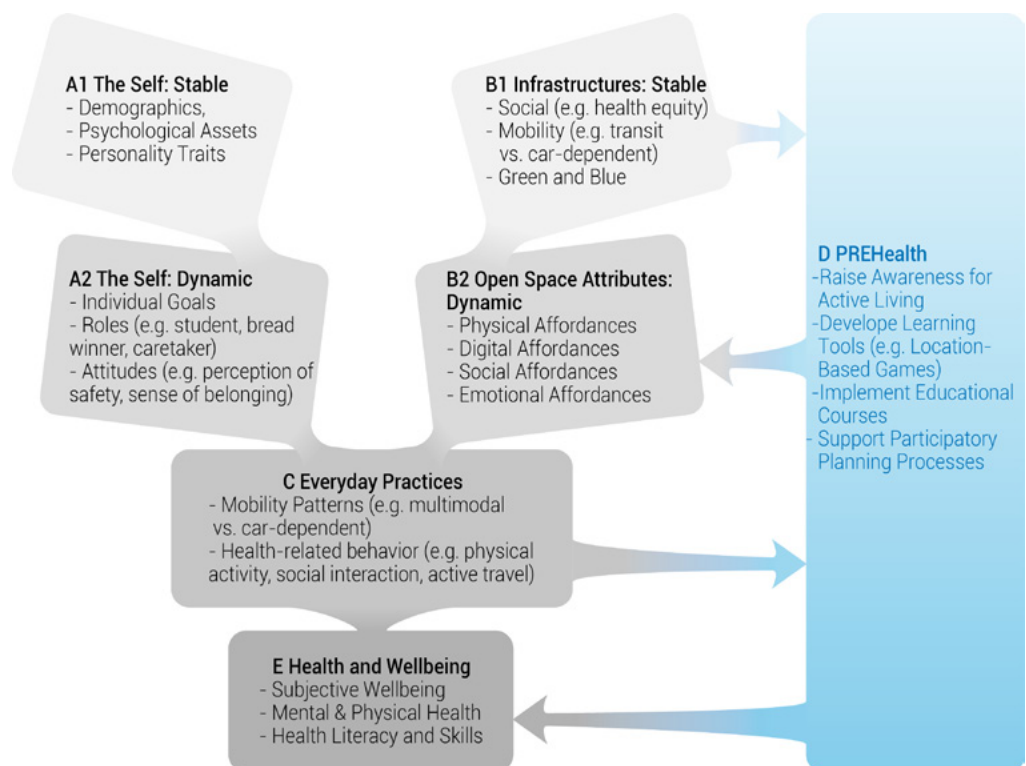


Figure 4. Introduces The PREHealth approach (D) in interaction with green and blue infrastructures (B1), Open Space Attributes (B2), health-related behaviour (C) and Health and Wellbeing (E). Adapted from Little (2010) and Knöll and Roe (2017).

The social component is of great importance, since the first two categories (active travel and active recreation) do not occur in isolation, but within a social and cultural environment. Social interaction is deeply influenced by the behaviour of others (Henderson & Bialeschki, 2005), rendering a complex relationship.

The built environment: urban open spaces, and green and blue infrastructure

The focus of this study are green and blue infrastructures in urban- publicly accessible - open spaces. A widely cited definition of *green infrastructure* is "an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations" (Benedict & McMahon, 2002, p. 12). Blue infrastructure in urban areas comprises all surface waters within a city, e.g. lakes, rivers, coastal water (Volker & Kistemann, 2015). Some of the benefits of blue infrastructure are stress

reduction, PA promoter, biodiversity promoter, among others.

According to Coutts and Hahn (2015), green infrastructures provide human populations with various *health-supporting services* which translate to benefits. These services are obtained simply by the presences of green and blue infrastructure (e.g. water, air, heat reduction), others from access to the infrastructure (e.g. physical activity), and yet others from mere exposure to the infrastructure (e.g. stress reduction).

The spaces where PA is performed plays an important role and may be key in implementing successful practices. "A meta-analysis provided some evidence of a positive benefit of a walk or run in a natural environment in comparison to a synthetic environment" (Bowler, Buyung-Ali, Knight, & Pullin, 2010, p. 456). A study carried out in the Netherlands in 2015 showed that "more



Figure 5. City of Darmstadt.



Figure 6. Early morning meditation in the Herrngarten, Darmstadt.

agricultural green was associated with less time spent on bicycling, sports and more time spent on gardening. And this was on the other direction on the urban green" (Picavet et al., 2016, pp. 7-14). As a conclusion of the Dutch study, the urban green is more effective enhancing PA (bicycling, sports and gardening) than the agricultural green.

Streets fall into the category of open space since they aren't developed by buildings. The street network is the representation of the urban system, which includes axes, intersections and nodes that conform at the same time the basis of the transportation systems in a city. Street network characteristics such as connectivity are important indicators for overall physical activity (Frank et al., 2003) and pedestrian comfort (Knöll et al., 2018). We assume that street network in combination to green and blue infrastructure are crucial to study and enhance active travel.

Seeing that green and blue urban open spaces may act as platforms to increase city dwellers' health benefits, both mentally and physically, it is crucial to define measurable

characteristics. One of the characteristics is accessibility, which doesn't seem to have a general consensus regarding the distance to or the amount of green and blue open spaces recommended in urban areas. For the PREHealth project a 500m distance to a green/blue infrastructure is considered as positive. This is a standard measure recommended by the New York City Departments of Planning, Design and Construction, and the Department of Health and Mental Hygiene (2013). Regarding the quantity, there are no general recommendations about the minimum standards of green area per capita.

The focus of this study will be the access and the active usage of these green and blue infrastructures.

The social component

As cited in McNeil, Kreuter and Subramanian (2006), although there is no definition of social environment that is universally agreed upon by social scientists, it is widely agreed upon that the social environment in which individuals live influences behaviour by "shaping norms, enforcing patterns of social control, providing or not providing environmental opportunities

to engage in particular behaviours, reducing or producing stress, and placing constraints on individual choice" (p. 1011). Thus, the socio environment can be displayed in five different dimensions according to the author: social support and social networks; socioeconomic position and income inequality; racial discrimination; social cohesion and social capital; and neighbourhood factors, which all affect directly or indirectly to health-related behaviour (McNeill et al., 2006). Therefore, it is important to pay special attention to the socio-environment (the socioeconomic position and income inequality) in order to determine potential groups on risk to be less physically active.

Research Questions

The research questions to be addressed by the project are as follow:

1. What is the relation between health-related behaviour (active travel, active recreational use, and social interaction) and urban open public spaces (green spaces, squares, street networks, blue infrastructure)?
2. How do socio-economic and cultural profiles relate to health-related usage of open public spaces?

Method

A systematic literature review of academic articles published within the previous ten years (2007-2017) was carried out. The primary database was PubMed. Google Scholar was also used to search supportive studies. The search strategy was based on the following keywords:

- Blue infrastructure, water bodies, green infrastructure, greenery, green space, public space, neighbourhood, park
- Physical activity, walkability, active travel, active commuting, active recreation, social interaction
- The countries: Germany, The Netherlands, Hungary, Greece

The search was focused on European countries; nevertheless, some studies from other countries were considered due to the lack of existing research on the region. It is important to mention that the studies considered were heterogeneous regarding characteristics such as methods, sample sizes, sample groups, type of study, and region of study. Nevertheless, the studies included were selected because of the area of study (European countries) or a specific interest on the study (valuable information which exists only for countries such as USA for example). The heterogeneity of the selected studies impedes us to give firm conclusions but rather allows us to deliver an exploratory overview on the topic.



Figure 7. Rudolf-Müller-Anlage in a warm summer day, City of Darmstadt.

4. Main findings

Health-related behaviour and urban open public spaces

There is a strong and vast documented relationship between PA and the built environment, including urban open spaces. These spaces act as a determinant for healthy human behaviours, meaning that the accessibility and characteristics of these spaces have the potential to enhance PA, active travel, social interaction and active recreation (Audrey & Batista-Ferrer, 2015; Cohen et al., 2007; Coutts & Hahn, 2015; Fraser & Lock, 2011; Hunter et al., 2015; Picavet et al., 2016; Safron, Cislak, Gaspar, & Luszczynska, 2011). These characteristics are quantitatively as well as qualitatively affecting health-related behaviours of the different socio-economic groups.

The *quantitative characteristics* of urban open public spaces can be

- the number of parks in a city
- the proximity of these spaces
- the total area of open spaces

The correlation between these quantitative characteristics of the urban open spaces and the increase of healthy behaviours are rather weak. A study conducted in Portugal (type of study: longitudinal; sample: 969 teenagers; method: questionnaires, GIS and accelerometers), which focused on young people and their leisure time in green spaces, found out that the distance to urban green spaces or to open sport spaces was not associated to changes in PA during leisure-time, and that the urban environment in the vicinity of residence did not affect changes in the practice of leisure-time PA (Da Fonseca & Ramos, 2016). In contrast, a study conducted in Denmark (Danish Health Survey; sample: 11,238 adults; methods: face to face interviews and questionnaires) found out that "Danes living more than 1 km away from the nearest green space report poorer health and health-related quality of life,

i.e. lower PA levels, than respondents living closer" (Stigsdotter et al., 2010, pp. 411-417). This shows the geographic differences and could be speculated that is attributed to urban spatial configurations of the cities. Nevertheless, the correlation between the quantitative characteristics of urban open public spaces and health outcomes (obesity, hypertension diabetes, back pain, poor joint mobility and psychosocial problems) is strong as outlined before.

The *qualitative characteristics* of urban open spaces can be understood as for example: safety, cleanliness, availability of sport areas, etc. These characteristics and an increase of healthy behaviour have a strong correlation (Audrey & Batista-Ferrer, 2015; Fraser & Lock, 2011; Hunter et al., 2015; Safron et al., 2011). For example, according to a systematic review performed on 2010 (number of studies included: 21; regions of the studies: USA, Australia, Canada, Scotland, South Africa and Spain; methods used on the studies selected: interviews and in situ observations) the qualitative characteristics of a park that enhances physical activity among citizens are the following:

- The features of a park (e.g. variety of amenities, trees, playgrounds, play equipment, barbecues, water fountains, picnic tables, bathrooms)
- The condition (e.g. cleanliness, maintenance of the surfaces, maintenance of green areas, quality of sidewalks/paths, not overfull rubbish bins, no dog faeces),
- The accessibility (e.g. proximity within walking distance, access to specific park attributes, public transport),
- Aesthetics (e.g. no graffiti and vandalism, cleanliness, no presence of wildlife, presence of trees, bushes, grass, flowers, water features, the quality of the air),

- Safety (e.g. undesirable users, lighting, heavy traffic, presence of broken glass) and
- Social environment (e.g. festivals and celebrations, social clubs, neighbourhood associations, collective activities, encourage of democratic park use, the park organization).

Therefore, is important to pay special attention not only to quantitative design aspects but also qualitative, which has been shown that have a great impact on open public spaces users (McCormack, Rock, Toohey, & Hignell, 2010).

In addition, a systematic review performed in 2015 (number of studies included: 12; region of the studies selected: US and Australia; methods of the studies selected: controlled pre-post design, natural experiments; focus group: low socio-economic and ethnic groups) focused on the impacts of interventions to promote PA in urban green spaces found out that, more than improving the qualitative assets of urban open public spaces, promotional programs should be included to obtain greater results (Hunter et.al., 2015). These promotional programs can be understood as: signage of the space (walking paths signs, banners), promotional incentives (water bottles, park branded key chains, outreach activities, hiring instructors, buying activity materials) etc. However, the authors mention that these results should be interpreted with caution due to the less amount of research on this specific topic.

Usage of the urban open space and the different socio-economic profiles

The relationship between the different socio-economic groups and the urban open spaces is variable depending on the group. For example, the intensity of the usage of the space, the activities practiced on the space or the impacts of the characteristics of the spaces on the different socio-economic groups.

Among men and women, men tend to be more physically active. In the European context, generally females are less active than men (WHO Regional Office Europe, no date a). Regarding the differences by sex of the active usage of open spaces, a study made by Cohen et al. (2007) in USA (method: direct observation of 8 parks for 1 week, 4 times per day and interviews to 713 park users and 605 residents living near the parks), found that more males were seen in parks than females (62% vs. 38%). Another study that supports these findings is Bedimo-Rung, Mowen and Cohen's (2005) study which states that females are more likely to be infrequent or nonusers of parks. Recent and European specific studies regarding users and behaviours in parks were not found, therefore, we take this study from the USA as a general reference. These facts suggest that females are a group particularly in risk of a more sedentary lifestyle.

Concerning children and young people and the usage of public spaces (parks and playgrounds) there is no evidence that the distance to open spaces increases usage. This might be because children are not completely independent in mobility and the parents need to bring them to these spaces. This is supported by a study made by Da Fonseca and Ramos (2016), which was a longitudinal study made in Portugal with young people (sample: 969 adolescents; method: self-reported questionnaires and GIS), and by Audrey and Batista-Ferrer's (2015) who realised a systematic review with studies from UK, USA, Australia, Canada, and New Zealand (33 studies; methods: experiments pre-post evaluation, observations). Nevertheless, Audrey and Batista-Ferrer (2015) state that, equipment and markings on playgrounds increase the PA and the usage of the space.

Regarding active travel and children and young people, Audrey and Batista-Ferrer (2015) found that accessible pavements and

street connectivity are considered important to facilitate active travel. Also, a systematic review made by Fraser and Lock (2011), which includes studies from UK, The Netherlands, USA, Canada, and Australia, found that for children, short distances as well as safe routes to school act as a predictor of active travel to school.

It is important to mention that research on active travel conducted in the USA, Australia, and New Zealand cannot be compared to a European context due to the differences in spatial configurations of the urban fabric, but the studies mentioned above were chosen due to the inclusion of at least one European country.

In a study conducted with German school children (sample: 460 children; methods: experiments with accelerometers and surveys), it was shown that features as residential density, intersection density, and public transit density, showed a positive effect on moderate to vigorous physical activity (MVPA), while land use mix revealed a negative effect on MVPA (Buck et al., 2015). These results highlight the contrast of the impacts that the features of the built environment have on different age groups (e.g. land use mix can affect positively PA on adults but negatively on school children).

Among adults (18 to 60 years old), a systematic review which included 74 studies from European countries, USA, Australia, and New Zealand, shows that sedentary behaviour was correlated to: retirement, professionals working in offices, working days, living in urban areas, air and noise pollution, weather and neighbourhood deprivation. Less sedentary behaviour was associated with: having children or having more dependents, having green spaces in the surroundings, increase in urban density and greater proximity (O'Donoghue, et al., 2016).

A study conducted in England of PA among adults (aged 60 to 69, most already retired) found that the barriers for performing PA according to the respondents were lack of leisure time, but the inverse was found to be the case. The retired adults (who have more leisure time) were more physically inactive and the reason to be sedentary was physical limitations. The study showed the lack of knowledge in the population of what constitutes sufficient PA (Chaudhury & Shelton, 2010). Other studies support the hypothesis that retired people are less active and use less urban open spaces although they have more leisure time (O'Donoghue et al., 2016; Cohen et al., 2007; Berger, Der, Mutrie, & Hannah, 2005). This shows that elderly and retired people are on risk of being less active.

Relating to ethnic and minority groups, a systematic review which included 44 studies from Western countries found that "In western countries[research] has shown that ethnic minorities mostly report lower levels of PA [during] leisure time and differences are particular marked among minority women" (Gerber, Barker, & Pühse, 2012, p. 314) and concludes that immigrants usually end adopting the level of PA of the host country.

Conclusively, we found that there is a strong and vast documented relationship between PA and urban open public spaces, but mainly in North America, Australia and New Zealand. These spaces act as a determinant for a health-related behaviour of human beings, meaning that characteristics such as the accessibility, quantity and quality (e.g. cleanliness, paved roads, short routes from A to B, good state of trees and green areas, etc.) of these spaces have the potential to enhance PA, active travel, social interaction and active recreation. These characteristics are quantitative as well as qualitative affecting

diversely the health-related behaviour of the different socio-economic groups. In regards of the different socio-economic groups of the population and their relationship with the urban open public spaces, the relationship varies depending of the group. The groups on risk of lacking health-related behaviours and using less actively the urban open public spaces are: women in general, adults who work in sedentary jobs (office), pensioners, and minority ethnic groups.



Figure 8. The different visitors and activities at the Herrngarten, Darmstadt.

5. Health-related behaviour per country: facts, policies, and planning

The aim of this section is to identify and compare as much as possible, facts, statistics, policies and practices regarding health and urban open spaces of the four partner countries and cities.

As a general background, the "Healthy Cities" movement is led by the WHO, comprehending nearly 100 cities in 30 countries of the European Region (WHO Regional Office Europe, no date b). Its primary goal is to position health higher on the social, economic and political agenda of city governments, and to reinforce the much-needed commitment to health and sustainable development. One of the instruments to do so is Health 2020, a comprehensive health policy framework to advance health and well-being in countries. It was adopted in 2012 by all European member states, making the partner countries beneficiaries of the framework.

The two strategic goals of Health 2020 are:

- Improving health for all and reducing health inequalities; and
- Improving leadership and participatory governance for health.

5.1. Germany: City of Darmstadt

Based on literature review and expert interviews performed, the results show that the German population is not sufficiently active. They are active mostly in open spaces and for recreational purposes. PA minimum levels are being barely reached by the German population. In 2012, only 39% of adults (44% males, 35% females) and 27.5% of children and adolescents (29% males, 25% females) reach the minimum standards of PA according to the WHO (see Table2 and 3).

German citizens tend to engage in active recreation more often than most citizens in the rest of the EU. For example, in 2013, 41% of Germans stated that they exercise or play sports with some regularity (33% for the EU) and 29% of Germans stated that they never exercise or play sports (42% for the EU) (EU Commission, 2013). In addition, 42% of the German population engage in sports and PA in open public spaces (in parks, outdoors, etc.), but most of them engage in PA or sport at home (46%) (EU Commission, 2013).

In the city of Darmstadt, the activities most performed on a daily basis and during leisure time are: watching TV or listening music, internet and communication in social

media and talking on the telephone. 43% of the citizens perform every day activities in open spaces. Moreover, with increasing age, activities in open spaces are performed more often (Wissenschaftsstadt Darmstadt, 2016). In Germany, the proportion of walking and cycling has been slightly increasing with the years. For the year 2013, 12.9% of all journeys



Figure 9. Herrengarten, City of Darmstadt.

were made by bicycle and 22.3% on foot (WHO, 2015b) but still the most common way to travel is by car (55% of the trips). In the city of Darmstadt, walking and bicycling is very common. Almost 70% of the citizens confirm that they walk or bicycle to do their daily shopping. Moreover, the usage of public transport in the city of Darmstadt is highly used by non-German nationalities and by young people (usually students), and less used by elderly (Wissenschaftsstadt Darmstadt, 2016).

Germans seem to be satisfied with their personal relationships and to participate in recreational groups or organizations. It is interesting to note that age is not a determinant to reduce the participation on recreational activities as in other countries. Older people in Germany appear to enjoy and join recreational activities as much as young people. Regarding satisfaction of life and happiness, more than 50% of the Germans state that they feel most of the time happy, 25% are sometimes happy and around 10% is rarely happy. The statistics mentioned above show merely the level of happiness and satisfaction with the social relationships, which at the same time are essential for the mental health of the human. They do not account for the quality or level of social interaction in open public spaces.

The amount of open public spaces in Germany is similar to the average in the EU countries: Germany has 12.5m² of sport and recreation areas per inhabitant, and 4.6m² of green areas per inhabitant (Umweltbundesamt, 2014). The situation of open spaces in Darmstadt is positive. Darmstadt is surrounded by a forest belt, which covers 49% of the municipal area. This makes Darmstadt one of the most wooded cities of in Germany. Playgrounds, cemeteries, garden equipment, barbecues and the edges of waters and watercourses complement the Green structure in the urban space and promote the adventure and

recreation in the city" (Wissenschaftsstadt Darmstadt, no date). The citizens confirm that they use actively and often the open public spaces and that the most important characteristics of these spaces are: maintenance and cleanliness, trees in good condition, and lawn areas to lie and play.

Regarding the social interaction in parks and green spaces of the city of Darmstadt, 15% of the citizens agree that they visit these spaces to be with other people (Wissenschaftsstadt Darmstadt, 2016).

Regarding active travel through the parks and green spaces of Darmstadt, only 25% of the respondents agree that they use these spaces as connection between two different spaces (Wissenschaftsstadt Darmstadt, 2016).

Policy and planning

Policies and practices are being implemented in Germany and in the city of Darmstadt to promote health-related behaviours among the citizens (active travel, active recreation and social interaction) and qualify urban open spaces to support these activities. One example is "Stadtumbau Ost" in Darmstadt, which is an urban renovation project that started in October 2016 and has as main goals to improve the public spaces, connect the blue and green infrastructure, upgrade the residential environment and to modernize the area.

According to expert interviews conducted with different planners working at the institutional level in the city of Darmstadt, the Landscape Plan ("Landschaftsplan der Wissenschaftsstadt Darmstadt"), in conjunction with the program 25 steps to the biological diversity in Darmstadt ("25 Schritte zur biologischen Vielfalt in Darmstadt"), help to integrate all the open spaces in the city. In addition, Darmstadt is in the process of creating the Masterplan 2030, which includes

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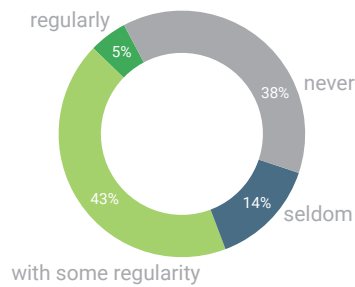
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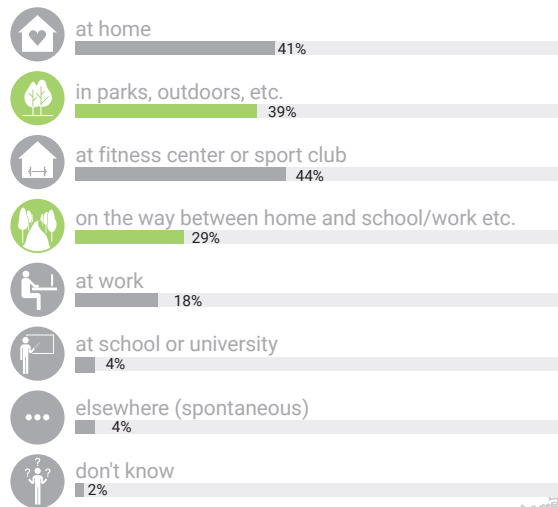
How often do you exercise or play sport?

European Commission (2017) Special Eurobarometer 472: Sport and physical activity [online].



Where do you engage in sport or physical activity?

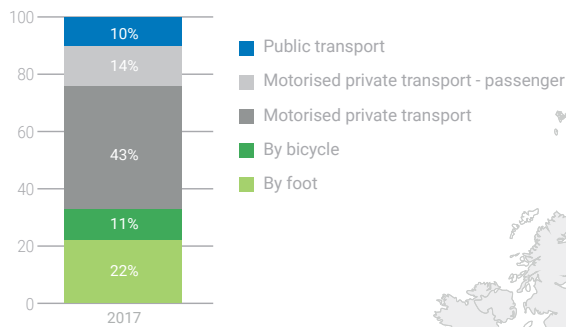
European Commission (2017) Special Eurobarometer 472: Sport and physical activity [online].



Active Travel

Modal Split (%) by total of trips

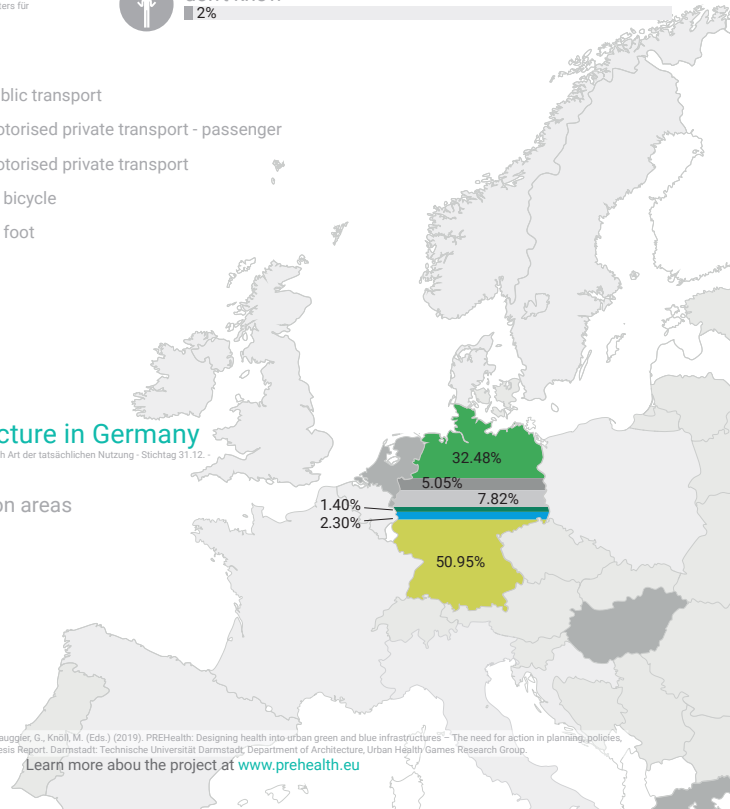
Follmer, R., und Gruschwitz, D. (2018): Mobilität in Deutschland – MID Kurzreport. Studie vom ifas, DLR, IVT und ifas 360 im Auftrag des Bundesministers für Verkehr und digitale Infrastruktur (FE-Nr. 70.904715). Bonn, Berlin.



Blue and Green Infrastructure in Germany

Statistische Ämter des Bundes und der Länder (n.d.) Bodenfläche nach Art der tatsächlichen Nutzung - Stichtag 31.12. Kreis- und kreisfr. Städte bis 2015 [online].

- Forest and other vegetation areas
- Traffic areas
- Built and free areas
- Urban recreational areas
- Water areas
- Agricultural areas



Suggested citation: In: Halblaub Miranda, M., Vasquez Fauglier, G., Knöll, M. (Eds.) (2019). PREHealth: Designing health into urban green and blue infrastructures. The need for action in planning, policies and research. International Synthesis Report. Darmstadt: Technische Universität Darmstadt, Department of Architecture, Urban Health Games Research Group.

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Figure 10. Fact sheet for Germany.

a new mobility concept foreseeing the expansion of bicycle lanes and sidewalks for pedestrians (Krehbiehl, 2017). For more in depth information about Germany and the city of Darmstadt, please see the "National Report Germany" (Vásquez Fauggier et al., 2019). This report gives an overview of the current knowledge about the relationship of health-related behaviours and the open spaces in Germany and in the city of Darmstadt. It shows that more research on the topic and more cooperation between institutions when planning is needed, e.g. to enable better pedestrian accessibility and active travel.

5.2. Hungary: City of Győr

The health condition of the Hungarian population, and the features of the physical activity (and inactivity) justify, how necessary it is to create measures, which can offer possibilities to increase the physical activity and active recreation. Based on demographic and public health data it is to be established, that the Hungarian society possesses one of the worst indicators among the OECD countries, whether we consider the life expectancy, or the number of years spent in health (Neulinger, 2007). A survey from 2014 shows, that 89% of the adult Hungarian population considers its health as satisfactory, while almost two thirds think that it is good (KSH, 2015). However, a significant part of the population is struggling with some kind of diseases. The most common chronic illnesses are high blood pressure (31%), waist and spine pain (21%), and cardiovascular diseases. Frequently diagnosed diseases are allergy (12%), as well as diabetes affecting 8% of the population. More than half of the adult population is overweight, and only every sixth is doing exercises corresponding to the WHO recommendations (Nemzeti Egészségfejlesztési Intézet - National Institute for Health Development, 2015). Although diseases do not necessarily mean

limitations in everyday life, still 9.2% of the population consider themselves heavily, while 20% moderately disabled. In the case of seniors (older than 65 years) already the self-sufficiency causes frequent problems. Half of the adults have problems with their seeing, 7-8% with their hearing, and 18-20% feel that they are restricted in their mobility (KSH, 2015). Most of the chronic diseases are obviously in connection with the unhealthy and sedentary lifestyle.

Two-third of the Hungarian population (67%) do not make any sport activities that last longer than 10 minutes a day (Nemzeti Egészségfejlesztési Intézet, 2015). Regarding the leisure activities it can be stated, that in the last three decades, the rate of the passive, motionless free time activities (like watching TV or using the computer) have significantly increased in the time use of Hungarians. The average time spent on sports or physical training is not influenced significantly by the residence, however, the rate of those, who do physical activities, is higher in bigger cities, than in other, smaller settlements. The average time spent on physical training is decreasing significantly with the passing of age. The youngsters (age 10-19) spend 2-3 times more time on sports and dynamic activities, than other age groups. Although groups with more free time (like pensioners or unemployed people) can spend more time on these activities, sport and physical training does not have much importance among the members of these groups. The higher education also goes together with a higher rate of physical activities, but the rate of physical activities is similarly high among those with the lowest education level. According to a national survey in 2015, the most popular sport is cycling. It is followed by swimming, handball, basketball, body building and football (Kovács et al., 2015).

If we take a look at active travel, it can be stated, that the pedestrian traffic is presented almost to the same extent everywhere in

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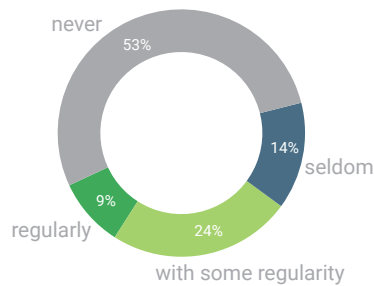
Fact Sheet for Hungary



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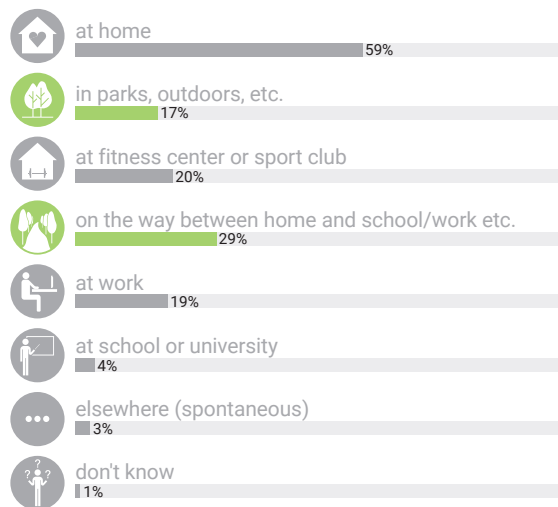
How often do you exercise or play sport?

European Commission (2017) Special Eurobarometer 472: Sport and physical activity [online].



Where do you engage in sport or physical activity?

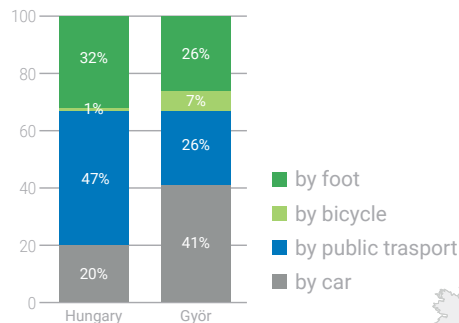
European Commission (2017) Special Eurobarometer 472: Sport and physical activity [online].



Active Travel

Modal Split (%) by total trips

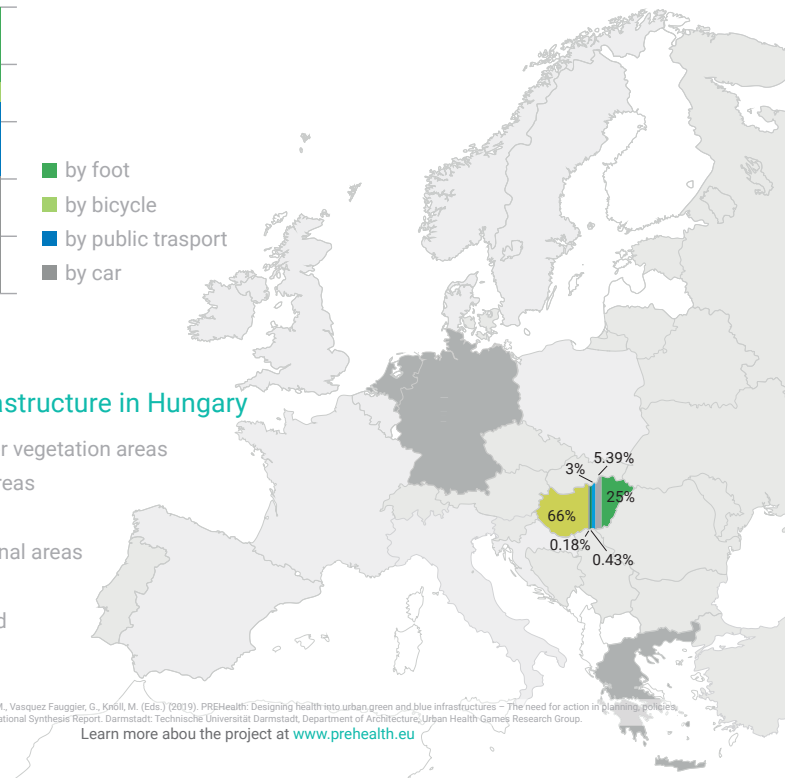
source: Endurance National Inventory for Hungary, 2011



Blue and Green Infrastructure in Hungary

source: Land Cover EEA Corine 2012

- Forest and other vegetation areas
- Built and free areas
- Water areas
- Urban recreational areas
- Traffic areas
- Agricultural land



Suggested citation: In: Halblaub Miranda, M., Vasquez Fauggier, G., Knoll, M., (Eds.) (2019). PREHealth: Designing health into urban green and blue infrastructures – The need for action in planning, policy and research. International Synthesis Report. Darmstadt: Technische Universität Darmstadt, Department of Architecture, Urban Health Games Research Group.

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Figure 11. Fact sheet for Hungary.

the country, and the average time spent on walking is around 20 minutes daily. However, in the case of cycling, only 12.5% of the Hungarians stated, that they are cycling. The smaller a settlement is, it is more likely to have bicycle-users among the local population. While in the capital city only 1.3% has stated, that they use the bicycle, this rate is 18% in smaller cities and 15.3% in other settlements.

By examining the sporting habits, it can be stated that the population is more likely to do their physical activities at home, or on their way to the workplace/school, and they do not really utilize the possibilities offered by the urban environment (like public spaces or green areas). Naturally in order to increase the rate of sports/physical activity among the Hungarian population, the awareness raising and the appropriate education is highly necessary. However, often creating the opportunity can also be a good incentive. It is important, especially in an urban environment, to develop places where people are able to spend their free time, and which can increase the time spent on sports and active recreation. It is important to emphasize, that despite the unfavourable health indicators, and the relative low proportion of sport and physical activities,

there is a growing need from the side of the Hungarian population to create a healthier lifestyle. Especially in urban environments a demand for healthier places has appeared, and there is a growing need for the elaboration of different public places and open spaces that can be used for sports and active recreation. However, in Hungary the size of high value green areas and public spaces is low and decreasing.

In the case of Győr, the territory of green areas is only counting for 1.2% of the total administrative area of the city. The size of the green area per inhabitant is 16m² in the city, and with this rate Győr is on the fourth place among the six big cities in Hungary. In the previous years, a particularly important role had been given to the quality improvement of green areas, and as a result many green areas had been renewed, and its functions had been expanded (parks, playgrounds, tree-planting programmes). Currently there are 13 public spaces and 44 km length of riverbanks in Győr, which are suitable for sport and recreation.

A survey from 2014 reveals that the health condition of the city inhabitants is better than the national average. The majority of the



Figure 12. Creating public spaces on rivers, Győr.

adult population is satisfied with its health condition (60%), or at least considers it as adequate (33%). However, the satisfaction rate diminishes with age: between 60-69 years 10%, while above 70 years 20% consider their health condition rather poor. Besides the physical health, mental health also has a great effect on life quality. According to the survey, almost half (49%) of the seniors (above 50 years) struggle with mild depression, 5.9% with moderate depression, and 1.9% with severe depression.

Majority of the population realizes the importance and prevention impacts of physical activity, although the possession of information is not equal to the implementation. 44% of the inhabitants in Győr do intense physical activity at least once per week. Regarding the weekly PA, men are in a significantly better position, however, with the increase of the age, the physical activity declines linearly. According to the education level, the graduates of secondary school are the most active, and those with primary education are the least active. On a single occasion, people spend averagely 45 minutes with physical activity, although this time is barely 30 minutes in the case of women, and almost 1 hour in the case of men.

Policy and planning

The city of Győr would like to become a "sporting city". In order to reach this, the policy makers emphasize the need to activate the inhabitants. This target is also supported by the budget of the city, by spending 1% of the total budget yearly on supporting competitive and mass sports since 2011, and many sports programmes also serve the interest of the local residents. The natural geography of the city (flat area) also contributes to the popularity of cycling. In 2011, 40 km of bike paths were available, however its length is continuously expanded. The bicycle sharing system (GyőrBike) started its operation in 2015.



Figure 13. City of Győr.

All in all, during the last decade, the decision makers of the city have taken conscious steps to connect health awareness and sports activities. Both the strategies concerning health development, as well as the sport concepts aim to further activate every segment and every age group of the population. However, increasing the green areas is not a strategic priority for the city. Problem also occurs at the suburb areas of Győr, where the highly intensive construction in residential areas are endangering the green areas of these districts. Although the city plans to stop this tendency, the growing need for new houses and residential areas undoubtedly risk this initiative. It would be worthy to put more attention on public spaces (and especially green areas) and their effects on health-related behaviour. By building and renovating the green areas and riverbanks, the urban designers can encourage the local population to the more frequent use of open spaces. Nevertheless, it can be stated that the facilities of Győr (primarily the abounding green areas and water habitats) absolutely make the city capable to develop a healthy urban environment.

For more in depth information about Hungary and the city of Győr, please see the "National Report Hungary" (Honvári, P., Jóna, L., Szörényiné Kukorelli, I. & Tóth P., 2017).

5.3. Greece: City of Athens

The main findings of the report reveal three broader issues that are interlinked and influence the current and future policy and practice in Greece, and Athens in particular, in terms of promoting public health through a better use of open spaces.

Deterioration of the health profile of the Greek population during the crisis period

The deep economic crisis in Greece since 2010 has seriously affected the health profile of the Greek population in many ways. Physical as well as mental health indicators' values have decreased (Tountas & Souliotis, 2015). The increase in mental health incidents (anxiety disorders, depression) combined with the change in the socio-economic profile of persons suffering also indicates that the economic crisis has made younger, married and employed persons more vulnerable to depression and anxiety disorders, probably due to their increased burden in terms of providing for their spouses and families. Furthermore, negative lifestyle factors directly linked to health such as smoking, malnutrition and lack of physical exercise seem to be on the rise. The acute reduction in physical exercise, together with the steep socio-economic inequalities reported (lower social and income layers suffer more from lack of physical exercise), can also be attributed in part to the crisis, revealing a worrying trend and affecting a wider range of socio-economic groups than in other European countries (Tountaset al., 2016).

Physical activity and sports trends

The physical activity and sports trends of the Greek population reveal a lack in relation to the EU average and especially countries of central and north Europe. Walking and house chores are the most popular forms of everyday physical activity among the Greek population (Valanou, Bamia, Chloptsios, Koliva, & Trichopoulou, 2006). However, although walking and house chores are indicative as

to how active is someone in his/her everyday life, in fact they do not relate to a conscious effort for promoting someone's health through physical exercise; both activities are related mainly to satisfying needs of the everyday life, like walking to go shopping and cleaning the house. The part of the Greek population that selects activities in order to promote their personal health besides personal enjoyment, (e.g. running, exercising a sport, gardening or cycling) is rather low in relation to other European countries, and has rapidly deteriorated during the last decade (European Commission, 2014). The findings related to the level of physical activity in the everyday lifestyle of the Greek population indicate that, although Greeks are relatively active in their everyday life, they seem to fall short in terms of systematic and intensive physical activity, mainly because of lack of time in the day and lack of interest or motivation.

Policy and practice

The proportion of available urban green spaces in relation to the population of Athens is particularly low. Moreover, green infrastructure in Athens faces a number of serious problems (ownership issues, illegal occupation by commercial uses, destruction and vandalism of infrastructure), placing the focus of related policy and practice on an effort to maintain the existing spaces and guarantee their green character and function. Although most green spaces in Athens include municipal sports facilities, i.e. basketball courts, volleyball courts etc., there is no explicit policy focusing on the promotion of health and physical activity in these spaces as a whole or in the framework of routes connecting green spaces of Athens. There is also lack of information reaching the city residents on opportunities available for physical activity and active recreation, using the existing infrastructure, and ways to combine different activities in order to maximize health benefits in relation to the residents' profile and needs. This is probably due to a

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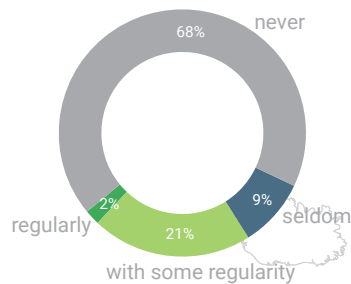
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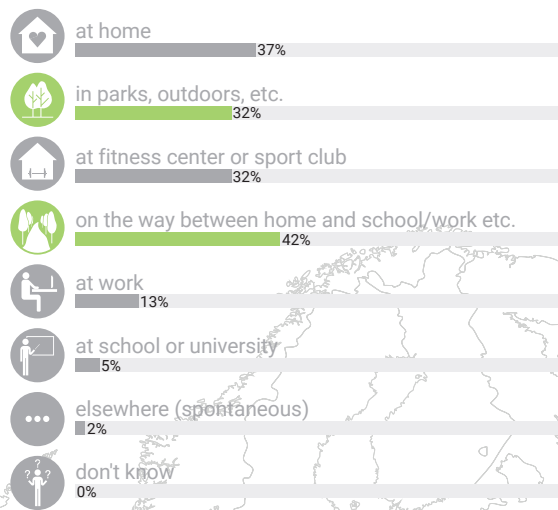
How often do you exercise or play sport?

European Commission (2017) Special Eurobarometer 472: Sport and physical activity [online].



Where do you engage in sport or physical activity?

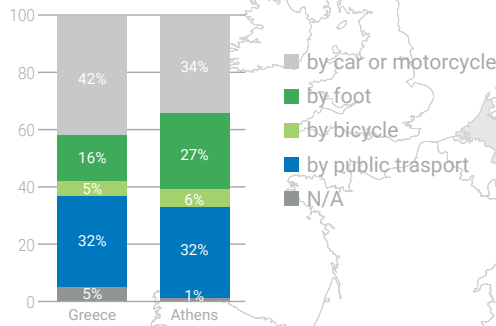
European Commission (2017) Special Eurobarometer 472: Sport and physical activity [online].



Active Travel

Modal Split (%) by total trips

* Economic Crisis, Society and Environment in Greece: A statistical analysis, 2013. Research paper performed by Public Issue for WWF Hellas, 2014.
 * Stamatou E., Paalaki M., (2013). Economic Crisis, Society and Environment in Greece. A statistical analysis. AKAKIA Publications, UK



Blue and Green Infrastructure in Greece

source: Land cover EEA Corine 2012.



Suggested citation: In: Halblaub Miranda, M., Vazquez Faugnier, G., Knöll, M. (Eds.) (2019). PREHealth: Designing health into urban green and blue infrastructures – The need for action in planning, policies, and research. International Synthesis Report. Darmstadt: Technische Universität Darmstadt, Department of Architecture, Urban Health Games Research Group.
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Figure 14. Fact sheet for Greece.

longstanding and structural problem regarding the management of open public spaces and green infrastructure: the management of the open public spaces in Athens is not the responsibility of one administrative body of the municipality, but shared between different directorates of the City of Athens, resulting in lack of coordination and most importantly in failure to promote an overall integrated policy regarding the promotion of health and physical activity in open spaces, and to create routes connecting different open spaces.

Cycling is one of the least widespread physical activities in Athens, mainly due to the lack of appropriate infrastructure (cycling lanes), due to the historical focus of the Athens transport planning policy towards car use, and the absence of sustainable mobility interventions. However, the "Athens Metropolitan Cycling Network", a proposed cycling network of 226 km connecting residential areas to green spaces and sports facilities, as well as public transport modes and other places of interest, aims at radically changing the transport model in Athens in the direction of sustainable mobility. Also, there has been a turn in policy towards introducing "green corridors" (i.e. green pedestrian and cycling routes that connect open and green spaces) in parts of Athens, aiming at encouraging active travel and offering spaces and routes for recreation and exercise. There also seems to be a turn in the municipality's policy related to sports, shifting towards a model of increased accessibility, directly reaching the city residents at neighbourhood or district level and providing information and opportunities for making use of the available facilities.

Synthesis

Taking the above issues into account, the need for formulating a policy on public health that will on the one hand inform the Greek population about the dangerous consequences of lack of physical exercise and on the other hand encourage the systematic

participation in some form of physical activity during free time, is both obvious and urgent. In this direction, and taking into consideration the various consequences of the economic crisis still affecting a great proportion of the Greek population, it is necessary to improve the existing infrastructure in order to support such a systematic engagement in physical activity and active recreation in a way that it is accessible and affordable for all age groups and socioeconomic strata. In the case of Athens, the role of the city's green spaces, as well as the planned networks of "green corridors" and cycling ways, as places offering an accessible and affordable alternative for engaging in systematic physical activity and active recreation, needs to be highlighted and supported with integrated interventions as well as information and awareness raising activities.

The orientation towards a better use of the existing and the creation of new green infrastructure that will encourage systematic physical activity and active recreation requires, in turn, changes in both the planning policy focus and the management structure. In terms of the planning policy, the focus needs to be placed in integrated interventions that also explicitly highlight this new role of the green infrastructure, besides its aesthetic, environmental and social function. With respect to the management of the city's green infrastructure, there is a need for abandoning the current management model of divided responsibilities amongst numerous municipal departments, and adopting a model that will concentrate responsibilities for promoting policies and interventions concerning the city's green infrastructure in a single management body.

For more in depth information about Greece and the city of Athens, please see the "National Report Greece" (Papageorgiou, F. & Mylonas, D., 2017).

5.4. The Netherlands: City of Eindhoven

The main findings of the report reveal several challenges and issues with regards to health status and physical activity behaviour in relation with the urban environment. In this summary, we report on the main findings in the Netherlands and the city of Eindhoven in particular. Next, we summarize the current policy and practice in Eindhoven with respect to the use of open spaces for promoting public health.

Health status in the Netherlands

In the Netherlands, perspectives on health are in transition. A new interpretation of health was launched in 2012 expressed in the concept of Positive Health. As the name suggests the concept has a positive view on health. Instead of focusing on diseases, Positive Health is about what people can do and not about what people cannot do. This

transition is also noticeable in the Dutch policy involving health.

Especially, in comparison with other European countries, the health profile of the Netherlands shows that Dutch people score above average for sports and physical excises but lower than the Scandinavian countries. However, in daily physical activities such as walking and cycling the Netherlands are by far European frontrunners. These results give the impression that the integration of physical activities in ordinary daily life is highly developed in the Netherlands. Large investments in cycling infrastructure and a long-standing tradition of cycling have developed a 'cycling culture', which over the generations has been internalized by most Dutch. This cycling culture incorporates rather unconscious cycling as the most natural and habitual way of travelling in daily life. Although,



Figure 16. Active travel in Eindhoven: from grey to green infrastructure.

in the Netherlands much less research has been done on walking, this might be also applied on walking activities in daily life. In this respect, paid work might be relevant. The lower educated people are often involved in work activities in which they have to be physical active, including walking. More focus on stimulating walking in daily life should be encouraged to further develop a 'walking culture'.

Most Dutch sports activities take place in organized settings and use dedicated sport facilities. Although, there are differences between age categories most Dutch are not used to use public space, such as parks and streets, for sports activities or physical exercises. Lack of time, financial constraints and absence of a partner interested in these physical activities are often mentioned as reasons to not participate. These arguments might be related to experienced lack of safety, absence of appropriate facilities in the residential environment or a culture, which doesn't encourage sufficiently obvious intensive sports activities in open public space. Integration and internalization of sports activities in open public space for all is still quite a challenge in the Netherlands.

Policy and practice

Eindhoven is one of the pilot-cities of the national 'Smart & Healthy City' policy program. This means that the city of Eindhoven makes use of policy and smart technologies that stimulates healthy behaviour in the city, primarily in public spaces. The policy is managed by the municipality itself and involves the increase of blue infrastructure, making parks attractive for urban sports and creating an urban environment and infrastructure that encourages healthy lifestyles and behaviour. There are also a lot of initiatives from local residents and entrepreneurs that stimulate healthy behaviour in the public space of Eindhoven. Many of these initiatives address challenges to

integrate and internalize PA in ordinary daily life. Especially, the initiatives seek to be easily integrated in activities of daily living. For example, the KWIEK exercise route that shows exercises that people can perform when they pass by for example on their way to work or to do groceries.

Need for action

The Netherlands is a highly-urbanized country, in which mechanical ways of transport, air pollution, noise, supply of unhealthy foods, alienation, and violence are factors, which can cause serious physical and mental diseases. It has been estimated that 50% of the current total disease burden in the Netherlands is due to modifiable risk factors, i.e. health-behaviours (e.g. diet, physical activity, tobacco use, and alcohol consumption) and their underlying environmental determinants. These determinants refer to physical environmental factors (like the accessibility of facilities, available infrastructure, air and water quality, green spaces, and physical disorder) and social environmental factors (like social capital, social support, bustle of people on the streets, and norms and values regarding health-related behaviours). Large inequalities between the sexes, age groups, income categories and ethnicities in these personal exposures occur.

The statistics give the impression that non-sports physical activities, such as walking, cycling and physical work activities, in the Netherlands are often integrated in daily life. The development of a cycling culture over the generations has contributed to the internalisation of cycling in most Dutch leading to a natural and habitual choice for cycling in daily life. For sports and physical exercise in open public space this is less the case. In Eindhoven, good initiatives to promote physical activity in open public spaces have been undertaken and are underway. More focus is needed on stimulating walking and making people more aware on the potential of

open public spaces for active recreation.

For more in depth information about The Netherlands and the city of Eindhoven, please see the "National Report The Netherlands" (Wilgenburg, W., Simons, M. & Dijkstra, M., 2017).

5.5. Discussion: the 4 Countries and Cities

The main findings with regards to the health status and open spaces in the four countries expose strengths, weaknesses and challenges to overcome. We found two global sources (beside the national sources) regarding active travel, active recreation and social interaction that compile information of the four countries of our interest (European Commission, 2014; WHO Regional Office, 2015b; 2015c; 2015d; 2015e). Both have gathered and interpreted data on the topic and have come out with different outcomes.

The WHO compiles information regarding PA coming from national sources with the objective to define the prevalence in percentage of population reaching the minimum standards of PA (for adults: at least 150 minutes of moderate-intensity aerobic PA weekly or at least 75 minutes of vigorous-intensity aerobic PA weekly or an equivalent combination of moderate- and vigorous-intensity activity). According to the WHO, PA is defined as any bodily movement produced by skeletal muscles that require energy expenditure. This includes all movements of the body and is not restricted to active

recreation (performing sports, cycling, etc.) only. Nevertheless, it is important to mention that due to the various sources that are considered by the WHO reports, using different data sets and translations, we found it difficult to compare the results between the four countries.

The EU Commission conducted a survey in 2013 regarding sports and PA, and the results are available on the document known as the "Special Eurobarometer 412.Sport and PA" (European Commission, 2014). In this case, the questions were the same for all countries and are conducted on a similar sample size and on the same year. Therefore, we use these surveys regarding sports and PA of the EU in order to compare the countries of our interests. This survey gives an overview of the regularity in which the population perform sports or engages in other forms of PA (walking, cycling, gardening, dancing). Here the definition of PA emphasises active recreation and probably excludes other forms of PA as active labour or housekeeping tasks. The following tables are all adapted from the Special Eurobarometer 412.

Table 2 presents the frequency with which the population engages sports or exercising. It is important to stress that almost 60% of the Greek respondents state that they never engage in exercising or sports. In this list, Hungary follows the EU average with 44%, while in Germany and The Netherlands, only 29% of respondents state that they never

	EU28	DE	EL	HU	NL
Total Sample	27,919	1,600	1,007	1,012	1,037
Almost daily	8%	7%	7%	15%	8%
A few times per week	33%	41%	24%	23%	50%
Occasionally	17%	23%	10%	18%	13%
Never	42%	29%	59%	44%	29%

Table 2. How often do you exercise or play sport? "Exercise" means any form of physical activity which you do in a sport context or sport-related setting, such as swimming, training at a fitness centre or a sports club, running in the park etc. (European Commission, 2014, p. 9).

exercise. These percentages show the scale of population groups in the four countries, who are most at risk of sedentary lifestyles and who could benefit from an active use of green spaces.

Table 3 presents the participants' engagement frequency in "other" physical activities for recreational and non-sport-related reasons. This covers broadly the three health-related behaviours active travel, active recreation and social interaction defined in PREHealth, minus sport-related activity. Again, the very high percentage of Greek participants, who never engage in, such activities, must be noted. On the opposite side of the spectrum, a vast majority (83%) of the Dutch participants state

they engage in such health-related activities almost daily or a few times a week.

Table 4 offers an insight as to the location where participants that stated to engage in some form of sport or physical activity do so. It is worth to note that Germans and Dutch engage in sports and PA in outdoor spaces such as parks or home, Hungarians mostly home and many Greek participants state they engage in sport or PA mainly on the way between home and school, work or shops. Whereas the location "on the way" (e.g. streets and paths), may point to active travel, such as walking, it is important to note that for 41% of the Greek respondents this also include exercising sports. The survey leaves

	EU28	DE	EL	HU	NL
Total Sample	27,919	1,600	1,007	1,012	1,037
Almost daily	15%	18%	8%	21%	44%
A few times a week	33%	45%	25%	30%	39%
Occasionally	22%	23%	18%	21%	11%
Never	30%	14%	49%	28%	6%

Table 3. How often do you engage in other physical activity such as cycling from one place to another, dancing, gardening, etc.? "Other physical activity" means physical activity for recreational or non-sport-related reasons. (European Commission, 2014, p. 14).

	EU28	DE	EL	HU	NL
Total sample	20,912	1,412	610	764	992
At a health or fitness center	15%	16%	20%	6%	18%
At a sports club	13%	21%	8%	5%	23%
At a sports center	8%	5%	5%	3%	10%
At school or university	5%	4%	3%	5%	6%
At work	13%	15%	10%	13%	13%
At home	36%	46%	31%	51%	35%
On the way between home and school, work or shops	25%	27%	41%	29%	29%
In a park, outdoors, etc.	40%	42%	33%	16%	37%
Elsewhere (spontaneous)	4%	2%	4%	3%	5%
Don't know	4%	2%	0%	5%	2%

Table 4. Where do you engage in sport or physical activity? (European Commission, 2014, p. 39).

open which formal and informal sports this contains, and does not clarify the specific outdoor spaces, that are used.

Adding the percentage of population that engages PA in open spaces (parks, squares) and in transit (on the way home, to school, to work) during active travel, there is a high percentage of the population who engages in sport or other forms of PA on these informal spaces (see Table 4). However, this report reveals a differentiated picture for the different countries and different kind of health-related behaviour. Whereas in The Netherlands, the “cycling culture” results in a broad percentage of the population to cycle or walk in open spaces as part of active travel, the Dutch seem to only slowly overcome their distanced relationship to active recreation in open public spaces, including physical exercises and sports. In Germany, in contrast, people do use open spaces for specific active recreation (i.e. outdoor gyms), but do less walking and cycling. Here lies the potential to promote green and blue infrastructures as scenarios and enhancers of PA, developing strategies that are specific to the culture, climate and sites in the four cities.

Regarding policies and practices on the four countries, the Netherlands seems to be

ahead of the other countries implementing programs which involve the active use of open spaces and the use of soft measures such as technology-based games, among others. In the other three countries, planners and policy makers are working and promoting health or the use of open spaces. A problem that has been named frequently in our expert interviews is the lack of cooperation of the different institutions that promote healthy behaviours and open spaces in the cities. At an institutional level, in most cities, health and open spaces are not strongly connected. Out of the four cities, only in Eindhoven has a central organ orchestrating activities and policies that promote health-related behaviours. Therefore, it is imperative to create integral institutions and programs that coordinate holistic approaches and solutions.

Finally, all four countries reported the need to further increase the health literacy of the population in order to promote health-related behaviour, to increase the active use of open green spaces (as implemented in Hungary), to increase the active travel culture (as seen in The Netherlands), and to promote more social interactions by offering activities in the open spaces.



Figure 16. Public concert in the National Gardens, Athens.



Figure 17. Art project in the open space: CLOUD from Caitlin D Brown & Wayne Garrett - GLOW 2013, Eindhoven.



Figure 18. A stroll in Goudi Park, Athens.

6. Conclusion

This report provides an overview on the state of the art in research and practice that aims to promote health-related behaviours in urban open spaces. Its goals were to identify best practices and research gaps in order to compile a first document of information and guidance for stakeholders in the PREHealth action and research project. Its results are exploratory due to a lack of available large-scale European research, which led to the compilation of information from studies with different methods, restricted sample sizes, and purposes. Therefore, it is not possible to make firm statements, but rather show tendencies and outline future research.

The relationship between health-related behaviours and urban open spaces appears to be complex due to the multiple factors that can affect health behaviours of the population. Within these complex relationships, this report highlights two established aspects found in literature:

First, there is a strong correlation between qualitative aspects of the urban open public spaces and the increase of health-related behaviours within the population. We found and gathered relevant characteristics of open space that tend to increase the population's healthy behaviours (e.g. increase of PA, active travel and social interaction). These are:

- Urban design features and infrastructure of a public space (e.g. variety of amenities, trees, playgrounds, play equipment, barbecues, water fountains, picnic tables, bathrooms),
- Condition (e.g. cleanliness, maintenance of the surfaces, maintenance of green areas, quality of sidewalks/paths, not overfull rubbish bins, no dog faeces),
- Accessibility (e.g. proximity within walking distance, access to specific park attributes, public transport),

- Aesthetics (e.g. no graffiti and vandalism, cleanliness, no presence of wildlife, presence of trees, bushes, grass, flowers, water features, the quality of the air),

- Safety (e.g. undesirable users, lighting, heavy traffic, presence of broken glass), and

- Social environment (e.g. festivals and celebrations, social clubs, neighbourhood associations, collective activities, encourage of democratic park use, the park organization).

In addition, this review finds that, more than upgrading the qualitative characteristics of the urban open spaces with the objective of promoting and enabling the increase of health-related behaviours within the population, it is important to support design and planning measures that include programs, activities, publicity, events, location-based games and other soft measures due to their strong and positive effect. Here lies the potential of the project PREHealth, which aims at promoting education and jobs to enhance the use of open spaces with participatory tools.

Secondly, there is a weak correlation between quantitative aspects of urban open public spaces and the increase of health-related behaviours within the population in Europe. The few available studies (only two), found that the distance to urban green spaces or to open sport spaces was not associated to changes in leisure-time PA, as seen for example in a study made in Portugal with focus on young people and their leisure time on green spaces; and that the urban environment in the vicinity of residence did not affect changes in the practice of leisure-time PA. Nevertheless, in the US, there is a large body of studies available that show a strong correlation between quantitative measures and the increase of health-related behaviours. This discrepancy between the regions might result from the different urban development patterns in both regions: in Europe, cities

tend to be more compact and the transport infrastructure relies less on motorised individual transport. However, this is subject to large geographical and cultural differences between European Regions.

From the review of the existing data on health-related behaviours in open spaces in each of the four partner countries, it can be stated that there is a large variation in the type and quantity of activities being carried out in urban open spaces. For example, Germans and Dutch engage in sports and PA in open spaces or at home, Hungarians mostly at home and Greek participants state they engage in a PA mainly on the way between home and school, work or shops. We also report on more wide spread active recreation in German open spaces in contrast to a more reserved attitude towards PA in Dutch and Greek open spaces, unless active travel is concerned. This shows that each country has different necessities and priorities; still for all of them it is important to promote healthy behaviours in open spaces due to the social interaction and mental health benefits that these spaces can bring to the population.

This report also identified socio-economic groups that were more at risk of not engaging in health-related behaviours. There is variance in the behaviours of socio-economic groups depending on the country and culture; therefore, the results should be interpreted as an overview of the European Region. Among men and women, men tend to use urban open spaces more frequent and intensely, and are in general more physically active. Moreover, children and young people are even less active than adults and barely reach the minimum recommendation levels of PA, which is an alarming fact for Europe. Among the elderly population, retired people are less active and use less urban open spaces although they have more leisure time. Among minority groups, ethnic minorities mostly report lower

levels of leisure time PA and differences are particularly marked among women from these groups. Therefore, it is imperative to promote healthy behaviour and the use of open spaces amongst children and young people, amongst women in general and retired elderly people.

The literature review confirmed the lack of a broader basis of empiric data on which to develop policies and planning. According to our search strategy, there are only few studies available that provide empiric data and distinguish between different health-related usages of urban open spaces and account for different socio-economic and cultural groups and different regions within Europe. More research on this topic is needed, for example: identifying which specific activities are being performed in different open spaces and by the different socio-economic groups.

In the area of practices and policies, countings and surveys suggest that commuting through green infrastructures is often preferred by cyclists and pedestrians instead of on the street next to heavy traffic, and that green features, such as street trees, can be enhancers of active travel. However, we found that municipal institutions often discourage active travel through green spaces, such as parks, due to the conflict between the different users: "passing through" and "staying". This situation reveals the need for new planning and design solutions that link green infrastructure and active travel which is able to minimize conflicts and maximize comfort for the different users. Green open spaces are under great pressure due to the increasing urbanization levels in European cities. This problematic and the conflicts mentioned above highlight the importance of both the preservation of the currently existing open spaces, and the promotion of policies that allow the creation of new green open spaces that offer opportunities to carry out a large variety of health-related behaviours among the residents.

There is a large discrepancy in the research that is available, and more studies and specifically empirical data is needed. For example, some of the information that should be gathered is: behaviours according to different socio-economic groups in open spaces in Europe or the effects of specific features of the open space that have on social interactions. Moreover, there is a large discrepancy in the data available regarding health-related behaviours between regional sources (as WHO or EU) and national or local sources. This is mainly because the studies used different data gathering methods. This proved to be a challenge for gathering, organizing and comparing data on the same topic. A systematization of the data is needed for the European Region. This report has shown several policies

and projects running in different European countries that aim to increase healthy behaviours (in open public spaces or anywhere). It was beyond the scope to evaluate whether they are functioning or not, but it was mentioned that there is need for more integrated approaches and collaboration between stakeholders, institutions and administrative bodies (e.g. planning department, policy, public health and social affairs) sharing similar goals in promoting health-related usages of open spaces. evaluate whether they are functioning or not, but it was mentioned that there is need for more integrated approaches and collaboration between stakeholders, institutions and administrative bodies (e.g. planning department, policy, public health and social affairs) sharing similar goals in promoting health-related usages of open spaces.



Figure 19. Strijp-S, Eindhoven.

7. Guidelines and recommendations for future research

As a next step in the PREHealth project, two types of surveys gathering information on users' behaviour and needs will be conducted in selected open spaces in the participating cities: face-to-face (on site) and online surveys (intellectual output 2). Ideally, this will be followed by a focus group of relevant stakeholders to discuss the results.

As a product of the present review, some guidelines and recommendations for the future implementation of research were outlined:

As a product of the present review, some guidelines and recommendations for the future implementation of research were outlined:

- It is highly recommended to do observations in situ. For the urban planning discipline especially, it is important to map urban green spaces with information such as health-related activities being carried out and the socio-economic background of users. It is also recommended to conduct long-term studies to collect valuable information about the changes and behaviours of the population during the time. This is out of the scope of this action and research project, but the aim is to develop methods and first experience in collecting this sort of data for further research

- Selection of interviewees: as stated in this review, the groups that are at higher risk of acquiring and maintaining unhealthy behaviours, and using less actively the urban open spaces are: women in general, adults who work in sedentary jobs (office), pensioners, and minority ethnic groups. Special attention should be paid to these socio-economic and cultural profiles when selecting interviewees. Nevertheless, it is important to include all groups in order to have a broad view of the open space users

- Selection of open spaces: in order to capture a broad variety of health-related behaviours and user types, the spaces to conduct the interviews should be selected according to their qualitative characteristics (safe, clean, equipped, etc.). These have been shown to have a great and positive impact on the healthy behaviour of users. However, in order to be able to study implementation strategies, it is recommended to also consider existing plans and development strategies of urban open spaces in interaction with the local stakeholders

- Green and blue: it is important to select both green and blue infrastructures due to their potential to increase healthy behaviours (PA, stress release, walkability, etc.). This will upgrade the quality of information obtained, and can be used to compare the spaces

- Stakeholders' selection: when selecting stakeholders, it is important to select, not only policy makers and planners, but also private organizations dedicated to offer PA programs/ activities on open spaces or companies who have developed and implemented LBG in open spaces. All the different stakeholders have valuable information for researchers and planners, and this information should be effectively used when creating programmes, planning events and any other activities for citizens

- In general, more research is needed on the relation between quantitative and qualitative measures of urban green and blue infrastructures and health-related behaviour in Europe.

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