INHERIT

Quantitative and Qualitative Evaluations of Impacts and Benefits of Nine INHERIT Case Studies

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1. Introduction

Preface

This report contains chapters reporting findings about impacts and benefits from nine INHERIT case studies. Each of the following chapters describes results from the quantitative/mixed method evaluations of one case study.

This introductory chapter outlines the overall aim of the INHERIT project, and its three evaluation methodologies (qualitative process evaluation, impacts and benefits, and economic evaluation). It describes how the 15 case studies for evaluation were selected, and the rationale for selecting the nine case studies for impact evaluation. Following this, the chapter provides a summary of the overall evaluation approach, drawing on INHERIT's Common Analytical Framework including the INHERIT model and the INHERIT Logic Model. These models were used to inform case specific logic models and research questions appropriate to each case study. The next section describes the development of the overarching evaluation framework for the quantitative/mixed methods impact evaluation, and the identification and selection of a set of tools for assessing physical activity, dietary behaviour and wellbeing. Short descriptions of these tools are provided along with information about additional qualitative methods. Finally, the introduction gives the outline structure of each case study chapter.

1.1 Setting the scene

INHERIT is an EU HORIZON 2020 funded project examining what kind of policies and interventions are needed to encourage and enable lifestyle and behaviour change across Europe to create a triple win: a healthier, more inclusive and environmentally sustainable future. Within the areas of living, moving and consuming, INHERIT focuses on four themes: increasing availability and access to green spaces, energy efficient housing, healthy and more sustainable diet, and active transport. All these areas are linked. Those living with low income in the most deprived areas have less access to usable green space, are less likely to take adequate levels of physical activity, more likely to live in poor quality and energy inefficient housing, less likely to afford healthy and sustainable diets, and more likely to live in areas with high levels pollution from motorised transport. Therefore, improving conditions for the least and less advantaged in society is important to create societies that are more equitable.

To this end, INHERIT identified 15 promising interventions for further study (INHERIT case studies) in the areas of living, moving or consuming. This report is one of three evaluation reports that evaluate INHERIT case studies from three different perspectives, all of which provide important evidence for policy and practice. The selected case studies for evaluation are listed in Table 1.

The overall evaluation was led by UCL, with RIVM taking the lead on evaluating intersectoral cooperation within the process of the interventions, UCL taking the lead on developing the quantitative/mixed method evaluation framework to evaluate impacts and benefits, and BC3 leading the economic analysis.

The reasons for conducting these three types of evaluations are threefold.

First, we are interested in the implementation process and learning about how different sectors work together. These are documented in the INHERIT Implementation Report (Anthun *et al.,* 2019) and the INHERIT report 'Success Factors, Barriers and Future of Intersectoral Cooperation: A Qualitative Evaluation of Twelve INHERIT Case Studies' (Report D5.1) respectively. From these studies we want to learn lessons about how to develop and implement policies and interventions for a triple win. In addition,

understanding the implementation process can support interpretation of the findings from quantitative/mixed methods evaluations. For the process evaluation, INHERIT partners in twelve INHERIT case studies held focus groups with representatives of the diverse stakeholders involved in the implementation process to tease out how to move from a good idea to successful implementation of a policy or intervention with potential to create a triple win.

Second, we want to know the potential impacts of INHERIT case study policies and interventions for health, equity and a more sustainable environment. For this, we are using a mixed method approach with quantitative methods augmented in some cases by written responses to survey questions, or by focus group discussions on impacts, as appropriate. This report (INHERIT Report D5.2) documents findings relevant to potential impacts and benefits of nine INHERIT case studies using quantitative and mixed (quantitative and qualitative) methods.

Third, we want to know about the costs and benefits of selected case studies. The INHERIT report 'Cost-Benefit Analysis of Four INHERIT Case Studies' (Report D5.3) documents economic evaluation results of four INHERIT case studies.

In further work, we synthesized key lessons learned from all 15 INHERIT case studies (Bell, *et al*., 2019a) An INHERIT project report, Report D5.4 (Bell *et al*., 2019b) synthesises evidence from all the evaluations to bring together learning from the cases studies.

Selection of case studies for evaluation

Case studies for evaluation were drawn from the INHERIT database of around 100 'promising practices' - real world interventions that involve intersectoral cooperation and have potential to create a triple win for health, the environment and equity.

INHERIT partners selected 15 of the promising practices reported in the database for evaluation, based on 12 agreed criteria, described in the INHERIT Implementation Report (Anthun *et al*., 2019).

INHERIT partners identified, designed and evaluated four types of cases, shown below:

Type of case study	**Definition of the type**
A	Adding a new element to a promising practice that contributes to the triple win (improving health, health equity and the environment) (e.g. a participatory process to include groups from diverse backgrounds).
B	Adding an element or elements from one promising practice to another promising practice.
C	Evaluating an aspect that has not been evaluated before for that promising practice (e.g. wellbeing, environmental improvements, impacts on groups from diverse backgrounds, cost benefit analysis.
D	Implementing an existing intervention in a new context.

Selection of case studies for impact evaluation

The following criteria were agreed by the INHERIT consortium to identify whether or not a promising practice intervention was suitable for further quantitative or mixed method evaluation of impacts and benefits within the INHERIT project (see Box 1).

Box 1: Criteria for selection of pilot studies for evaluation of impacts and benefits

1. Suitability for employment of quantitative methods to answer the research questions
2. Suitability for analysis to evaluate the impact on health, environment and equity
3. Availability of baseline quantitative data
4. Availability of a comparison/control group
5. Size of target population, large enough for quantitative analysis
6. Area of the pilot: at least one pilot study from each area of living, consuming and moving
7. Capacity/resources available for collection and analysis of data
8. Willingness of the partners (INHERIT partners and implementing partners)
9. Scalability/transferability

Table 1 (below) summarises the INHERIT case studies and gives information about the type of case study (A, B, C or D as indicated above) and the kind of evaluation used for each one (qualitative evaluation of intersectoral collaboration, quantitative/ qualitative evaluation of impacts and benefits, and economic evaluation). Nine case studies were evaluated for impacts and benefits (shaded in Table 1) and the analytical tools used for each of these nine case studies are summarised in Table 3. Each chapter in this report focuses on one of the nine case studies evaluated for impacts using quantitative or mixed methods.

Table 1: INHERIT Case studies and evaluation type

Name	Location	Nature of intervention	Type of pilot study	Qualitative/ Intersectoral cooperation	Quantitative/mixed methods Impacts	Cost benefit analysis
GREEN SPACE						
Malvik Path	Norway	Implementation of a recreational path connecting two communities	C	X	Mixed methods Population survey' Observation of use and activity level in two seasons, Structured onsite interviews, short on-site survey and digital counter	✓
Restructuring Residential Outdoor Areas	Sweden	Regeneration of and improved access to an open space	A	✓	Case control/pre-post Household survey and Observation of use and activity level	X
Thinking Fadura	Spain	Improved access to an open space	A	X	Observation of use and activity level	✓
Restructuring Green Space	Netherlands	Restructuring of and improved access to an open space	C	✓	Observation of use and activity level in two seasons	X
GREEN SPACE AND CONSUMING (HEALTHY EATING)						
Gardening with Green Gym and Meat Free Monday	UK	Gardening activities with children in a primary school and promotion of a meat free day/week	B	✓	Mixed methods Accelerometers, questionnaire survey, children's drawings, focus groups with children, structured questionnaire with teachers and instructors, participant observation	X
SUSTAINABLE PRODUCTION AND CONSUMPTION (HEALTHY EATING)						
PROVE	Portugal	Sustainable farming practices creating closer links among producers and consumers	C	✓	Quasi-experiment, pre-post study design with mixed methods Farmers and consumer studies INHERIT five country survey, consumers questionnaire, European Social Survey, farmers questionnaire, focus groups impact questions (farmers and consumers)	X
Ghent en garde	Belgium	Local food initiatives	C	✓	X	X

Name	Location	Nature of intervention	Type of pilot study	Qualitative/ Intersectoral cooperation	Quantitative/mixed methods Impacts	Cost benefit analysis
The Food Garden (De Voedseltuin)	Netherlands	An urban community gardening initiative	C	✓	X	X
GemüseAckerdemie (Vegetable Academy)	Germany	Increasing volunteers to support vegetable academy programs for school aged children to connect with nature and origins of food	A	✓	X	X
Sustainable food in nursery schools	Spain	Introducing sustainable foods at local nurseries	C	✓	X	✓
LIVING						
Lifestyle e-coaching	Netherlands and Greece	A life style change application	A	x	Randomised control pre-post study design, questionnaire survey	X
Place Standard	Latvia and Macedonia	Implementation of Place Standard Tool: a framework to structure conversations about place and community	D	✓	X	X
MOVING						
UrbanCyclers	Czech Republic	Biking intervention using UrbanCyclers app	A	✓	Randomised control study pre-post design questionnaire survey, data from mobile app	X
ENERGY EFFICIENT HOUSING						
Eco Inclusion	Germany	Capacity building and awareness program on energy efficiency in housing	A	✓	Cross sectional survey of knowledge transfer	X
Retrospective Analysis of Energy Efficiency Investments	UK	Energy efficiency investments including Double-glazing, insulation and improved heating systems	C	x	X	✓

1.2 Evaluation approaches

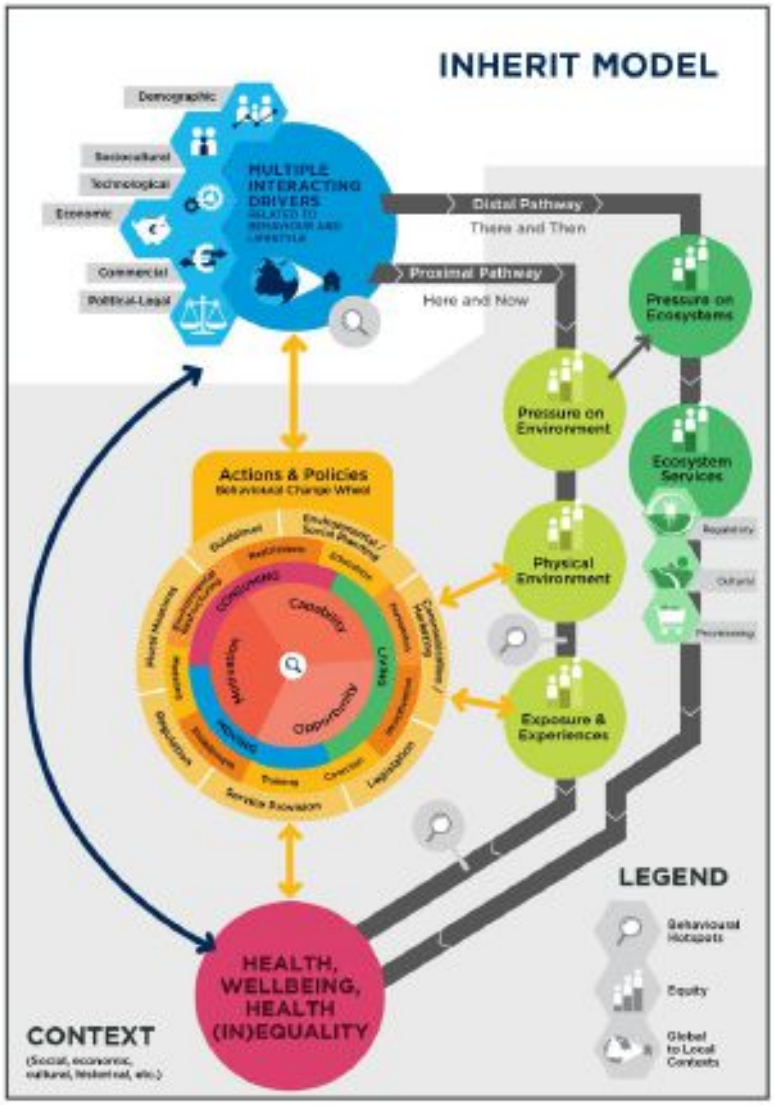
The foundation of INHERIT's approach to evaluations is that they should be theory driven, and evaluate aspects identified through examining pathways to behaviour changes that the INHERIT project set out to study and advocate. Therefore we based the evaluation framework on the Common Analytical Framework

(CAF) (van der Vliet *et al.*, 2018), which includes the INHERIT Model (Figure 1) and the logic model (Figure 2). A description of the INHERIT model can be found at https://inherit.eu/project/caf/.

INHERIT's approach to evaluation recognises the complexity of the real world in which multiple factors, many of which cannot necessarily be predicted or controlled, influence outcomes (Rutter *et al.*, 2017). Therefore, INHERIT used mixed methodologies to evaluate the process of implementation, intersectoral cooperation, benefits and impacts, and to conduct economic evaluations of selected case studies. However, it was not possible to apply each of these types of evaluation to every case study.

Given the complexities involved in measuring health outcomes, particularly given the short amount of time to implement/evaluate the INHERIT interventions, we did not expect to see measurable changes in health outcomes. Therefore, the focus of the evaluations was on short term and intermediate outcomes described in Figure 2. Evaluations in some cases examined how interventions might influence people's capabilities, the opportunities and people's motivation to change behaviours. Most evaluations assessed health related behaviours (physical activity or aspects of healthy eating). Some cases studies assessed well-being or life satisfaction.

Figure 1. INHERIT model



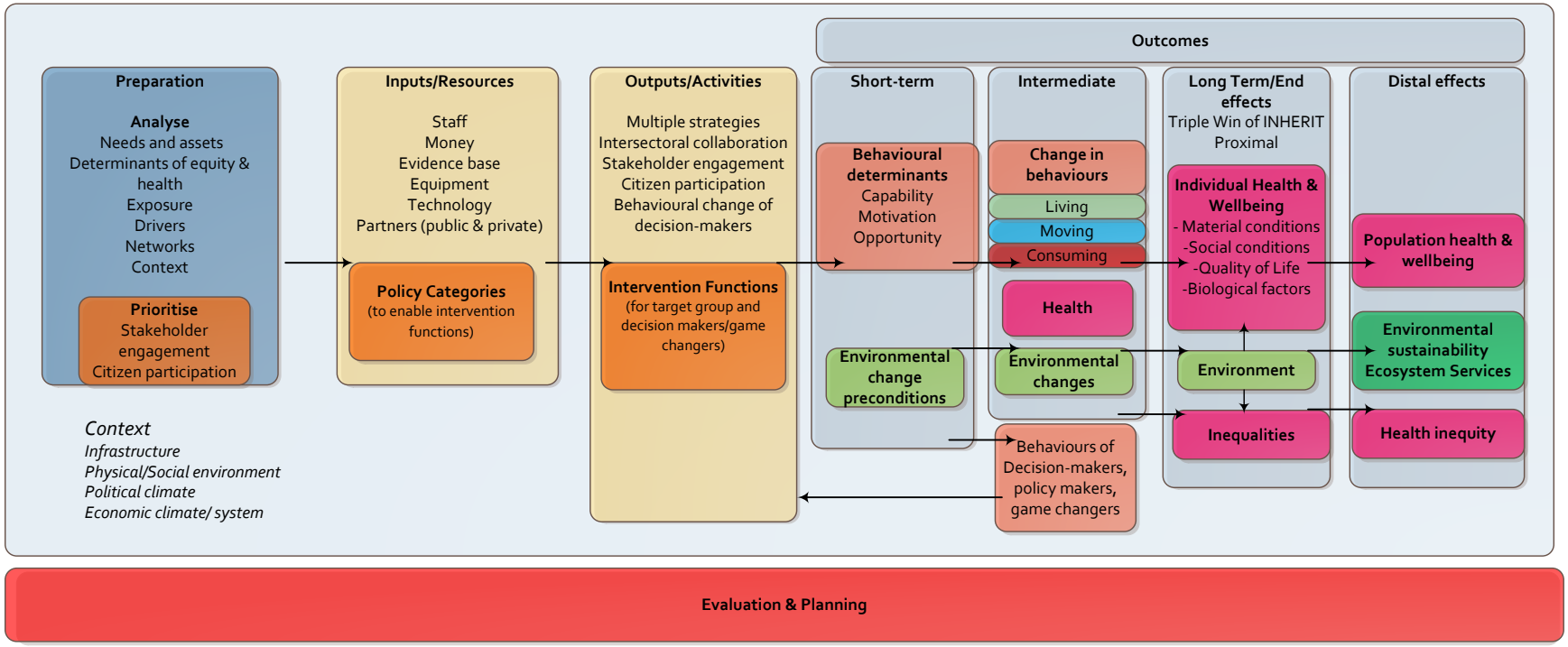
Similarly, while it was not possible within the scope of the INHERIT project to evaluate the effects of the interventions on environmental sustainability, we maintained a focus on environmental sustainability in three ways. First, we were able to assess pro-environmental behaviour as an outcome in some case studies that used qualitative impact evaluations. Second, some case studies involve improvements to the natural environment that directly contribute to environmental conservation. Third, INHERIT partners considered aspects of environmental sustainability during selection of the pilot studies. For example, the UrbanCyclers case study promotes active transport; using a low-energy transport to commute can reduce the carbon footprint and reduce air and noise pollution - having a significant impact on the urban environment.

As with health, it was not generally possible within the scope of this study to investigate differences in health-related impacts across social

groups. INHERIT partners took different approaches. Lifestyle e-coaching examined effectiveness of a lifestyle e-coaching application among a group of people living in poor socioeconomic circumstances. Some case studies already had social inclusion built into their design by engaging diverse groups in the planning and design of interventions. Many case studies were on interventions implemented in areas of relative deprivation, so it could be deduced that they could potentially have an impact on health inequalities depending on the effectiveness, scale and intensity of any future implementation. Logical inferences could be made on the basis of existing evidence in relation to health inequalities. In relation to the case studies around green space, for example, there is much evidence to show that deprived areas typically have less attractive or usable green spaces than more advantaged areas (Astell-Burt *et al.*, 2014), and that certain social groups are less likely to use open or green spaces. We also know from existing evidence that use of green space has health and social benefits – such as mental wellbeing and opportunities for physical activity and social activities (Roe *et al.*, 2013; Wolfe *et al.*, 2014; Sugiyama *et al.*, 2018; Khan and McGeown, 2019). So, the logic behind improving green space in deprived areas (as in the Breda case study in the Netherlands) or improving access to green space (as in Malvik path in Norway, and Thinking Fadura in Spain), is that the benefits to health of green space will be better distributed in society. Hence, we would ultimately expect to see that creating more usable green space and broadening accessibility of green space would contribute to improvements in health and reduction health inequities over the longer term. However, this should be viewed from the perspective that multiple social, economic, environmental and political factors determine population health and the distribution of health, and that a holistic approach to reducing health inequalities and improving population health is necessary. In the short term, in the current evaluations, we are looking at how access to open or green spaces improves, and how the green space is used for physical activity or social activity with a view to identifying what further changes could be made to encourage inclusive use of green space.

INHERIT partners used the generic INHERIT Logic Model (Figure 2) to develop specific logic models for each of the cases studies. In addition, for each case study, specific research questions were identified that are related to the overall INHERIT aims.

Figure 2: INHERIT Generic Logic Model



Source: van der Vliet et al, 2018

INHERIT partners formulated the research design appropriate to their case studies and the associated research questions identified within the framework of INHERIT. Two of the case studies were designed as Randomised Control Studies (UrbanCyclers and Lifestyle e-coaching). One (Gardening with Green Gym and Meat Free Monday) was a quasi-experiment with embedded qualitative methods that investigated the impact of an innovative pilot intervention within a primary school with two parallel classes enabling a case control methodology and pre and post intervention comparisons. In the case of Eco Inclusion, another innovative pilot intervention, no comparison group or before/after assessments were possible, and a simpler post-intervention knowledge assessment was the pragmatic approach. PROVE and interventions to improve green or open spaces are forms of 'natural experiment' that is, the groups studied are exposed to changes effected by real-life policies or actions already taking place, rather than being randomly assigned to control or intervention groups. In the case of PROVE, healthy eating among the PROVE consumers was compared with Portuguese data from the INHERIT five country survey.

Evaluation framework

UCL developed an evaluation framework to suit the range of case studies examined for impacts and benefits, the case specific logic models developed, and the research questions identified.

To do this the UCL team identified validated tools from research literature and proposed a set of tools that would be suitable. The choice of these tools was informed by an extensive literature review carried out by UCL (Matluba Khan) who compiled a database of tools used to assess physical activity and dietary behaviours. For mental wellbeing a systematic review of tools measuring well-being (Linton, Dieppe and Medina-Lara, 2016) was consulted. The final selection of tools was based on a set of criteria: it should be a standardised tool, available in multiple languages, available for and tested with different age groups, tested for reliability and validity. The burden on study participants was also taken into account so that the surveys would not be too long. In addition, the level of resources (costs and personnel) needed to use the tool were taken into consideration.

The selected tools assess levels of physical activity, food preferences, and mental wellbeing, as well as an observation tool to assess use of green or open spaces in relation to features of the green space, and survey items to assess aspects of demographics socioeconomic position (see Table 2).

Table 2: Proposed tools for impact evaluation of INHERIT case studies

	Measures	Instrument
Part 1	Introductory questions	Demographic and socioeconomic information
Part 2	Physical activity	International Physical Activity Questionnaire (short form) IPAQ-SF
		System for Observing Play and Recreation in Communities (iPad) iSOPARC
		Accelerometry
	Healthy Eating	Short Food Frequency Questionnaire (SFFFQ)
		Modified child nutrition questionnaire (MCNQ)
		Knowledge of Nutrition and Plant Science (for children) (NKK)
	Mental Well-Being	Short Warwick-Edinburgh Mental Well-being Scale (SWEMWB)
		Stirling Children's Mental Well-being Scale
Part 3	Additional questions in survey	Environmental opportunities, program evaluation

INHERIT partners designed surveys using the instruments described (Table 2) where they were appropriate for their study, and in some cases identified other suitable tools from the research literature. Details are provided in the case study chapters.

INHERIT partners applied for ethics approval to their respective organisations and ensured that where ethics approval was required, it was in place before data collection started.

Physical activity

Several validated tools were used to assess physical activity.

The short form of the International Physical Activity Questionnaire (IPAQ-SF) was used in several case studies. IPAQ is a validated tool for measurement of health related physical activity among adults (age range of 15-69 years) (Dai, 2015; Murphy *et al.*, 2017). IPAQ-SF is available in multiple languages, therefore considered to be a suitable tool to measure physical activity in INHERIT. The tool was applied in three pilot studies: restructuring residential open spaces (Sweden), lifestyle e-coaching (Netherlands and Greece) and UrbanCyclers (Czech Republic). In the latter studies it was used to measure the impact of social and behavioural interventions based on physical activity delivered by mobile phone-based applications.

The System for Observing Play and Recreation in Communities (SOPARC) is an established and validated observation tool to assess the use of public spaces in community settings (McKenzie *et al.*, 2006). SOPARC is used to record individual (gender, age, physical activity level, and ethnicity) and contextual characteristics (in a given area) and primary activity for each observed person. SOPARC was used to systematically observe the use of three parks/public open spaces (Malvik Path, Thinking Fadura and Restructuring Green Space in Breda) at two phases during Summer (July-August 2018) and Autumn (September-October 2018). The SOPARC was also used to evaluate whether residents' use of an outdoor residential space in Stockholm changed between pre and post regeneration. SOPARC was also used in a nearby open space within the same locality with similar characteristics with no change in the environment in order to compare the results. Observations of gender, age and ethnicity were carried out according to the guidance in the standard protocol outlined by McKenzie and colleagues in 2005 and 2006). However, study partners recognise the limitations inherent in making these observations.

The compiled SOPARC data enables evaluation of the number of users at different times and days of the week, as well as assessment of user characteristics, activity levels and common activities carried out by users at the observation locations. Furthermore, at the beginning of each observation, weather conditions were recorded and pictures were taken to visualise each area and its features. Observations took place at each of the four parks/open spaces during three weekdays and one weekend day, four times a day. The observations were conducted using i-SOPARC, an application developed with the iOS framework for Apple's iPad devices and validated by Santos et al., (2016). The layout and main functions of iSOPARC® follow the original protocol and data collection system follows the same procedures (e.g., for scanning target areas and people).

In the case of the Gardening with Green Gym and Meat Free Monday pilot study pre and post intervention phase we used accelerometers to assess children's physical activity levels in an average school week. GENEActiv wrist worn accelerometers were used to objectively measure children's physical activity. GENEActiv is recognised as a valid and reliable tool for measuring children's physical activity levels (Huberty *et al.*, 2015).

Healthy eating

The Short form of Food Frequency Questionnaire (SFFFQ) collects data on quality of diet in population surveys and it is validated against an extensive Food Frequency Questionnaire (FFQ) and a 24h diet recall (Cleghorn *et al.*, 2016). SFFFQ was used in the case study of PROVE, as a cross sectional survey to collect data on consumer's quality of diet.

In the pre and post intervention phase of the Gardening with Green Gym and Meat Free Monday case study a modified child nutrition questionnaire (MCNQ) was used to collect children's fruit and vegetable preference data. This reliable and validated questionnaire was developed to assess dietary patterns associated with positive energy balance and food behaviours, attitudes, knowledge and environments associated with healthy eating among children (Wilson, Magarey and Mastersson, 2008). As the current study only assessed attitudes to, frequency of and preferences in fruit and vegetable consumption, only these questions were kept in the questionnaire. The Fruit and Vegetable Preference Survey includes a pictorial 7-point scale to select whether children know a fruit/vegetable, have tried it and mark their preference accordingly.

In addition to the MCNQ, a nutrition knowledge questionnaire (NKK) was used to measure children's knowledge of nutrition and plant science due to the intervention. This is a 7-item multiple choice questionnaire and is selected from the University of Missouri (UM) 'Eating from the Garden Curriculum' survey and developed by the UM nutrition and evolution specialists. The survey was used in previous studies (Wells *et al.*, 2015) and validated for clarity and comprehension with primary school children. The content validity of the instrument was established by the Healthy Gardens, Healthy Youth Curriculum development team. Construct validity was established with children aged 7-8 years and 10-11 years (Wells *et al.*, 2015). Both MCNQ and NKK were applied in the Gardening with Green Gym and Meat Free Monday in the UK

Mental well-being

Mental well-being was measured using the Short Warwick Edinburgh Mental Well-being Scale (SWEMWBS). The SWEMWBS is a shorter version of the 14 item Warwick and Edinburgh Mental Well-being Scale (Clarke *et al.*, 2011) which is designed to assess mental well-being and has been validated by Tennant et al., (2007). The short version comprises 7 positively worded statements and participants rate each statement in relation to their experience in the past two weeks on a 5-point scale (1 = none of the time; 5 = all of the time), resulting in a minimum score of 7 and maximum score of 35. A higher score indicates higher level of mental well-being. This measure has been translated into different languages including Norwegian, Swedish and Chinese and validated in the respective contexts (Haver *et al.*, 2015; Ng Fat *et al.*, 2016). The measure was applied in two case studies: a) Lifestyle e-coaching in the Netherlands and Greece, and b) Restructuring outdoor residential areas in Sweden.

Children's mental well-being was measured using the Stirling Children's Well-being Scale (SCWBS), developed by the Stirling Council Educational Psychology Service (UK) as a 12 item positively worded measure of emotional and psychological well-being in children aged eight to 15 years (Liddle and Carter, 2015). The scale draws on theories of well-being and Positive Psychology with an aim to provide a means of measuring the effectiveness of interventions and projects designed to promote children's well-being and emotional development and validated against 1849 children from 18 schools. This measure was used in the Gardening with Green Gym and Meat Free Monday case study in the UK.

Case studies used these instruments or alternatives, as appropriate to their research questions. Table 3 summarises use of the instruments by case studies. Further details of methodology and instruments are in the individual case study chapters in this report.

Table 3: Methods and instruments for evaluating impacts and benefits by case study in this report

Ch.	Name	Location	Nature of intervention	Quantitative/mixed methods Impacts	Quantitative Instruments	Qualitative methods (Focus group/structured open-ended questions)
1	Malvik Path	Norway	Implementation of a recreational path connecting two communities	Population survey Observation of use and activity level	Population Survey iSOPARC	Short survey among users
2	Restructuring Residential Outdoor Areas	Sweden	Regeneration of and improved access to an open space	Case control/pre-post Household survey & Observation of use and activity level	IPAQ-SF SWEMWBS iSOPARC	Open questions in survey for written responses
3	Thinking Fadura	Spain	Improved access to an open space	Observation of use and activity level	iSOPARC	
4	Restructuring Green Space	Netherlands	Regeneration of and improved access to an open space	Observation of use and activity level	iSOPARC	
5	Gardening with Green Gym and Meat Free Monday	UK	Gardening activities with children in a primary school and promotion of a meat free day/week	Mixed methods	MCNQ NKK SCWBS Accelerometry	Focus groups Written responses (teachers and project leaders
6	PROVE	Portugal	Sustainable farming practices creating closer links among producers and consumers	Mixed methods Farmers and consumer studies	FFQ Questionnaires matched questions with those in INHERIT five country survey (consumers) or selected items in European Social Survey 2015 (farmers) for comparison	Focus group
7	Life style e-coaching	Netherlands and Greece	A life style change application	Randomised control design, pre/post survey	IPAQ-SF, SWEMWBS, perceived behavioural control	
8	UrbanCyclers	Czech Republic	Biking intervention using UrbanCyclers app	Randomised control design, Pre and post	Life satisfaction IPAQ-SF Travel behaviour, views on preferred improvement in respondent's city, and on UrbanCyclers app	
9	Eco Inclusion	Germany	Capacity building and awareness program on energy efficiency in housing	Survey of knowledge transfer	Knowledge questionnaire	

1.3 Methods and Report Structure

Qualitative methods

In addition to the quantitative measures, partners conducting case study evaluations used some qualitative methods (i.e. focus group discussions and/or open-ended survey questions) where feasible to give a richer understanding of participants' perceptions and experiences of interventions. These are detailed in respective chapters. For example, In the case of Gardening with Green Gym and Meat free Monday, focus group discussions with children were used to gain insights into how the intervention helped or hindered children's health behaviour. In the case of 'restructuring residential areas in Stockholm', qualitative material was gathered from free text questions in the population survey, and dialogue at resident's meetings gave additional insights. Qualitative insights helped interpretation of results from quantitative methods.

Structure of this report

The following nine chapters describe the impact evaluations and findings from the nine case studies using the following format:

Background

Overall aims

Context

Research Questions

Methodology

Results

Discussion

Limitations

Learning points for future research

Learning points for potential scale up and transferability

2. Malvik Path

2.1 Background

Ensuring that public green spaces are accessible for all population groups can promote social interaction, increase physical activity levels (e.g., walking, running and cycling) and, therefore, help improve both the wellbeing and health of people (Whitmee 2015). The Malvik Path is a green space area with a 3-kilometer-long path along the coast in the municipality of Malvik, outside the city of Trondheim, Norway. Placed on an old railway-track, it connects two residential areas. The Malvik Path was officially opened to the public in June 2016. Today, it has become a destination and a public space valued by both inhabitants and visitors. Because of its location, the Malvik Path enables access to green and blue space. Along the path there are designated spots for social interaction, fishing, playing and barbecuing. Benches have been placed along the path, inviting people to take a rest and admire the scenery. Information boards on historical events and the area's wildlife and historical artefacts are displayed to provide a sense of the place in a wider context. Moreover, the path has been designed according to the principles for universal design (defined by the Disability Act of 2005), meaning that the design and composition is so that it can be accessed and used by all people regardless of their age, size, ability or disability.

A municipal inter-sectoral project group was responsible for planning and implementing the Malvik Path. The initiative was anchored within the community - among property owners in the nearby residential area, local politicians, local businesses and inhabitants. Broad user involvement was ensured throughout the entire planning and implementation process (e.g. public meetings, meetings with local politicians,

Photo 1: From the Malvik Path (Kirsti S. Anthun)

Search conference (Magnus *et al*., 2016), participative planning workshop with inhabitants, Photovoice (Wang and Burris 1997) with children and seniors) (Anthun *et al.*, 2019; Lillefjell *et al.,* 2018).

The Malvik Path was chosen as an INHERIT case study because of its potential to promote health and well-being, environmental sustainability, social inclusion and health equity. It supports active lifestyles;

encourage people to choose biking or walking instead of using their car, and is universally designed, thus allowing all groups access and possibilities to use it.

2.2 Overall aims

The overarching aim of the Malvik Path evaluation study was to investigate who uses the path, what type of activities the path stimulates, and to provide knowledge on whether and how green spaces are beneficial for health, social inclusion and physical activity for all citizens in the communities.

2.3 Context

Malvik municipality is situated along the coast, 23 km north of Trondheim city, and has a population of approximately 14,000 inhabitants. The municipality displays a variety of settlements ranging from urban to rural. According to the national health register data as presented by the National Institute of Public Health, the inhabitants of the municipality of Malvik, compared to other Norwegian municipalities, are above average when it comes to health, education, income and life expectancy and they use less tobacco and alcohol (Statistics Norway 2019).

The municipality has extensive green spaces; out of a total of 168 square-km land, 124 square-km constitute forests, 14 square-km farmland, and 7 square-km freshwater lakes (malvik.kommune.no). Traditionally farming has constituted the main livelihood. Today farming has gone down, and the main occupations are within commodity trade, hotel and restaurant management, communication, finance, real estate and health- and social welfare services (Statistics Norway 2019).

Sixty percent of the municipality's workforce commute to Trondheim, and Malvik municipality is considered to belong to the 'Trondheim region' in terms of it being integrated in the same housing- and labour market. Although Malvik in general could be described as a socioeconomically advantaged municipality, representing a resource-rich environment both in terms of composition (inhabitant's education and income) and context (high proportions of green space for food production and leisure activities), the municipality's population include people from all socioeconomic groups.

The creation of supportive settings for health has been outlined as one of the leading strategies within health promotion (Hamano *et al.,* 2013; Abraham, Sommerhalder & Abel 2010). Neighbourhoods can promote health through the provision of social and material resources (Leventhal & Brooks-Gunn 2000). Additionally, neighbourhoods can promote healthy lifestyle by offering arenas for activity (Thompson 2013). Much attention has been paid towards the walk- and bike-ability of neighbourhoods, which can promote physical activity both for transport and leisure and increase contact among neighbours simultaneously (Thompson 2013; Hankey, Marshall, Brauer 2012). Similarly, the availability of nearby green-spaces has been linked to positive health outcomes and more physical activity (Stigsdotter *et al*., 2010; Maass, Lindstrøm & Lillefjell 2014).

2.4 Research questions

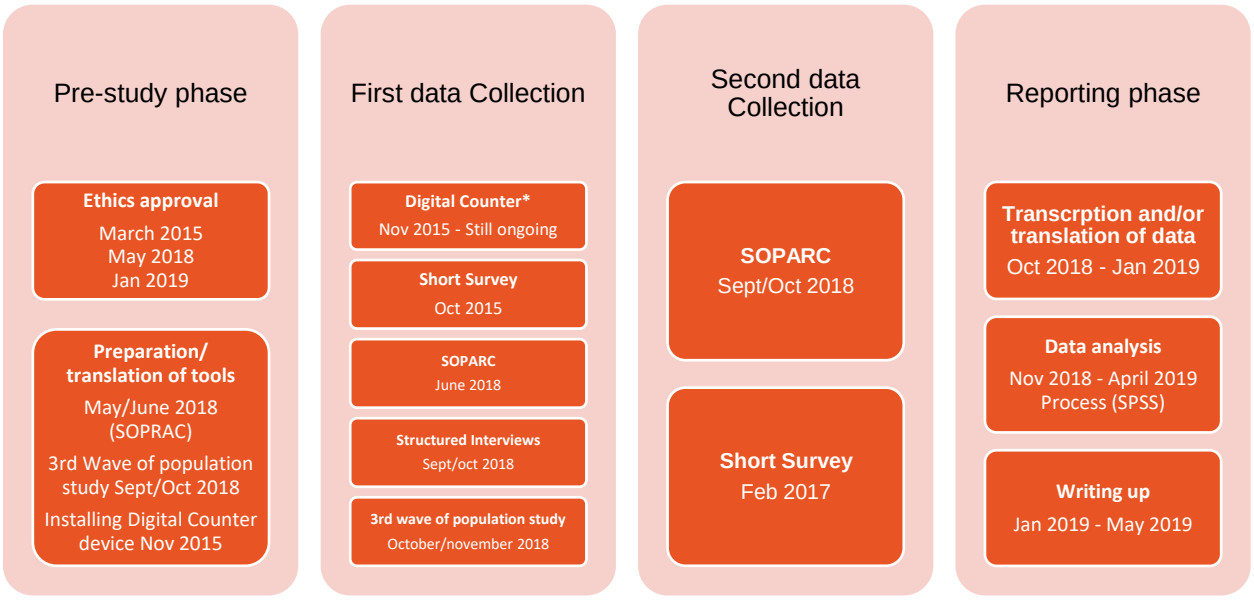
In line with the INHERIT model (van der Vliet *et al.,* 2018), which incorporates the COM-B model, the study examines what opportunities the Malvik Path affords for physical activity, and whether the path is beneficial for health and social inclusion.

- What are the main determinants for using the path?
- What health behaviour (type of activities) does the path impact?
- How do the environmental features of the Malvik Path encourage different activities among users of the path?
- Is the path beneficial for health, social inclusion and physical activity for all groups of citizens?

2.5 Methodology

The Malvik Path evaluation study was developed and conducted by the NTNU team (Norway), in close collaboration with the Municipality of Malvik (local implementers) and with research teams at UCL, England (Quantitative evaluation studies) and Bc3, Spain (economic evaluation studies).

A mixed method research design (Johnson & Onwuegbuzie 2004), combining a quantitative component consisting of counting data, questionnaire surveys and registry data, with a qualitative component of observations and structured interviews, is applied to fulfil the aims of the outcome evaluations. The use of a diverse range of data and information sources will provide relevant and sensitive evidence of effects, including types of activities afforded by the path and possible social- and health benefits. Attention to context will be vital since the effectiveness of similar interventions can vary according to context (Oliver *et al*., 2014).



*A digital counter registers the number of people visiting the path

Figure 1: Evaluation plan for Malvik Path/Green Space/Norway

Methods

The mixed methods evaluation included: 1) a digital counter that registers the number of people using the path each day; 2) iSOPARC, an observational tool being used for obtaining direct information on people's use of open spaces; 3) a population survey conducted onsite among inhabitants in the

municipality of Malvik; 4) structured, onsite interviews with users of the path, and 5) a short survey to users of the path.

Digital counter

A digital counter that registers the number of people visiting the path each day was set up prior to the official opening of the path (June 2016). The counter has registered total traffic since October 2015 and is still ongoing. Daily average, weekdays, weekend days, monthly average, busiest day of the week, and busiest days of the period is registered.

Systematic observations: SOPARC

To examine how the path was used, the System for Observing Play and Recreation in Communities (SOPARC) was applied. SOPARC is a tool for assessing physical activity (PA) level and characteristics of park or green space users (McKenzie *et al.,* 2006). It supports collecting data in terms of the number of users, gender, age and PA level. Recordings were made electronically in the iSOPARC application during four days from the 25th to 30th of June 2018, and four days in one week, from the 27th of August to the 1st of September 2018. The four-day schedule observing four times a day has been shown to provide robust estimates of physical activity levels and user characteristics (Cohen *et al*., 2011). An extra observation time was added for the systematic observations in June, due to the long hours of sunlight in the northern hemisphere. Out of the four days in each of these weeks, three were weekdays and one was a Saturday or Sunday. During the first observation period (in June), the weather was dry, sunny and warm with temperatures ranging from 20 to 25 degrees Celsius. During the second observation period, in late August, beginning of September 2018, the weather was dry and partly sunny and a little bit cooler than in the first period, with temperatures ranging from 15 to 20 degrees Celsius.

Given that this is an assessment of the use of a walking path, and not a park or playground, the observation protocol of SOPARC (McKenzie and Cohen 2007) was customised slightly to enhance its relevance for assessing the use of a walking path. The Malvik Path have multiple access points but has a clear starting point in the residential areas of *Hommelvik* (area 1) and *Muruvik* (area 2) (see map, figure 2). Therefore, it was decided to use each of these access points as observation points or coding stations. A coding station is an identified spot near or on the path that can be found easily and from which observations can be conducted without obstruction (Meyers *et al*., 2012). This is the point or location from which the walking path observations were conducted. Each person passing the observer, or coder, was registered as s/he passed by the coding station. The person would be registered with gender (male/female), age group (see below for further description of the age categories) and physical activity-level (sedentary, walking or vigorous).

Figure 1: Map of the Malvik Path and the three observation points marked with "1 Hommelvik", "2 Muruvik", and "3 beach area".

Using each starting point as coding stations would increase the probability of registering users who only walk or use half of the path.

The decision was also connected to the fact that there is a digital counter placed half way along the path which registers each passing. It was therefore important to find alternative coding stations that could complement the type of data registered by the counter.

In addition to these two coding stations, a third observation point was chosen. This area was chosen because it is a discrete area close to the path, but not on the path, which represents a space in which various activities may occur. The area fits the description of a target area (McKenzie and Cohen 2007) because it is large enough to accommodate activity, but small enough to accurately count everyone who may be using the area. This target area (observation point 3) was called 'the beach area' and is located approximately half way between observation point 1 (*Hommelvik*) and 2 (*Muruvik*) (see Figure 2 above). In the following, the three observation points will be described in more detail.

Coding station 1: Hommelvik Starting Point

The Malvik Path is 3.5 meters wide and consists of a gravelled, firm surface. Signs mark the start of the path at *Hommelvik* (coding station 1). Approximately 80 meters from the path there is a parking area, a small café with WC-facilities (only open Saturdays and Sundays) and a large pier for small boats. *Hommelvik* is a residential area, which contains 40 houses in the close vicinity of the path, and there are 134 households in the area, with 371 residents. The municipal centre with schools, shops, train station and the municipal administration locates 1.5 - 2 km from the Malvik Path.

Photo 2: Hommelvik starting point (Kirsti S. Anthun)

Coding station 2: Muruvik Starting Point

Muruvik is a residential area with approximately 144 houses/households, with altogether 474 individuals. This area also includes 40 summer cabins. This end of the path provides path users with a seating-area. The path has been made wider here to make enough room for benches and information boards. On one side of the path there is a wood and some summer cabins, while on the other side of the path, the sea-side, there is a fence for safety since the path runs very close to the sea in this area and there are steep rocky cliffs down to the sea-level. From the wider seating area, there is a narrow steep path leading down to a small pebbled beach. 50 meters from the seating area, the path ends abruptly. The gravelled surface

ends and it is possible to see the old train-tracks continuing in the landscape. There is a disabled parking bay here, and within 150 meters there is another beach area and several summer cabins.

Photo 4: Muruvik starting point (Kirsti S. Anthun)

Photo 3: Muruvik starting point (Kirsti S. Anthun)

Target area: The beach area (observation point 3)

The beach area is a pebbled beach. Four boat-houses are situated at the top of the beach, close to a small forest that separates the beach from the Malvik Path. There and two seating areas in front of the boat-houses, where picnicking and barbequing facilities are available. A narrow 25-meter-long path leads from the beach, through the small forest and up to the path. The beach area was selected because it is a popular area for a varied set of activities, picnicking, swimming, sun-bathing, playing, climbing rocks and sea-shell picking. Since this is a pebbled beach, with big and small rocks, it is not easy to walk here, and it is inaccessible for wheelchair-users or individuals with roller-walkers. The forest behind the boat-houses is a popular play-ground for children.

Photo 6: Beach area (Kirsti S. Anthun)

Photo 5: Family picnicking in the beach area (Matluba Khan)

Data collection

Data collection using the iSOPARC tool

Observations were made during specified times in the morning, noon, afternoon and evening. Specifying observation times for the two observation periods in June and August/September would permit improved conditions for comparison across the two data sets. In coding stations 1 and 2 (starting points Hommelvik and Muruvik) observations were made five times per day in June, starting at 8 AM, 11 AM, 1 PM, 4 PM, 6

PM for coding station 1, and starting one hour later for each observation period at coding station 2. In the observation period in August /September observations were made four times a day, starting at 8:30 AM, 12 AM, 3 PM and 5 PM, and starting one hour later for each observation period at coding station 2. In the target area, the beach area, scans were made 8 times a day, two scans in the morning, two during mid-day, two in afternoon, and two during the evening.

All registrations and scans were done by the same data-collector (KSA), who had been trained in the SOPARC tool and the iSOPARC App[1]. The data-collector would start registering path users and their activity levels and characteristics in coding station1 (*Hommelvik starting point*) and would remain there for the duration it takes to walk the whole path, which is 32 minutes. Each path user was electronically coded as sedentary (i.e. being pushed in a stroller, wheelchair), walking (walking at a steady pace) or vigorous (activity more vigorous than ordinary walk or considered to have a greater energy expenditure than walking, such as i.e. running, biking, power-walking). Demographic information, based on direct observation, was also registered by the data-collector for each user; gender, age group (child 0-12 years, teenager 13-20 years, adult 21-64 years, senior 65 and older). In the beach area the users' gender, age group and activity level were registered, but here a scan was performed of the area; an observational 'sweep' or a single observation movement from left to right across the target area. Each scan should be considered a static record of what was happening at the specific time of the scan, and any change in users or activity level between scans was not recorded.

During the observation periods in June and August/September several organised activities took place. These were one relay run with approximately 150 participants and two school outings with several school classes (approximately 100 individuals combined for the two outings). While the probability of registering the relay-run can be considered low, the probability of registering an organised event in general is quite high. There are several organised activities along the path at different times over the year; pensioners have regular walking groups (one group for women and one for men), there are school-competitions (relay runs), staff at the municipal administration have "walking meetings" on a weekly basis, the local brass band has had concerts along the path, and school-classes use it for day-outings. One important purpose of the Malvik Path is that it is supposed to be easily available for all people and various types of activities, including organised activities.

Population Survey

The evaluation of the Malvik Path draws on register data from two population surveys conducted in 2014 (before the path was opened) (N= 989) and in 2018 (two years after the opening of the path) (N=2072) (Maass 2018). All participants were residents of the municipality of Malvik and adults (≥18 years old). Data were collected using an online survey. The use of the data in the population register database was ethically approved by The Norwegian Data Protection Authority.

The population survey includes demographic and socio-economic data such as age, gender, income and education, as well as data on area of living/neighbourhood. It also contains data on self-rated health, life satisfaction, neighbourhood social capital, physical activity, satisfaction with availability and quality, as well as use of neighbourhood-resources (seaside, woodlands, walk- and bike paths). This survey also includes satisfaction with availability and quality and use of the Malvik Path.

[1] A common training was arranged for all INHERIT case studies using the SOPARC tool. This was arranged by UCL.

Variables included

Gender was coded as a binary variable (1= female and 2= male). *Income* describes the total household-income and is measured categorically based on 9 intervals with a range of 100–200 Norwegian Krones (NoK) (1 Norwegian krone is approximately .10 Euro), with "more than 1.5 million NoK" as the highest category. *Education* was assessed through 5 categories, ranging from "primary school" to "higher education, more than 4 years". *Self-rated health* (SRH) was measured as a single item on a four-point Likert scale ranging from *very good* to *poor.* SRH represents a validated measure which is widely used (for example in the large Norwegian HUNT- study)[2,] and which has been linked to a variety of health-outcomes including mortality (Idler & Benyamini 1997). *Life satisfaction* (LS) was measured through a single item "Considering your life at the moment, would you say that you by and large are satisfied with life, or are you mostly dissatisfied". Answers were given on a five-point Likert scale ranging from very satisfied to very dissatisfied. This question is a validated measure of life satisfaction, frequently used in national and international studies (Bowling 2005). *Neighbourhood Social Capital* (NSC) was assessed through agreement on seven statements such as, "I feel safe in my neighbourhood" and "Generally, people do thrive here" (Carpiano 2007). Answers were given on a five-point Likert scale ("Totally agree" to "totally disagree") and are indicated by the sum-score on all variables (range 7-35, with higher scores indication higher NSC). *Physical activity* was measured by frequency (1= less than once a week, 2= once a week, 3= 2-3 times a week, 4= almost daily), intensity (1= low intensity, no sweating, 2= middle intensity, I get short of breath and sweaty, 3= high intensity, I exhaust myself) and duration (1= shorter than 30 minutes, 2 = 30 min to 1hr, 3= longer than 1 hr). Satisfaction with the availability and *quality of neighbourhood-resources* was measured using single items describing assessments of outdoor facilities (nature contact and seaside facilities), facilities for physical activity and bike-paths, and the Malvik Path specifically. These were evaluated on a 5-point Likert scale ranging from "very satisfied" to "not satisfied at all". *Use of facilities* was measured on a similar 5-Point Likert Scale, ranging from "not at all" to "very often". The internal consistency, measured by use of Cronbach's alpha, were satisfying for all variables included.

Table 1: Population characteristics

		2014	2018
Gender (% female)		61	59.7
Age Mean (SD)		47.49** (13.46)	49.57** (15.18)
Income*	<400 000 NoK)	11.2	10.3
	400-700 000	27.4	26,6
	700 000- 1000 000	29.9	28.5
	1 000 000-1 500 000	26	27.5
	> 1 500 000 NoK	5.5	7.2
Education	Primary school	6.6	7.3
	Vocational education	25.8	25.3
	Secondary school	11.1	11.7
	Higher education, less than 4 yrs	25.9	24.5
	Higher education, more than 4 yrs	30.5	31.2

** Significant change 2014-2018 on a .001 level
*Income: 1 Euro = approx. 10 NoK
SD = Standard Deviation

[2] The Nord-Trøndelag Health-study: the HUNT study is one of the largest health studies performed. It is a database of questionnaire data, clinical measurements and samples from a County's inhabitants from 1984 and onwards. See https://www.ntnu.edu/hunt

Participants in wave I (2014) were on average 47.49 years old and thereby approximately two years younger than participants in wave II (2018) (mean age 49.57). Otherwise, no significant changes were identified. Samples were comparable in respect to gender (61 % women in wave I and 59.7 % in wave II), large proportions of middle- and high-income groups (With almost 1/3 earning more than 1 000 000 NoK), and very large proportions of participants with higher education (with over half of the population having a University-degree, and about ¼ holding a vocational education (Table 1). Overall, participants of this survey could be described as on average younger, better educated and with more income than the Norwegian average.

Structured on-site interviews

In September 2018, while conducting the systematic observations (SOPARC), short, structured interviews were conducted on site with fourteen adults (Male N=3), aged thirty-two to seventy-three (mean age 51.2, SD 14.7). Users of the Malvik Path were approached during a midday observation period between 1 and 2.30 PM and were invited to take part (n=18). Those agreeing to participate were interviewed. Inspired by a former similar study by Schipperijn, Hansen & Rask (2015), the interviewees were asked: *1. How far had they travelled to get there? 2. What did they think of the idea of developing the path, 3. What did they particularly like about the path? 4. What did they not like about the path? 5. What did they use the path for?* Data from these interviews would provide some insight into who the users are (local/non-local residents), their motivation for using the path and what types of activities they engage in when using the path. All fourteen interviews were recorded and transcribed in verbatim

Short on-site survey

A short survey was conducted on the Malvik Path in October 2015 (before the path was officially opened) and in February 2017. Representatives from residents' associations randomly approached users on the path and asked if they would participate. Those who accepted answered the survey on-site and handed it back to the representatives from the residents' association. In 2015 the survey was conducted during three weekdays, two days during after-work hours (between 4 and 7.30 PM) and one during mid-day (from 10 AM to 2.30 PM). In 2017 the survey was conducted for two weekend-days (from 11 AM to 2 PM) and during two weekdays (from 4 to 7.30 PM both days). In the first iteration there were 142 respondents (54.9% female, mean age 46.4), while in the second iteration there were 49 respondents (58.3% female, mean age 42.8). This case study has only assessed the demographic data (gender, age and level of education) and answers to the questions *How often have you used the Malvik Path the last seven days?* and *Why do you use the path?*

Data analyses

In this study we applied a repeated cross-sectional observational study design. A diverse range of data were collected before and after the opening of the path.

Counter data

In order to examine the actual use of the path, counter data, collected daily during a period of 37.5 months, were analysed by use of an Eco-Visio data analysis platform. The platform was used to sort, compare and perform descriptive data analysis.

ISOPARC

The iSOPARC data were compiled in Excel and totals and percentages of use by different age groups and their activity levels were calculated.

Population survey

To examine whether the path is beneficial for health, social inclusion and physical activity for all groups of citizens, descriptive and comparative analysis was conducted on socio-demographic background variables (including age, gender, household-income, level of education as well as census-tract), and on various outcome-variables such as self-rated health (SRH), life satisfaction, thriving in the municipality, neighbourhood social capital (NSC), physical activity-levels (frequency, intensity and duration). Satisfaction with availability and quality of neighbourhood-resources (woodlands, seaside, arena for physical activity and walk- and bike-paths), as well as the use of these resources is also described. All of these variables were assessed and described both in the survey conducted in 2014 (before the construction of the path/new elements) and in survey conducted in 2018 (after the construction of the path/new elements). Comparative analysis is applied to examine for changes in these variables between the two times of measurement. Moreover, satisfaction with availability and quality, as well as use of the path is included in the evaluations of the path.

To determine whether all groups benefit from the path, and to examine determinants for the use of the path, data was analysed in four steps: first, changes in the respective variables between 2014 and 2018 were assessed (see above). Second, a descriptive analysis of the group reporting to use the Malvik Path "very often" (n= 200) was conducted. Moreover, perceptions and use of the path were assessed according to household income, to ensure a focus on socio-economic differences.

Next, included variables were checked for their correlation with the measurement for the use of the Malvik Path through a Pearson's Correlation Analysis. Significant correlations were then included into the regression analysis. In the first step of the regression analysis, gender, age, education and income were entered, to assess their impact on use of the path, and to apply these as control variables for later steps-of-analysis. For the second step, we applied two separate strategies: first, we conducted a series of individual regressions of all variables (controlled for gender, age and income). This was done to check for individual influences of the various variables on use of the Malvik Path. Last, all included variables (age, income, thriving, NSC, Satisfaction with the availability and quality, as well as use of nature-contact and seaside- facilities, facilities for physical activity as well as bike-paths) were entered into the model at one step. This was done to highlight, and control for inter-relations between potential predictors, and gain a clearer picture of how use of the path could be facilitated for.

Structured on-site interviews

Transcripts from the fourteen short interviews with individuals using the Malvik Path were cleaned, removing unusable "fillers" that are found in interviews (i.e., issues that are unrelated to the topic in hand and small words that contain no meaning) (Burnard 1991). Interviewees answers were then summarised and tabulated using summative content analysis (Hsieh & Shannon 2005).

Short on-site survey

Data was summarised using simple descriptive statistics. The dimensions *Level of education* was cross-tabulated with how often respondents use the path per week (the fixed options were *1-2 times*, *3-4 times*, *5-6 times*, *7 or more*). Respondents' answers to the open-ended question 'why they use the path' were provided in free-text where respondents listed several reasons. The reasons from the 2015 survey and the 2017 survey were summarised and listed according to frequency of mention, using a summative content analysis (Hsieh & Shannon 2005). Similar phrasing was categorised together. For instance, the accounts such as "Because I love the scenery and nature" or "I use it to enjoy the nature along the path" were categorised as "Experience nature and view".

2.6 Results

Digital Counter

A digital counter registered the number of people visiting the path each day before (2015) and after (2018) the official opening of the path. As shown in Table 2, the number of people that are visiting the path has increased both weekdays and weekend days since the opening. However, the busiest day (Sunday), and busiest time of the day (13.00 PM), remain identical during the whole data collection period.

Table 2: Use of the path, measured before (2015) and after (2018) the official opening of the path

Traffic	2015	2018
Monthly Average (N)	2226	4448
Daily average (N)	71	147
Weekdays	53	126
Weekend days	118	203
Busiest day of the week	Sunday	Sunday

Figure 3: Busiest time of the day weekdays and Busiest time of the day weekend days 2015

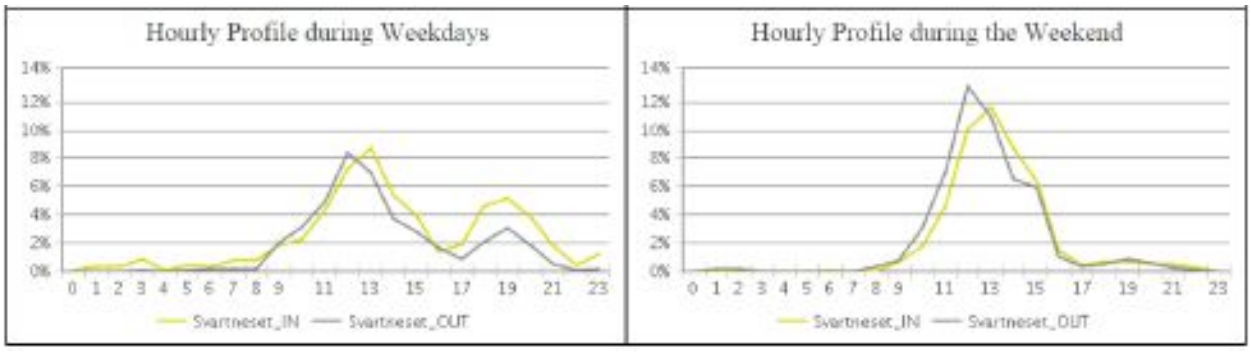
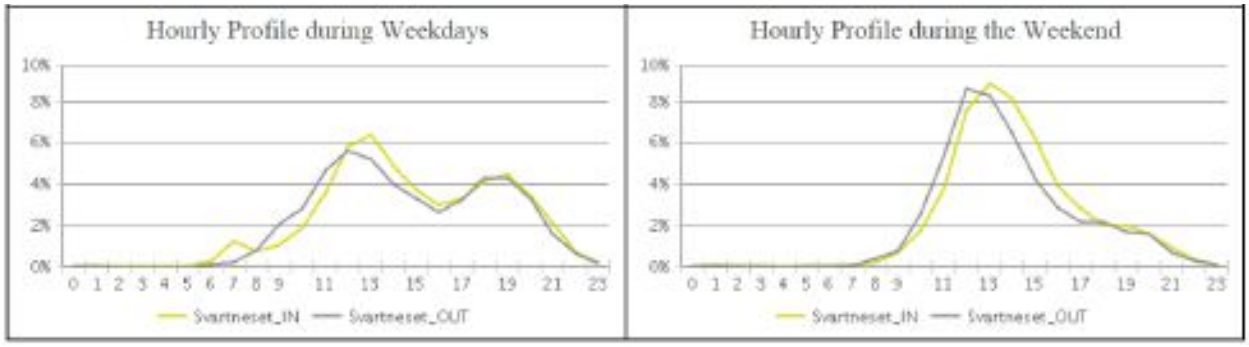


Figure 4: Busiest time of the day weekdays and Busiest time of the day weekend days 2018



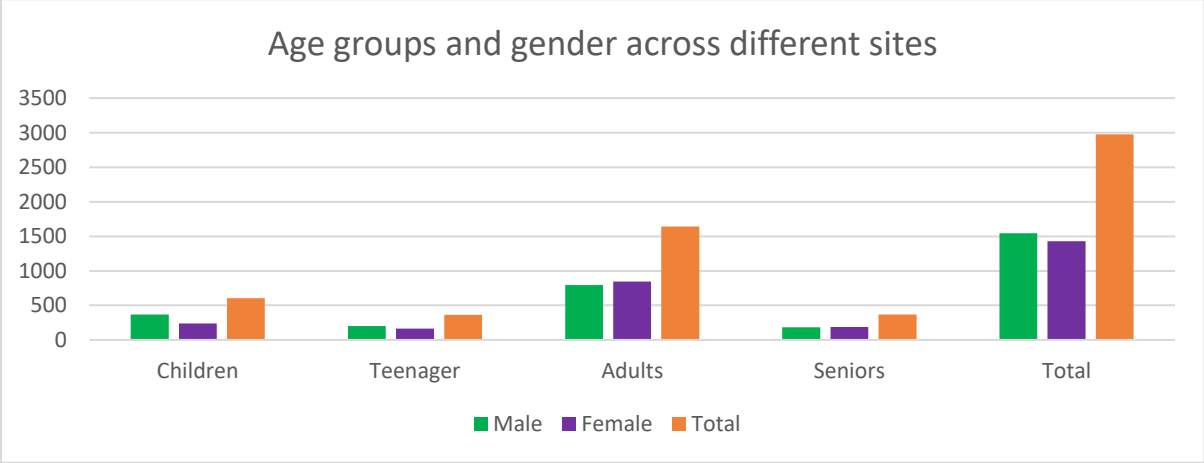
ISOPARC

The iSOPARC protocol describes separate observations at the three observation points "Hommelvik starting-point", "Muruvik starting point" and "beach-area". Overall 2972 registration of use were registered across the two coding stations and the target area, 1544 (52%) of them male and 1430 (48%) female, thus the path is equally used by both male and female members of the community.

Age Groups

Registrations on gender and age groups' use of the path showed that most participants observed were adults (n=1640, 55%). Twenty per cent were children (n= 602), 12% were teenagers (n= 362), and 12% were senior (n=370). For all age groups there were more male people observed than female, apart from adults – only 48% of adults (n=794) were male whereas 52% of adults (n=846) were female. See figure 5.

Figure 5: Age groups and gender of people observed from all sites (as chart)



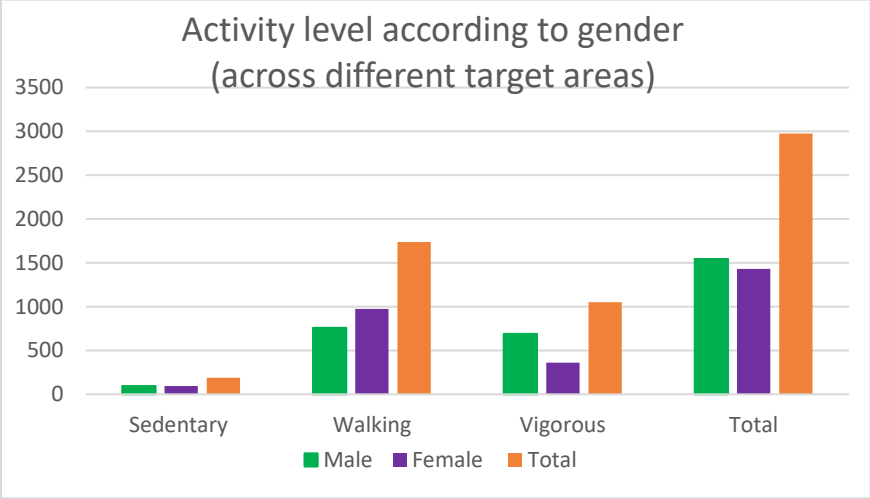
The iSOPARC data also showed that the make-up of the observed path users in terms of age groups is relatively similar for the "Hommelvik Starting Point" and the "Muruvik Starting Point" with the clear majority of people observed there being adults. The "beach area" however is somewhat different – the majority of people observed there were children (n= 92, 63%) and adults (n= 52, 36%). There were no teenagers seen there and just two seniors (1%). The data suggests that the "beach area" is primarily used

for family outings (children and their parents or other guardians). This is also an area that motivates a variety of activities; people were seen picnicking, standing, running, sun-bathing, playing in the sea. Having said that, in 86% of scans at the "beach area" no users were observed in the area. In 22 scans (17%) the main activity there was sitting.

Activity Level

Activity levels observed were classified as sedentary, walking or vigorous. Figure 6 illustrates the physical activity level observed for male and female and total numbers of the path users.

Figure 6: Overall activity level for male, female and total (as chart)



According to the observations, there was practically no difference between the genders regarding sedentary behaviour, more women than men were observed walking and more men were observed engaged in vigorous activity. The latter might be because a day of observation coincidentally fell on a day when a relay run took place at the path, and more men than women participated in the run.

In general people were using the path in an active way, where 35% (n=1050) of the activities were vigorous and 58% (n=1736) walking, whereas only 6% (n=188) were sedentary. The activity levels did not vary much between coding stations 1 and 2, but in the beach area, more sedentary activity took place compared to the other two areas.

Figure 7: Activity levels in different observation points (as chart)

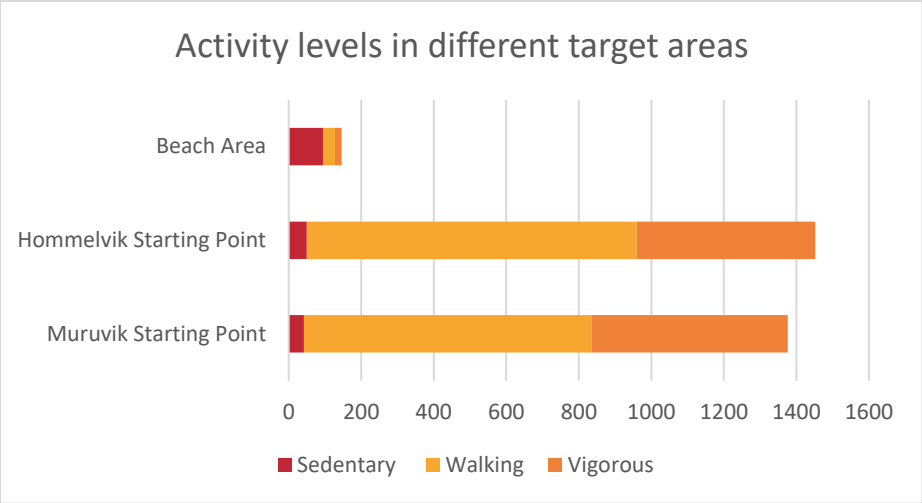


Figure 7 shows that the different observation points *Hommelvik*, *Muruvik* and 'the beach area' triggered different kind of activity levels. At coding stations 1 and 2 (*Hommelvik* and *Muruvik*) most people were coded as walking or vigorous, whereas in 'the beach area' 66% (96) were sedentary and only 22% (32) were walking and 12% (18) engaged in vigorous activity.

Photos 7-10: Activities along the Malvik Path (Kirsti S. Anthun)

Population survey

Population survey data indicate that more than three quarters of participants experience good or very good health, while respectively 3.1 % (2014) and 2.2 % (2018) report poor health. Even higher proportions of participants report high or very high life satisfaction (84.6% in 2014 and 85.5% in 2018) and very good or good thriving in the municipality (88.5%, 86.9%, respectively).

On average, participants are measured to have neighbourhood social capital (NSC)-levels of respectively 26.26 (SD: 5,18) and 26.65 (SD: 4.94) in 2014 and 2018 (range 7-35, with higher scores indicating higher NCS). Around three quarters of participants report to engage in physical activity more than once a week. Equally many describe that they engage in physical activity intense enough to get sweaty (74.2 % (2014); 73.6 % (2018)), and more than 9 of 10 report to engage longer than 30 minutes at a time.

Table 3: Descriptive and comparative analysis of outcome variables population survey 2014 and 2018

		Malvik municipality	
		2014 (N=989)	**2018** (N=2072)
Self-rated health (% good/very good)		77.2	81.6
Life Satisfaction (% satisfied/very satisfied)		84.6	85.5
Thriving in Malvik (% very good/good)		88.5	86.9
Neighbourhood Social Capital (range: 7-35) Mean, (SD)		26.26 (5.18)	26.65 (4.94)
Physical activity (%)	*Frequency- More than once a week*	76.2	78
	Intensity -I get sweaty and short of breath	74.2	73.6
	Duration- Longer than 30 minutes	93.4	94.4
Satisfaction with availability of neighbourhood-resources (% satisfied/very satisfied)	*Nature-contact*	90.8**	88**
	Seaside	87.8**	83**
	Sports facilities	64.1	66.2
	Walk/bike-paths	55.4**	58**
Satisfaction with quality of neighbourhood-resources (% satisfied/very satisfied)	*Nature-contact*	87.2	87
	Seaside	81.7	80.3
	Sports facilities	56.9**	63**
	Walk/bike-paths	49.6**	54.7**
Use of neighbourhood-resources (% often/very often)	*Nature-contact*	17.8**	69.7**
	Seaside	7.1**	37.8**
	Sports facilities	10.9**	31.6**
	Walk/bike-paths	28**	53.5**
Satisfaction with availability of the Malvik Path (% satisfied/very satisfied)		-	79
Satisfaction with quality of the Malvik Path (% satisfied/very satisfied)		-	83.4
Use of the Malvik Path (% often/very often)		-	33.9

** significant change from 2014 to 2018 on a .001 level

Trends 2014-2018

No significant changes in respect to health, life satisfaction, thriving, NSC or physical activity were found. However, satisfaction with availability and quality as well as use of neighbourhood-resources changed from 2014 to 2018. Among inhabitants in Malvik municipality, satisfaction with the availability and quality of nature-contact and the seaside has slightly declined, while satisfaction with availability of sports facilities and walk-/bike-paths has increased. Comparison of use of these neighbourhood resources indicate a substantial increase in the use of all resources.

Satisfaction and use of the Malvik Path was only assessed in 2018, and data analysis reveals that 79 % are satisfied with availability, and 83.4 % are satisfied with the quality of the path. Approximately one third reports to use the path often or very often (Table 3).

Main determinants for using the path

Table 4: Characteristics of "very frequent users" of the path

		"Very frequent users»
Age (Mean, SD)		52.25** (14.29)
Gender (% female)		66.0**
Neighbourhood (%)	Hommelvik	80.0**
Thriving (%)		93.0**
Physical activity	Frequency	91.7**
	Intensity	73.6
	Duration	96.9
Neighbourhood Social Capital (Mean, SD)		28.11 **(4.94)
Satisfaction with availability	Nature	91.9**
	Seaside	91.4**
	Sports facilities	73.4**
	Walk- and bike-paths	69.6**
	Malvik Path	93.5**
Satisfaction with quality	Nature	94.9**
	Seaside	89.7**
	Sports facilities	70.1**
	Walk- and bike-paths	65.5**
	Malvik Path	95.9**
Use of	Nature	89.0**
	Seaside	63.1**
	Sports facilities	34.5
	Walk- and bike-paths	73.6**

** significant difference from the whole sample on a .001 level

SD = Standard Deviation

Inhabitants that report that they use the path very often are older than the average inhabitant (52.25 vs. 49.57-year-old), and almost two thirds are female. Proximity emerges as a strong predictor for use of the path: 80% of very frequent users live in *Hommelvik*, the nearest included neighbourhood. Frequent users

experience more social capital than the average population, report to thrive better and display higher satisfaction with availability as well as quality of neighbourhood-resources. Satisfaction with nature and seaside-facilities is higher than satisfaction with sports facilities and walk/bike-paths. Especially in respect to the Malvik Path itself, frequent users express high satisfaction: 93.5% of frequent users are satisfied with the availability, and 95.9% with the quality of the path (against respectively 79% and 83.4% in the whole population). Frequent users of the Malvik Path also report use of other neighbourhood-facilities more often than the average, especially nature facilities (89% report to use them often) and walk- and bike paths (73.6%). They also tend to engage in physical activity more often, but not more intense or longer than the average participant.

No significant differences in health (78.4% good/very good) or life satisfaction (85.6% high/very high) were found between frequent users and other inhabitants.

Income

When looking at use and perceptions of the Malvik Path by level of household income, it becomes apparent that very frequent use of the Malvik Path decreases with household income. A significant drop in proportions of very frequent user appears among members of households with over 1 million NoK a year. On the other hand, the relationships between income and perceptions of the path are complex. Members of households with the lowest income are the least satisfied with availability and quality of the path but report most use. Members of households with a middle income seem to experience most satisfaction with the paths' availability and quality.

Table 5: Perceptions and use of the path according to household income

Household income	Satisfaction with availability	Satisfaction with Quality	Frequency of use
< 400 000 (n=199)	73.1	75.2	19.1
400- 700 000 (n=515)	83.1	86.7	18.2
700 000- 1 000 000 (n=553)	89.3	82.5	16.7
1 000 000- 1 500 000 (n=533)	77.2	84.3	7.0
>1 500 000 (n=139)	78.0	81.0	6.8

Regression analysis revealed that personal variables (gender, age, income and education) combined explained 2.4% of all variance in use of the Malvik Path. Education was not significantly linked to use of the path. Income emerged as the strongest co-efficient (BETA=-.108) which indicates that frequent users of the path are more likely to earn less than average. Frequent users are older than the average participant.

In the second step (not shown in table 6), all independent variables (thriving, self-rated health, NSC, life satisfaction, physical activity, satisfaction and use of neighbourhood-resources including the Malvik Path) were checked for their influence on path-use individually, while controlling for gender, age and education. No significant correlations were found between use of the path and health, nor for intensity-levels of physical activity. The strongest relationships were found between perceptions of availability and quality

of the Malvik Path (BETA= .384 and .359 respectively): These variables also contributed most to explained variance, raising it to respectively 17.1% and 15.8%. Next, use of nature- (BETA=.327) and seaside-facilities (BETA=.285), as well as walk- and bike paths (BETA= .250) added substantially to explained variance in use of the path (and raised explained variance to respectively 12.8%; 9.9% and 8.3% of explained variance). Satisfaction with quality of seaside raised proportions of explained variance to 6.7% (BETA= .211).

Other included variables (thriving, NSC, satisfaction with availability of neighbourhood resources and with the quality of nature-/sports- facilities and bike paths, use of sports facilities, health and frequency, intensity and duration of physical activity) displayed weak correlations with use of the path (Beta ranging from .113 for duration to .179 for frequency of physical activity). Levels of explained variance varied between 3.3% and 5.6% for these variables.

In the last step, all variables were entered into the regression simultaneously in order to control for mutual inter-relations. Together, the regression model explains 32.6 % of all variance in use of the path. Satisfaction with the availability of the Malvik Path emerges as the strongest predictor for frequent use of the path (BETA=.377), followed by satisfaction with the quality of the path (.220). Income, use of nature- and seaside- facilities as well as walk/bike paths also emerge as significant predictors (see table 6), while none of the other included variables became significant at a .001-level.

Table 6: Regression analysis of potential determinants for use of the Malvik Path

Step	Entered variables	Significant co-efficients	Variance explained (%)
1	Gender	-.072*	
	Age	.104**	
	Income	-.108**	
			2.4
3 **All variables entered at one step**	Income	-.113**	
	Use of nature	.209**	
	Use of seaside	.173**	
	Use of walk/bike-paths	.115**	
	Availability Malvik Path	.377**	
	Quality Malvik Path	.220**	
			32.6

** = significant at .001 level

Structured on-site interviews

Out of the fourteen interviewees, eleven were females. The respondents´ age varied from the youngest at 32 to the oldest at 73, the mean age being 51.2 (SD 14.7). Eleven of the fourteen came from the local area (*Hommelvik* and *Muruvik*) and had travelled less than two kilometres. The three interviewees who travelled the longest had travelled twelve and thirty kilometres. A summary of the interviewees' answers is presented in table 7. The interviewees were in general very positive to the idea of developing a path on the old railway tracks. They liked the access to the seaside and that the path had been developed so that it could be accessible for all people. The old path in the area was more rocky and uneven and therefore probably less accessible for people with physical disabilities.

When asked what they liked about the path, “accessibility” and “sea-view” were the most commonly cited answers, followed by “soft surface” and “flat surface”. Eight interviewees had nothing to remark when it came to what they did not like about the path. Among the six who provided answers to this question, two said that the path is too elevated, something which potentially makes it a bit risky for small children (the interviewee is referring to the fact that since the path was laid on top of railway tracks, it is a bit elevated from the ground, sometimes as much as 40 cm higher). Two referred to a local debate about the name of the path, but without saying that they disliked the name. One interviewee stated that the path lacks lights, which could be good to have for late night walks, and one found the path to be too flat and therefore not challenging enough.

Most interviewees (n=11) use the Malvik Path for walking, two mentions that it is most important for them to meet people there, and one interviewee responded that she uses it for exercise, not specifying if this exercise is walking, jogging or biking, while one uses it for jogging.

Table 7: Summary of interview answers

Inter-viewee	Age	Distance travelled	What do you think about the idea of it?	What do you like in particular?	What don't you like?	What do you use the path for?
1	70	0,03 km	Nice. I walked here before the new path. Now it is better, because it is so flat that I can walk with walking poles.	I like the benches. I can rest there and therefore I can walk the whole path.	They have to clean it so it does not become overgrown.	Walking and meet people. We chat, and when the boathouse is open, I take a coffee. I walk every day. And I bike here.
2	35	30 km	Good that they can use the tracks to make this.	My first time here, …but I like that it is so easy to walk here with a trolley.	I don't know since I haven't walked here before.	Walking.
3	40	30 km	I find it great that they can re-use the railway-track like this.	Nice that it is flat, so we can take small kids here.	I can't say, since this is my first time.	We want to be outside, enjoy the nice weather and meet people.
4	66	1 km	It is just fantastic that the area is open to all people who wants to be outdoor. Beautiful to walk along the sea.	I like that if we can alternate between easy and hilly path. And that it is accessible for everyone. The nature is also nice.	I can't come up with anything here.	I use it to walk out in the nature. If I want an easy outdoor experience.
5	73	1 km	It is great. We use this beach more than the path. And it is nice, maybe nicer, to walk the old path.	That it is accessible, even for those with wheelchair. And the fishing-places and that you can go down to the sea.		I use this beach. We take the grandchildren here and barbecue.
6	32	1,5 km	It is very good. A good place for walking my dogs close to where I live.	The view, the nature surrounding it, the sea, the smell of the sea.	That is hard to say. I think I am satisfied with everything as it is.	I use it for exercise and to walk dogs.
7	35	12 km	Fantastic. It is a great view here.	The sea close by. And that you can bring children here. You can bike and go fishing.	It is a little bit too elevated.	I use it for walking.
8	37	0,5 km	It is great. You can walk here and have access to the sea and the hills.	I like that it is so close to where I live.	It is a bit too elevated. My two-year-old son could trip and fall down.	For walking. I think that I will come here and jog too.
9	47	0,4 km	It is fantastic, I wanted a path like this when I moved here 8 years ago.	I like that it is so accessible to everybody.	Nothing.	Mostly for walking my dog. Or I take a walk by myself to listen to the sea.
10	50	2 km	Good to have a hiking opportunity so close.	That it is so accessible to everybody.	Sometimes there are too many people and bikes here.	I use it for walking.
11	48	2 km	I think it is good.	Everybody can come here. It is a path even for those in wheel-chair.	I can’t think of anything I don’t like with the path.	For the most part: walking, and sometimes biking, and to walk my dog.
12	65	1 km	It is a paradise. I love it.	The sea and that the cover is gravel, it is soft.	Some feel the name is not right.	Walking.
13	67	1 km	I love it.	The sea, the soft surface and the view.	Some disagree about the name of it.	Walking. Exercise.
14	54	1 km	I think it is very good.	I like that many people walk here, at all hours during the day. Then I feel safer.	Lights should be put up so we can walk here in the evenings.	I use it for walking and jogging. Sometimes I go by bike too.

Short on-site survey

In 2015, 54.9 % of the sample were female, while in 2017 58.3 %were female. The average age in 2015 was 46.2 years, and 42.8 years in 2017. In 2015, 65.6 % had no or low education, while in 2017 only 47.8%had no or low education.

Table 8: Population characteristics

	2015	2017
N	142	49
Gender (% female)	54.9	58.3
Mean age (SD)	46.4 (20.2)	42.8 (16.1)
Frequency of level of education (%)		
No education	22 (15.49)	6 (12.24)
High School	62 (43.66)	16 (32.65)
Bachelor's degree	28 (19.72)	11 (22.45)
Higher education	16 (11.27)	13 (26.53)
Missing	14 (9.86)	3 (6.12)

Respondents (n=48 (2015); n=44 (2017)) provided additional feedback to an open-ended optional question regarding their motivation for using the path. The three most frequently motivating factors for using the path are the same in 2015 and 2017. In 2015 the most cited reason for using the path was "Experience nature and the view". This was an important motivator in 2017 too but listed second when summarising frequency of mention. In 2017 the main reason for using the path was "Nice path for walking and good surface". This was ranked as the number three reason in the 2015 survey. Apparently, what attracts the users to the path are contextual features and qualities on and around the path (nature, view, good (soft) surface). Interestingly "Exercise and health benefits", an important reason for use both in 2015 and 2017, had dropped somewhat in importance for the respondents in the 2017 survey. In table 9 and 10 the number of reasons is listed with number of mentions for 2015 and 2017 respectively.

Table 9. Reasons for using the path 2015

Reasons for use	2015
Experience nature and the view	18
Exercise and health benefits	17
Nice path for walking and good surface	15

Table 10. Reasons for using the path 2017

Reasons for use	2017
Nice path for walking and good surface	24
Experience nature and the view	11
Exercise and health benefits	9

2.7 Discussion

The overarching aim of the Malvik Path evaluation study was to investigate who uses the path, what type of activities the path stimulates, and to provide knowledge on whether and how accessible green spaces are beneficial for health, social inclusion and physical activity for all citizens in the communities.

A mixed method research design (Johnson & Onwuegbuzie 2004) including a diverse range of relevant and sensitive data and information sources (counting data, questionnaire surveys, registry data, observations and structured interviews) was applied to capture the complexity of the phenomenon and fulfil the aims of the outcome evaluations. Findings are discussed in relation to INHERIT aims of improving health, equity and the environment.

This study shows a significant increase in use of the path from 2015 (before the official opening) to 2018. People in general are satisfied with the path. Contextual matters are identified as important determinants for using the path. The path is used by all social groups for various types of activities.

Observations from the SOPARC data-gathering indicate that the path is mostly used by "adults", and less by seniors or adolescents. This could be jeopardised by the relay run happening during the observation where mostly adults participated. On the other hand, comparative data from the population survey indicates that the average user of the path is slightly older than the average Malvik population. Living nearby emerged as a strong predictor for use of the Malvik Path in the comparative analysis, with 80% of very frequent users living in the closest included neighbourhood, Hommelvik. This was also supported by regression analysis, where availability of the Malvik Path emerged as the strongest predictor of use in the last step of analysis. Moreover, "availability/accessibility" emerged as an important reason for using the path in the analysis of the structured on-site interviews. Regression analysis revealed that personal variables, namely income, age and gender explained 2.4 % of all variance in use of the path (education did not reach significance at all). This relatively low proportion of explained variance indicates that personal variables "who you are", does not impact use of the path substantially. Moreover, when all possible influencing variables are entered into the equation, income is the only socio-economic variable which is still significant, indicating that people facing socioeconomic disadvantages tend to use the path more often than people with no socioeconomic difficulties. Entering contextual variables into the model also raised levels of explained variance substantially (from 2.4 to 32.6%). This is in line with findings from on-site short surveys; while "exercise and health benefits" came high on the list as the reason for use in 2015, this was less important for the users in 2017, indicating that the focus had shifted somewhat from personal goals to contextual features. This is supported by the short interview of fourteen persons using the path in 2018, where only one person claimed that she used it for jogging (exercise) while the remaining thirteen said they used it for walking.

These results indicate that contextual matters were more important determinants for using the path than personal variables. This suggests that the path is perceived as inclusive, and as it is used regardless of belonging to any particular socio-economic group. These findings indicate that putting effort into the location and design of this kind of outdoor facilities might prove beneficial. This is in line with previous research underlining the importance of creating supportive social and material settings to promote health and social inclusion (Hamano *et* al., 2013; Abraham, Sommerhalder & Abel 2010; Leventhal & Brooks-Gunn 2000).

Perceived quality of the Malvik Path emerges as the second most important predictor of use. As perceived quality might indicate the "fit" between feature and audience (Maass *et al*., 2014), the high satisfaction with quality of the path especially among frequent users might be understood as a consequence of inclusive processes throughout the planning, design and implementation of the path and it's features.

On the other hand, as illustrated in table 5, this link between perceptions and use of the path might vary according to socio-economic group: while participants living in households with income below 400 000 NoK expressed the least satisfaction with both availability and quality of the path, they also reported the highest proportion of very frequent users. This might indicate that it is not necessarily just about perceived quality, but also about having an affordable option, to be active outdoors for those with lower income. In addition, this might point towards other factors which are not included in this analysis but might be important predictors for use (Maass *et al*., 2014). On the other hand, following the above argumentation, this might be understood as a pointing towards which groups to specifically include in later processes or other projects.

Next, frequent use of other nature and seaside-facilities as well as bike-paths emerged as important co-efficients of use of the Malvik Path. On the one hand, this might indicate a well-known dilemma in the domain of public health: people who are already active also tend to dedicate new resources to a more active use, thereby widening the gap in health rather than diminishing it (Mittelmark 2014). On the other hand, as frequent use of the Malvik Path might simultaneously affect reported use of bike-paths, nature- and seaside-facilities (as the path could be described as either of these), these results are hard to interpret.

According to observational data, the path facilitates both walking and vigorous activity, even if walking seems to be the activity people engage in the most. Fewer people engaged in sedentary activity like picnicking or sitting. Moreover, comparative analysis of very frequent users with the average population indicates that frequent users also engage more often, but neither more intense or longer in physical activity in general. This supports descriptions of the path as a low-threshold amenity, which can be used by people regardless of level-of-fitness and kind of activity one wants to engage in. This is also supported by findings from the on-site surveys, which indicate that the proportion of people who uses the path mainly for exercise has decreased between 2015 and 2018.

Looking at the various areas of the path highlights differences in the use of these areas indicating the path's affordances for different types of activities. While large proportions of people are engaged in walking or vigorous activity in the pathway (the Muruvik and/or the Hommelvik starting points) people are engaged in more sedentary activity (sitting, picnicking) at the beach area and the seating area. Hence the path attracts uses of different capabilities with different purposes. The seating area provides older adults and families with children the opportunity to rest half way between the two ends. A 3 km long pathway could be too long for older adults to walk at one go, and hence a seating area half way offers the opportunity to sit and relax before resuming the walk. This is supported by the finding from short onsite structured interview: "I like the benches. I can rest there and therefore I can walk the whole path" (age 70)

No significant changes in self-rated health, life satisfaction, social capital, thriving or levels of physical activity could be found between 2014 and 2018 on a population-level. This might be understood as the path not improving health or health-indicators significantly during this period. On the other hand, as the population survey does not track changes on an individual level, and frequency-of-use of the path differs

among participants, it is difficult to conclude on the basis of this comparison. Moreover, a substantial increase in the use of neighbourhood-resources has been found. Despite some insecurity linked to this measure (see limitations section below), this points towards people indeed being more engaged with their neighbourhood, which might contribute to social connectedness and benefit health in in the long run. This is supported by comparative findings, which suggest that very frequent users of the Malvik Path experience more social capital in the neighbourhood than the average inhabitant.

Findings pointing towards income being the only significant personal variable, and its negative correlation with use can nevertheless be understood as a sign that the path is inclusive towards citizens facing socioeconomic disadvantages.

2.8 Limitations

The present evaluation of the Malvik Path builds on a mixed-method design with a broad range of data, both quantitative and qualitative. Accordingly, a variety of methods were applied during data-gathering and interpretation. This also implies a variety of specific challenges and limitations linked to the various types of data.

The population survey on which part of this report is built on is a cross-sectional survey which does not track individuals but assesses health and health-indicators in the municipality on a population level. Thus, changes in outcome-variables cannot be linked to individual behaviour over time but must be described at a population-level. This makes it impossible to assess how behaviour at one point in time affects health later. However, as health promotion seeks to promote health for all, being restricted to assessing health on a population and group-level might be beneficial: if we cannot explain a lack of impact in some social groups by individual behaviour within the group, the focus is turned unto contextual features and group-characteristics. Statistical power could potentially be an issue here, however, the number of survey participants indicates good statistical power even in subgroups. The lowest number of individuals in a specific sub-group analysed here is n=199, which again indicates sufficient statistical power to draw conclusions.

The cross-sectional design of the population survey makes it difficult to assess the direction of some relationships. This leads to some uncertainty about how to understand a number of measures. This is illustrated by the above-described difficulties to assess whether use of neighbourhood-features increases use of the Malvik Path, or whether frequent use of the Malvik Path influences how one describes ones use of bike paths, nature and seaside-facilities in general. Next, some specific uncertainty is linked to the measurement of use of neighbourhood-resources from 2014 to 2018: while the frequency-of-use in 2014 was assessed through five specific statements (at least once a month/week/daily etc.), participants in 2018 were asked to describe their frequency-of-use on a 5-point scale ranging from “very often” to “not at all”. On one hand this might give a less exact picture of the frequency of use and increase uncertainty as to whether levels of “very often” are comparable between individuals and groups. On the other hand, such subjective descriptions might give a deeper insight into the perceived importance of a feature or activity: if I report to use the path very often, this might indicate that it is a very important feature and activity in my life. However, for the sake of this report, the substantial changes in frequency-of-use has to be interpreted with great care.

Structured observations using the iSOPARC contributed to the material by providing on-site observations about activities on various locations along the path. However, as these represent spatial observations,

this method is very sensitive for happenings and contextual matters, such as at which time of the day observations are made. Furthermore, the path was assessed during only one season (early and late summer) making it impossible to infer annual usage rates across other seasons of the year. The path assessments were only conducted in pleasant weather conditions, and other activity levels and number of users might have been registered in rainy and/or cold weather. For instance, during the winter season the path may be slippery, during wet weather, less people are engaged in out-door activities. Originally, iSOPARC was developed to assess people's use of different areas in a park or community open space. As observations are structured according to pre-defined categories, the emerging picture might be skewed or distorted, if ambiguous observations are bent to fit with the categories (for example by coding gender-ambiguous individuals as "male"). This also implies a chance for observer-bias, and inconsistent coding across observers. While paper based SOPARC provides an opportunity to code openly, the newly developed iSOPARC tool offers less flexibility in terms of coding the activity levels as the activities are predefined in the application. The observer must judge and determine age or gender, which may impact on the reliability of the method. However, the reliability of this method has been tested and it is a validated tool.

Both the short survey and the structured interviews were conducted on-site, and provided important information about perceptions, and helped to fill some of the emerging concepts with content. On the down-side, these interviews include few individuals. Moreover, there was substantial variation in who was willing to be interviewed on the path: for example, fewer men than women were willing to participate, resulting in a skewed sample. Additionally, as these interviews were on-site, these cannot provide information about who does not use the path. Taken together, even if each method of data-gathering and analysis yields specific limitations and insecurities, the broad range and variation of gathered data provide a rich picture of who uses the path for which kinds of activities.

2.9 Learning points for future research

Looking ahead there is still a need to further explore benefits in health and wellbeing from green space interventions and to include contextual determinants/factors when evaluating effects on health, as this study indicated, it was contextual factors such as location, availability and designated spots for social interaction that motivated the users of this specific green space. Furthermore, further research should focus on investigating various groups' access to sustainable lifestyles and environments and the needs and requirements of especially vulnerable groups. Such knowledge can contribute to creating more effective health promoting and inclusive communities.

2.10 Learning points for potential scale up and transferability

Greater attention should be directed towards social equity considerations in the planning, design, implementation of interventions, and policies that aim to reduce social inequalities in health. To obtain this, community planners and policy makers should improve opportunities for participation and community involvement in design for all groups. This study shows that the Malvik Path was not used mainly for exercise, but for other reasons such as the opportunity to experience nature, the scenery and the sea view and for social interaction. While these factors are by themselves important for health and well-being, a secondary long-term effect is that people are getting more physically active.

3. Restructuring Residential Outdoor Areas

3.1 Background

Between 2016–2018, the Swedish government allocated funds of SEK 1000 million (Euro 100 million) to support upgrades of outdoor areas in socially deprived residential areas. The National Board of Housing, Building and Planning (NBHBP) administers this financial support. The aim was to improve outdoor environments so that they stimulate physical activity and social interaction, and to maintain or develop the design of residential outdoor spaces in areas with socioeconomic challenges. Under this funding scheme, the interventions should make a long-lasting contribution to creating attractive, functional, and safe outdoor environments and reducing environmental inequalities. The support can be applied for by property owners in residential areas with socio-economic challenges, defined as an area where more than 50% of households have low purchasing power. The financial support was given to support interventions where a new facility was created or for an existing facility renovation. For example, a facility can be a meeting place for cultural and leisure purposes, pedestrian and bicycle paths or building related art. One criterion that makes interventions more likely to be chosen for this financial support is that the intervention in questions includes dialogue with residents. In addition, priority is given to interventions that involve multiple stakeholders such as property owners, industry, civil society and local authorities. It is key that citizens who live and work in the area where the intervention takes place must be engaged and involved in the planning of the upgrades. These people have valuable knowledge about how their neighbourhood works and what local challenges they face. This local base of knowledge and experience can contribute to a better basis for relevant decision-making in the area.

3.2 Overall aims

The objectives of the intervention were:

- To increase the use of the residential outdoor area and stimulate physical activity and social interaction.
- To create a safe and comfortable residential area for all tenants using a participatory approach.
- To break the trend that young men dominate the outdoor residential area, and to create an attractive, functional and equal environment where all tenants feel safe.

The aim of this INHERIT case study is to investigate and evaluate the effects of the intervention to restructure a residential space in a deprived neighbourhood in Stockholm on residents' behaviours. This study seeks to examine aspects of wellbeing, physical activity, safety and social interactions following a participatory approach to restructuring an outdoor area into a more attractive and green outdoor residential area with renewed opportunities for various physical activities.

3.3 Context

The triple win approach of INHERIT aims at improving equity, health and environment in communities across Europe. Restructuring residential outdoor areas in urban settings provides the opportunity to support these three goals.

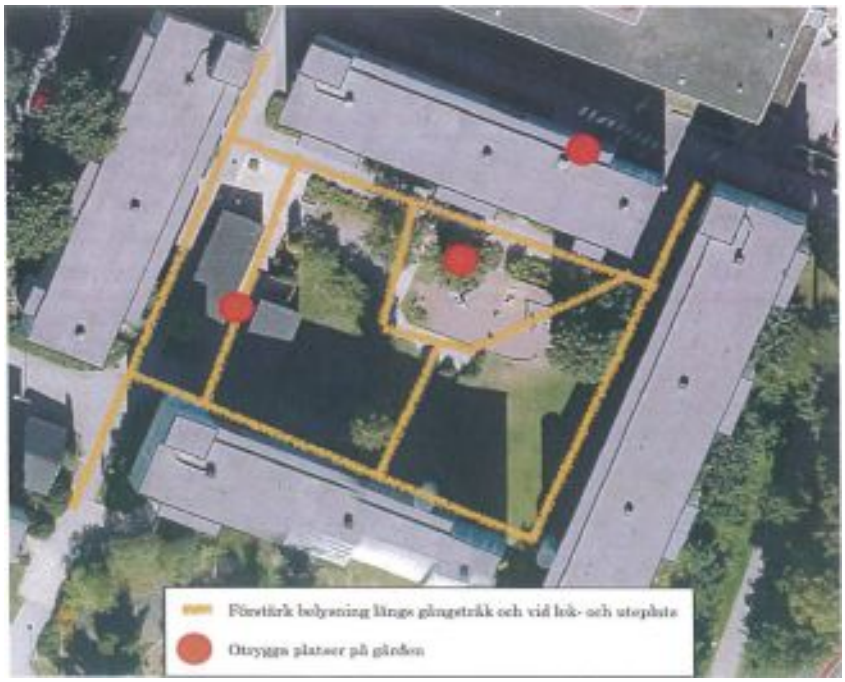
Giles-Corti (2005) reported that people who have access to attractive green spaces were 50% more likely to engage in high levels of walking. Bancroft *et al*., (2015) provide a review of literature that links proximity of parks and measured physical activity, highlighting the benefits of nearby green spaces for people's

activity levels. Physical activity improves health and can help prevent cardio-vascular diseases and diabetes. In a recent paper, Chastin *et al*., (2019) for example reviewed the literature on the relationship between light physical activity and cardiometabolic health and mortality in adults; according to their review several studies suggest that even light physical activity could improve cardiometabolic health in adults and reduce their mortality. Improving outdoor spaces may therefore encourage greater use of them in ways that contribute to health.

Offering free opportunities to engage in physical activity by providing green space (especially in low socio-economic areas) can be seen as a means therefore to contribute to improving health equity. A study from the US has suggested that greening programmes are more likely to happen in wealthier areas (Conway *et al*., 2010). Investing in restructuring open spaces in more deprived areas may contribute to reduce environmental inequalities and support improvements in health equity (Jennings, Laron and Yun 2015).

Providing more green outdoor spaces in urban areas also contributes to environmental sustainability (Staatsen e*t al*., 2017). Greening and increasing biodiversity in urban outdoor spaces and parks also enhances people's experience and enjoyment of these spaces (Palliwoda, Kowarik and von der Lippe 2017) which is also likely to encourage use of outdoor spaces in urban areas.

The entry point for the action in restructuring residential outdoor areas in this case study is therefore the physical environment, with the aim of improving the outdoor environment of a residential area in a deprived neighbourhood by incorporating social aspects of urban planning. This way, the residents' exposure to outdoor activities, social interactions and safe environments should increase, and opportunities for social activities, nature-contact and tension-reduction should be improved.



The study area is a residential area, in Husby, Stockholm. The suburban Husby has about 18 000 inhabitants and it was built as part of a governmental program in which 1 million dwellings were built in a decade 1960-1970 in Sweden to meet the need of affordable housing, the "Millionprogram". The area consists of four multi-family houses and a courtyard/open space (Figure 1) that was designed and restructured in 2018. A neighbouring open space that was not restructured served as a comparison control area for the study.

Figure 1: Intervention area (unsafe places marked, more lighting planned along the yellow lines)

The neighbourhood has a population with low socio-economic status. Local Government statistics show that among the residents, more than 80% originate from Asia and Africa The voting participation is low,

unemployment is higher and income and purchasing power is lower than average in the municipality of Stockholm. High levels of social problems (e.g. unemployment, crime, alienation) and poor health are reported in the area (Local Government statistics, 2018, The Swedish National Council for Crime Prevention). Also, drug trade/trafficking is a major problem in the area.

The property owner Hembla (former named D. Carnegie & Co) initiated the intervention to reconstruct the outdoor area in 2017, (planning started in 2017, intervention June – November 2018, evaluation finished in January 2019). The intervention was planned in collaboration with several stakeholders including urban planners, an architect, project manager and residents. Ideas for restructuring the area were developed in a participatory manner with the residents. The property owner financed the project with 50% support from NBHBP.

Urban planners (Urban Utveckling), who were commissioned by the property owner Hembla organised a dialogue with residents. Forty people (23 women, 17 men) participated in the dialogue. More than half of the participants, 23 (including 14 children) provided suggestions about how the area could be improved. Hembla circulated the announcement about the consultation and the importance of residents' participation in the dialogue. Maps were used during the dialogue to generate discussion so that participants could point out specific parts which needed improvement. Food and drinks were provided during the consultation. It emerged that the residents felt unsafe in the residential outdoor area. Young men dominate the outdoor area and drug dealing was a common activity. Residents also felt that the community between neighbours should be strengthened. A special focus was how to stimulate women to spend more time on the outdoor area. Therefore, the residents wanted the area to include: play and activity areas for children, community areas that could facilitated interaction between neighbours ensuring gender equity and safety/security, increased visibility in the courtyard, more green areas in the courtyard, and functionality and accessibility in the outdoor area.

A large modernisation of facades, balconies, stairwells, elevators and attics was conducted in the spring and summer 2017. The outdoor residential area is surrounded by about 100 dwellings. The design of the outdoor area such as playgrounds, vegetation and lighting were outdated and in need of refurbishment. Working with the social aspects of urban planning the property owner wanted to create an attractive, functional environment where all tenants, regardless of gender, age and ethnicity, feel safe. This includes activities such as renewal of meeting places (e.g. improved lighting and gardening initiatives) and activity areas to stimulate social interaction (e.g. picnic areas, tables and chairs), removal of illegal traffic, and increase of safety and trust between the tenants as well as with the property owner.

Description of the intervention area, Nordkapsgatan

The area (approx. 1400 m2), was mainly flat with a slope in the south direction in the yard. The exterior, before the renovation, only had grass, several trees and some small paths of asphalt for pedestrians. It also included a playground (swings, sandbox, a slide) for children and benches that can seat several persons. The play equipment and the benches consisted mostly of plastic, wood and steel. The yard was not in the best physical condition before the renovation, and the benches, the playground and the asphalt were worn-out. The main construction material in the area is concrete with some wood and steel. The area was used as a playground for children, however the most dominating activity observed was walking, with individuals using it as a thoroughfare enroute to somewhere else. The weather conditions during the

summer season were fine and perfect for observing activity in the area, because there were many people moving around in the area.

Photo 1: Intervention open space (before)

Photo 2: Control open space (before)
Friberg/Merritt 2018

Photo 3: Intervention open space after the restructuring
Friberg/Merritt 2019

Description of the intervention area, Tönsberg

The control area is about the same size (approx. 1400 m^2) and is identical to the intervention area in landscape character and features with some exceptions. The area is surrounded by the buildings occupied by the residents and has a mound just like the intervention area. The area is surfaced with grass and has paths of asphalt for pedestrians. The area also includes a playground in the centre with swings and benches around it. The physical condition of the area is rather worn-out; the benches and asphalt were more dilapidated than the playground equipment. The difference with the intervention area is that the paths here are not used as a thoroughfare as the paths do not connect to other areas. The spontaneous impression is that there were similar activity levels in both areas, but in the target area the flow of people was greater than in the control area. The people in the control area appear to stay for a longer period than in the intervention area.

Description of the 'intervention'

The intervention included replacement of the surface cover (e.g. grass and sand) in several places with new land filling, lawns, artificial grass and concrete tiles, installation of larger playground equipment (slide, trampoline, zip line and stepping logs), a bicycle park and new benches. Many trees were removed, and new footpaths have been added to the area. The slope is still there and used for encouraging physical activity. The asphalt and the benches in the playground were replaced with new improved ones.

Photo 4: New equipment in the intervention area
Friberg/Merritt 2019


Photos 5-6: New equipment in the intervention area
Friberg/Merritt 2019


Photos 7-8: New sandbox in the intervention area
Friberg/Merritt 2019


Photos 9-10: New tables, benches barbeques in the intervention area
Friberg/Merritt 2019

3.4 Research questions

The aim of this pilot study is to investigate the effects of an intervention to restructure and improve neighbourhood open space on health-related behaviour and well-being of its residents (including level of physical activity, use of outdoor space, social interactions and well-being).

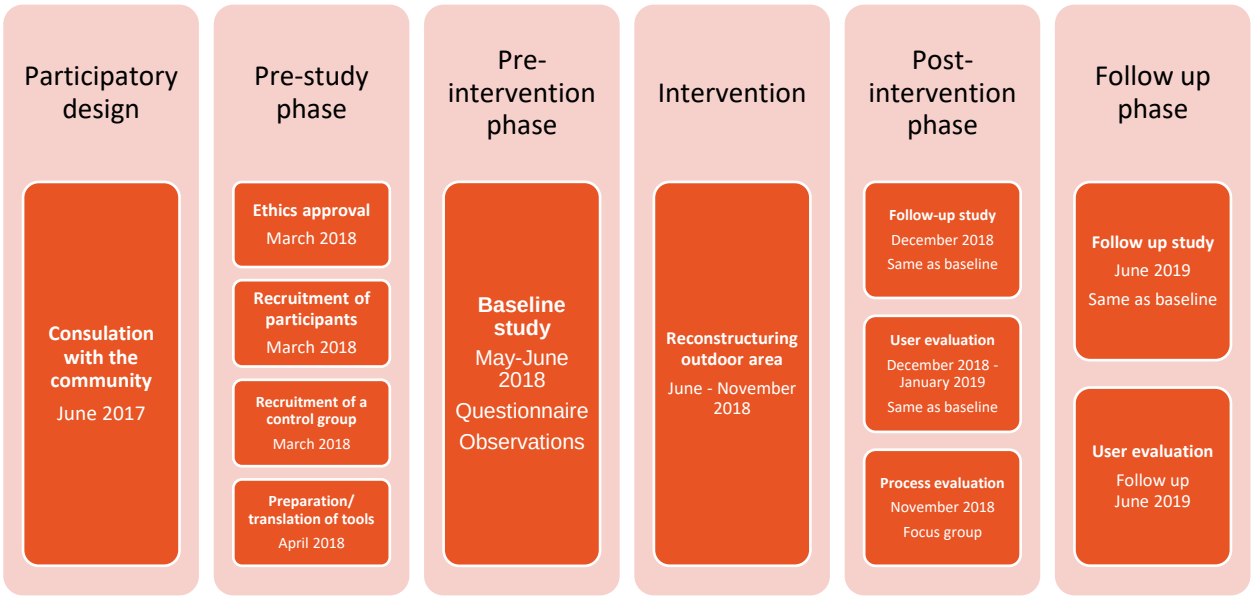
1. How does restructuring an outdoor space in a disadvantaged neighbourhood impact residents' health-related behaviours (physical activity, and social interaction) and mental well-being?
2. How does the design of the restructured area stimulate different activities among the residents?

3.5 Methodology

A quasi-experimental mixed methods approach was adopted to evaluate selected aspects of this urban regeneration programme. The evaluation plan is illustrated in Figure 8. The pre-intervention data were collected in June 2018, post intervention data collection was held in December 2018-January 2019 and another follow up data collection is planned for June 2019. The outcome variables are physical activity, and well-being measured using a household survey questionnaire as well as a systematic observation using the System for Observing Play and Recreation in Communities (SOPARC). The intervention area (Nordkapsgatan) was compared to another neighbourhood with a similar composition but no change in the open space (the control area Tönsbergsgatan). A post intervention dialogue with local residents was held in order to enrich understand of the findings.

A process evaluation with focus groups consisting of the various stakeholders was used to gain knowledge of the intervention processes in the target area (reported in Report D5.1).

Figure 2: Evaluation plan



Systematic observations

Systematic observations of the intervention area and the control area were conducted during two periods; May/June 2018 and November/December 2018. Each time observations took place for four days including a weekend day for a total of 16 scans over the data collection period at each location. Both the areas were observed by the same person at each period.

Figure 3: Map of the yard of the intervention and control area. (The number shows observation spot.)

Before the intervention started in May/June 2018

The observer found a functional spot for observations on the northeast corner of the yard, which established a good overview of the area (marked with the number "1" on the map above). There was a storage for bicycles located on the yard, which interfered with the overview, and created a blind spot. The blind spot was just a small area behind the building and the observer did checkouts at this area between regular observations to make sure that there was not much physical activity behind this building.

Like the target area, the observer found a spot with an overview over the control area in the northeast corner of the yard. This yard also included a storage in the middle of the yard. This storage however, created a bigger blind spot than in the target area, but could be handled by doing checkouts at this spot between the ordinary observations, like it was done in the target observation.

After the renovation November/December 2018:

The second set of observations were made in November/December, due to a delay in the process of renovating the yard. This was unfortunate as the weather in Stockholm at this time of year is cold and damp. The observations were made during November/December, which could have affected the result since the weather conditions during winter might not encourage people to engage in activity in the area to the same extent as during summer season.

Household Survey

Distribution of questionnaires for quantitative evaluation of the intervention

Prior to the reconstruction of the outdoor area (end of May 2018), questionnaires were distributed to each household by personnel from the Public Health Agency of Sweden (FOHM). The questionnaires included background questions (i.e. gender, education level, age), questions about physical activity (based on the International Physical Activity Questionnaire (IPAQ), well-being (based on the Short Warwick-Edinburgh Wellbeing Scale, SWEMWBS) and about the outdoor area (frequency and type of use). The questionnaire in full was only available in Swedish, however the residents could get support from the FOHM personnel in Arabic, Russian and English. Part of the questionnaire, the IPAQ questions was also available in English and Arabic on request. Questionnaires were distributed to the households in the control area in the same manner. One envelope including two questionnaires, an information letter and a return envelope (including postage) were inserted in letterboxes directly attached to each apartment. In total, 106 envelopes were distributed in the intervention area, and 128 in the control area. Three weeks later, a reminder letter was distributed in the same fashion. A few weeks after the intervention was finalised (early December 2018), follow-up questionnaires (same as at baseline) were distributed to each household as described above (including a reminder).

Dialogue with residents

Due to the low response rate for the survey among residents (between 8-17% for the different sites and time points, see table 1), FOHM conducted a dialogue with 8 adult residents (aged 40-70 years) to gain further insights. The residential board helped to organise this meeting.

3.6 Results

SOPARC

In total, 151 park users were observed using the SOPARC tool in the two areas. At baseline, 111 people were using the park during the whole period of observations and at follow-up only 40 people were using the park, despite the same number of scans. Below are some main findings, results are also shown in figures 9-13.

- Generally, more people were present in the two areas at baseline, compared to follow-up
- The most common activity was walking and at follow-up it was the only observed activity
- More women than men were present in the intervention area on both occasions, compared to the control area
- The main type of activity observed was walking. For most SOPARC scans, no activity was observed, i.e. no person was present.
- At baseline, there were mostly children present in both areas, compared to follow-up where barely any children were present. At follow-up however, there were more adults and adolescents present compared to baseline.

Figure 4: Activity Level in the intervention area at baseline and follow up (number of people)

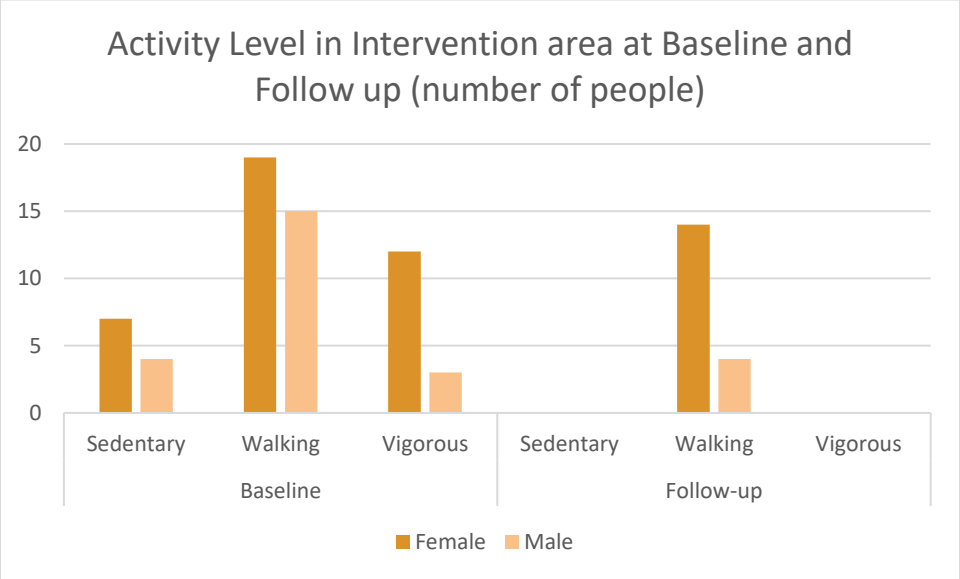


Figure 5: Activity Level in the control area at baseline and follow up (number of people)

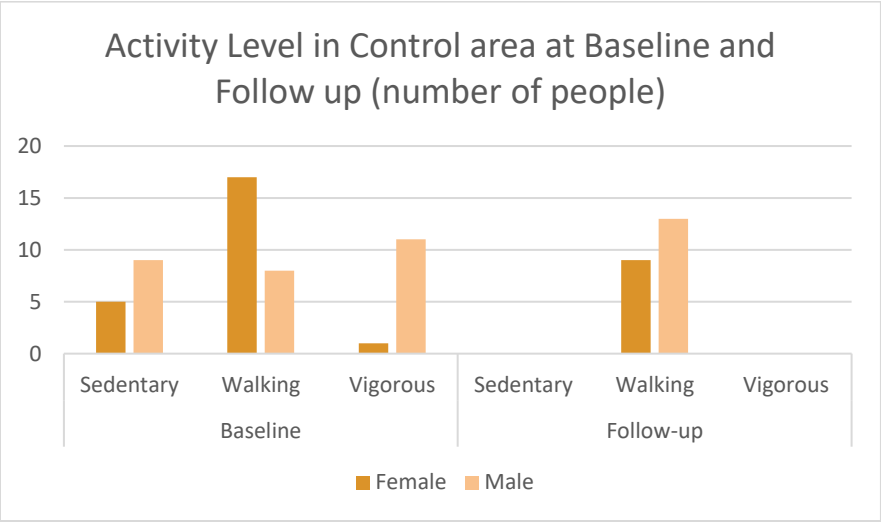


Figure 6: Main activity at baseline in the control and intervention area

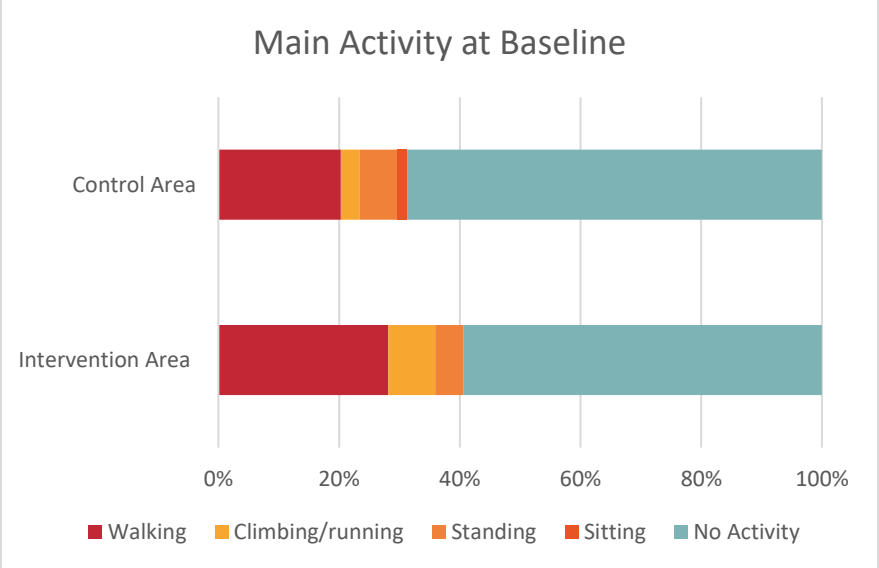
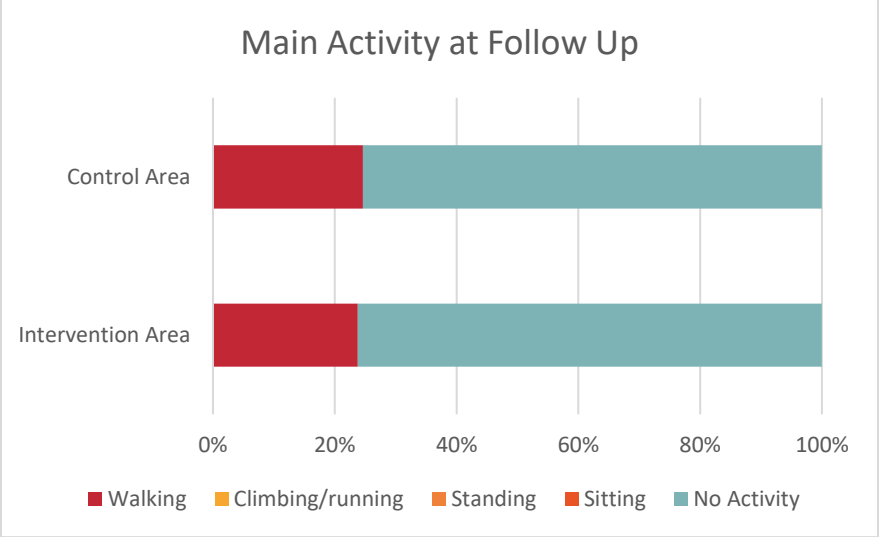


Figure 7: Main activity at follow up in the control and intervention area



Household Survey

The numbers of responses to the survey are shown in Table 1. The response rate ranged between 8-17 percent depending on area (intervention/control) and time (baseline/follow-up). The response rate was higher in the control area. Each household received two questionnaires but only one questionnaire was used for those households that replied.

Table 1: Number of responses to the household survey at baseline and follow-up

Areas	No of responses at baseline	No of responses at follow-up
Control area (n=128)	22	17
Intervention area (n=106)	9	11
Total (n=234)	**31**	**28**

Demographic Information

The respondents were evenly distributed between males and females and the average age was 58 years. The mean number of people in the household was 2.3. The educational level was rather high, 42 percent had studied at university and most people were either working (26 %) or were retired (42 %).

Physical activity

The International Physical Activity Questionnaire (IPAQ) was used in the survey to inquire about people's physical activity pre and post intervention. At the control site, none of the IPAQ items had a significantly different mean at follow up compared to baseline.

At the intervention site there were two items that had significantly different means at baseline and at follow up. For the item "7b) How much time did you usually spend doing vigorous physical activities on one of those days? (minutes)" the mean went from 165 minutes (SD=57) down to 51 minutes (SD = 51); t(9)=3.088, .013). However, it should be stated that average number of days that participants indicated to work out every week went up (albeit not statistically significantly) from .8 to 2.3. The other item that was significant in the intervention group was the item "9b) How much time did you usually spend walking on one of those days?". While the mean at baseline was 100 minutes (SD = 45) it was only 50 minutes (SD = 24) at follow up; t(10) = 2.537; p = .028).

Well-being

Participants were asked to rate their general health on a scale from 1-100. For the control group the mean of 70.62 (SD = 20.617) at baseline went down to 59.76 (SD = 29.179). However, this change was not significant. For the intervention group the mean went down from 56.89 (SD = 23.84) down to 48.91 (SD = 29.96) – this change was not significant either.

Participants were also asked to fill in the Warwick Edinburgh Wellbeing Scale – by adding the individual items, the overall wellbeing score was calculated. For the control group the mean for this score went up from 24.94 (SD = 4.465) to 25.27 (SD = 3.654). For the intervention group the total score went up from 23.50 (SD = 2.563) to 24.40 (SD = 5.985). However, neither the score-change for the control group nor that of the intervention group was statistically significant.

Perceived safety and opinion about outdoor area compared to other outdoor areas nearby

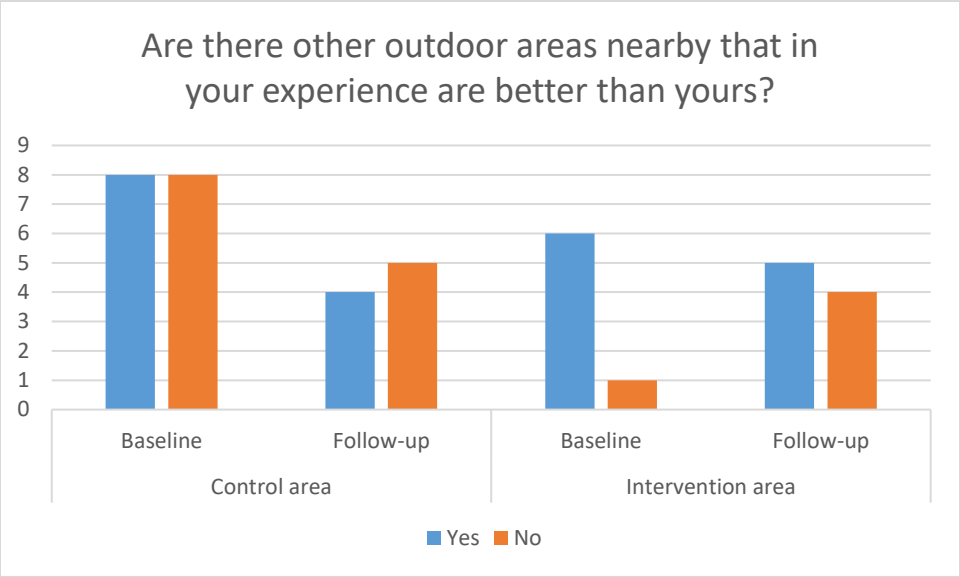
The quantitative data regarding feelings of safety in the control and intervention areas are inconclusive because of the low number of respondents.

However, written comments from five respondents at baseline in the control area when asked why they did not feel safe showed concern about issues such as drugs and drug sales, noise from builders in the area, and intercultural issues ("Those that are there belong to the same homeland, and they are there with the whole family and friends, so it is difficult for others to be there"). At the follow up there was only one comment and it touched on drugs and gangs.

In the intervention area, several participants (six) also mentioned issues regarding drugs; furthermore, mopeds were mentioned, fear of rape, the need for supervised playgrounds, and the need for renovation of the area. In the follow up drugs were mentioned again by several people, as well as issues regarding teenagers being disruptive (e.g. using explosives/ fireworks), burglary and issues with weapons, the fact that cars can drive into the yard was also mentioned as a problem.

When asked if there were other better outdoor areas nearby, a larger proportion of people in the intervention area stated "yes" at baseline, compared to follow up. In the control area, it was no difference between the two occasions, and equal between "yes" and "no".

Figure 8: Better outdoor areas nearby in the control and intervention area



Dialogue with the residents

In Box 1 points made by residents during the post intervention dialogue are shown.

Box 1: Points made by residents during the post intervention dialogue

What aspects of outdoor space use are important?

- *I think I will use the area for barbeque and snack breaks ("fika").*
- *I will use it more with the kids, but not now in the winter.*
- *The access balconies are used to meet and talk, the hope is that more people will come down to the outdoor area. The redesigned open space might attract those people to come down and use the ground.*

Those who did the survey – did they feel the questions probed for the relevant aspects of outdoor space? General experience with the survey.

- *Yes, but I haven't made any changes since I answered the questions the first time.*
- *Yes, but have not been able to use the area since the winter came when it was reopened.*

What meaning did it have to them that they were offered the opportunity to get involved in the project/ have a say?

- *Good that we were invited to have a part of it, but it should be given more opportunities.*
- *It was the residential board that helped the landlord to collect our views, knocked doors and asked everyone what they wanted.*

Has the neighbourhood changed significantly as result of the project?

- *The elderly think the outdoor area is nice.*

- *Open and transparent just as we wanted, maybe a little empty now but it will change later with the vegetation (flowers, bushes, trees).*
- *Good with gates that reduce cars in the yard*
- *Nothing for the kids, no swings*
- *Too little for the younger children, they will be disappointed*

What would they change if they could/ do differently? What have they been unhappy with?

- *They showed drawings at a relatively late stage, when most things were decided.*
- *More contact with residents is a wish, other landlords/property owners have more frequent and they listen more.*
- *Bad information all the time from our landlord/property owner.*
- *Be more transparent, they think they are, but we disagree. Still to see if the landlord learns from this.*

3.7 Discussion

Two observation periods were conducted in order to make a comparison of the area before and after it had been renovated. However, the first observation period was during the summer season, and the second period took place in November. It is reasonable to assume that this could affect the level of activity in the area, since there were more active people during the summer period. The weather conditions during autumn/early winter might not engage people in activity in the nearby outdoor area to the same extent as during the summer season. It may also be more common to visit other nature areas, such as forests, during this season. Another possible explanation for the low activity at follow up could be that the area seemed closed off although it was finalized. There were equipment and material left in the area for some time. This may have prevented people from venturing into the area. The area was not officially "launched" for the residents.

Acknowledging this fact, it is difficult to conclude whether the renovation has had an effect on the level of usage of the area, or if the low number of people in the area is due to the season. A more complete evaluation would include summer observations of both areas.

The physical condition of the intervention area changed substantially after the restructuring. Benches were replaced, new asphalt was applied and the playground was provided with new equipment (mainly in wooden material) including a trampoline, a zip line and stepping logs. In addition, it appears that an important purpose of the refurbished area was to encourage neighbours to socialize. By comparison, before the renovation, while the main use of the area was as a playground for children, the most dominating activity was by people walking through the area to go somewhere else. In the intervention area, a clear majority stated at baseline that there was a better outdoor area in the area (86%) whereas at follow up a smaller proportion of people thought so (56%). In the control area, there was no difference between baseline and follow up (approx. 50% at both occasions). However, the low response rate makes it hard to interpret the data.

A participatory approach was used to engage residents in the area and to have a dialogue with the residents on how the outdoor area was currently used, and ideas on how they want to use the area in the future. It had emerged that the residents felt unsafe in the residential outdoor area, and these unsafe sites were located, together with the residents. This was valuable knowledge for property owners and

urban or community planners. The residents felt they were listened to. There were of course many different opinions, and it was not possible to take them all in consideration. For instance, some people thought there were too few options for children to play in the renovated area. On the other hand, the area was improved regarding more meeting points for all ages, i.e. BBQ, tables, seating. It is therefore likely that some residents were disappointed with the measures taken and might have influenced others to be negative.

Several residents mentioned issues regarding drugs and the need for supervised playgrounds, which is currently planned after recent talks with the police. In the follow up, drugs still seemed to be an issue among the residents, as well as issues regarding teenagers being disruptive (e.g. using explosives/ fireworks), burglary and issues with weapons. The fact that cars can drive into the yard was also mentioned as a problem and safety issue, although this has been made more difficult after the renovation (barriers). Prolonged safety-related worry and fear of crime is suggested to lead to behaviour modification, such as decreased physical activity and limitation of residents' personal freedom. A study in Sweden examined safety related concerns at the local level in deprived urban communities and found that several factors influence residents' perceived safety in a neighbourhood, e.g. environmental, socio-demographic, and personal factors (Kullberg *et al*., 2009). In this context the follow-up period for this case study might have been too short in order to assess the behaviour modification.

Due to the low rate of activity (SOPARC) and participation (Survey) and the possible explanations above, our research questions cannot be fully answered. The only significant results from the IPAQ items were showing a decreased physical activity in the intervention area at follow up. Apart from the obvious lack of power of data it is reasonable to believe that overall physical activity is less in the winter season. The SOPARC observations also showed less activity in both areas at follow up. Due to the tight time schedule, a follow up had to be conducted in November, 4 months after finalizing the renovation. However, it would have been desirable to perform both the SOPARC observations and the survey in the same season as baseline, hence in June the following year.

3.8 Limitations

Residents' opinions were valued and taken into account when planning the interventions and its evaluation. There were a whole range of different opinions, and it was not really feasible to take all opinions and suggestions expressed into consideration. It is therefore possible that some residents were somewhat disappointed with the outcome of the intervention.

The response rate to the household survey was low, and more efforts could be taken to engage residents with the evaluation, perhaps by involving them in the development of the evaluation process itself from an earlier stage. Other barriers to responding to the survey might include factors such as language barriers and mistrust.

The low number of respondents meant that the analysis had insufficient power, and the results are inconclusive.

3.9 Learning points for future research

Ideally a follow-up set of observations one year on from the regeneration would be conducted for this case study, since the areas may be used differently in summer compared to winter. In addition, the impacts and benefits of regenerating the area may take longer to be realised.

In terms of wider learning points, it would be beneficial if evaluation is designed within the participatory planning process of regenerating urban areas, and residents could be involved in development of any evaluation in a participatory way. This could help provide information about whether the regeneration meets the needs of the residents, or whether adjustments need to be made to the regenerated area. Distributing questionnaires during an event on site and meeting the residents face to face may also increase survey response rates or willingness to respond. In addition, the quality of design should be rigorously evaluated to understand what worked and what did not work in meeting residents' needs.

3.10 Learning points for potential scale up and transferability

In Sweden there is a strong political will and movement in the area of urban planning that also has a focus on aspects around equality and inclusion. The financial support was critical for the intervention in this study. The purpose of the financial support is to contribute to the regeneration of outdoor environments that stimulate activity and social interaction and to maintain or develop the residential areas in deprived neighbourhoods. The measures should be a long-lasting contribution to an attractive, functional, equal and safe outdoor environment. The property owner gets endorsed and incentivised to continue inter-sectoral collaboration in this important field.

In order to scale up and/or transfer this INHERIT case, more frequent dialogues with the residents, engaging the local authority, and more frequent follow-ups during the process would be recommended. It would also be crucial to include an objective evaluator early in the process of planning and implementing.

Evaluation of the design (from a landscape architecture point of view) is also critical for scale up and transferability. Not all restructuring or redesign are of good quality and bad designs if implemented might not be successful in attracting people. The design quality and the process should be evaluated at the same time.

4. Thinking Fadura

4.1 Background

Thinking Fadura is an umbrella programme that includes multiple initiatives aiming to improve people's health and well-being in Getxo (Spain). The initiative chosen for in-depth study in the context of the INHERIT project is the one concerning the opening of a formerly restricted park to the general public. The park has sporting facilities that are linked to, and coexist with, a natural park and a river.

4.2 Overall Aims

The overall aims of the INHERIT case study is to investigate how this green space in Getxo is used, and what impact it can have on health and well-being in low-income groups. Moreover, the study seeks to estimate the value of the park relative to the rate of use (the proportion of population using the park and frequency of use). Economic evaluation is reported in Report D5.3, Cost benefit analysis report.

This chapter reports quantitative findings from observations of use and level of physical activity using the SOPARC methodology (described in Chapter 1 of this report).

4.3 Context

For further details of the background, overall aims and context of Thinking Fadura please see the INHERIT Report D4.1 Implementing Triple-Win Case Studies for Living, Moving and Consuming that Encourage Behavioural Change, Protect the Environment, and Promote Health and Health Equity.

4.4 Research Questions

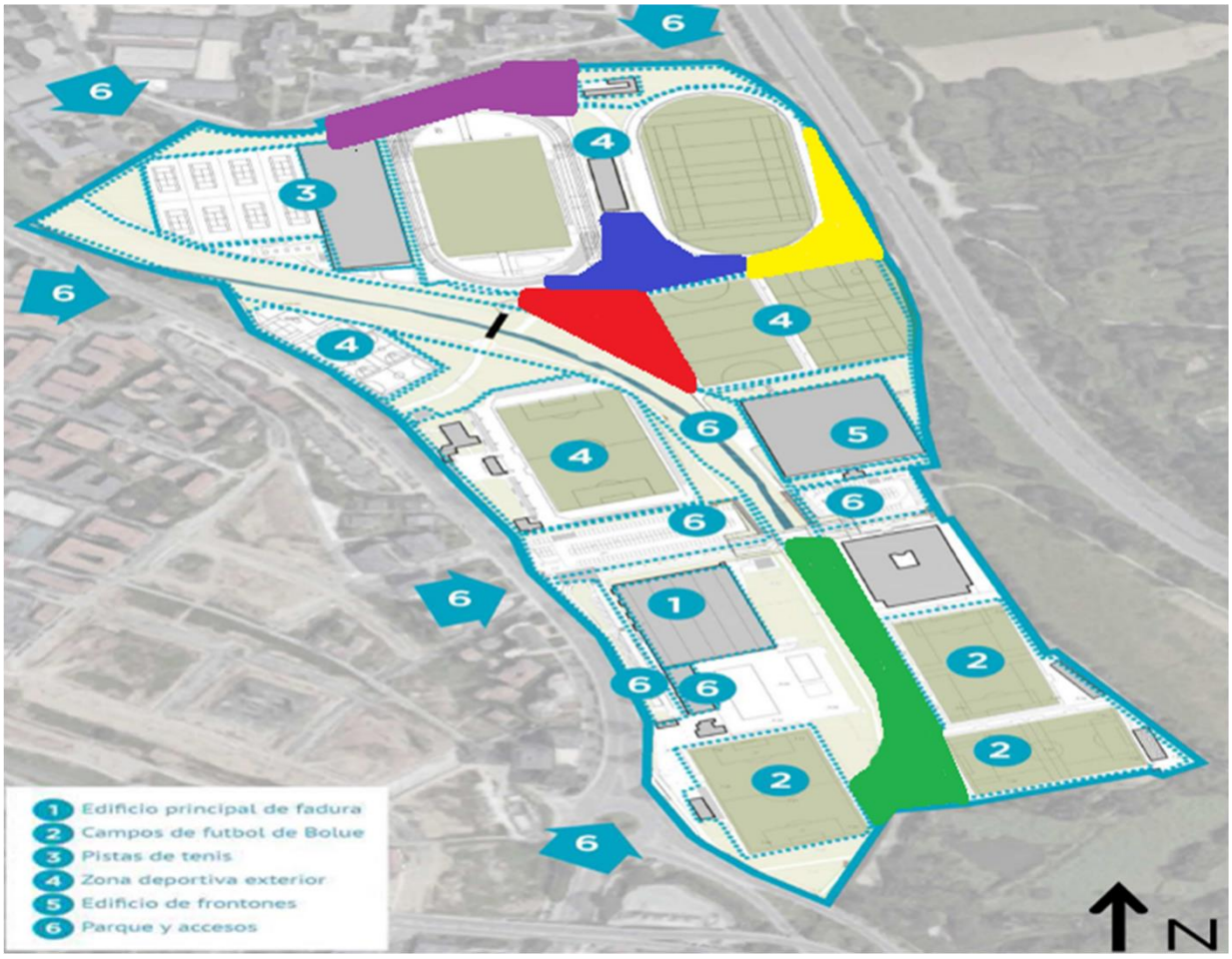
This chapter addresses questions regarding how the Getxo green space is used and what types of and levels of physical activity it affords.

4.5 Methodology

The iSOPARC assessment was conducted in the green areas opened as a result of the Thinking Fadura initiative. In total, they cover around 4 hectares of land, and are divided into 5 target areas (Figure 1). There were no benches in the target areas. They can be briefly described as follows:

- Target Area 1: Path Along the Stream. 400m long, with trees and shrubs along the river.
- Target Area 2: Triangle Next to the Stream. Mainly lawn with trees.
- Target Area 3: Green Space Between Two Sporting Fields. Mainly lawn with trees.
- Target Area 4: Green Area Near Tennis Court. Mainly lawn with trees.
- Target Area 5: Green Area Next to Highway. Mainly lawn with trees.

Figure 1: Target areas in the iSOPARC assessment in Thinking Fadura.



Number	Name	Colour
Target Area 1	Path Along the Stream	Green
Target Area 2	Triangle Next to the Stream	Red
Target Area 3	Green Space Between Two Sporting Fields	Blue
Target Area 4	Green Area Near Tennis Court	Purple
Target Area 5	Green Area Next to Highway	Yellow

The observations were done by two observers in August 2018. In total, sixteen site visits were carried out in each Target Area at different times of the day – 9.00am, 12.00pm, 5.00pm and 8.00pm – and over the course of twelve different days, covering both weekdays and weekends. This information is brought together in Table 1. Every site visit covered the five target areas.

Table 1: Site visits in the iSOPARC assessment in Thinking Fadura.

Visit time	Visit days												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
09:00		1		1	1		1						**4**
12:00			1					1			1	1	**4**
17:00	1	1	1			1							**4**
20:00			1			1			1	1			**4**

Below we show photographs of Target Area 1 and 2 in Fadura.

Figure 2: Photos taken in Thinking Fadura. Left and right photos are Target Area 1 and 2, respectively. (Silvestre García de Jalón)

Figure 3. Map of Thinking Fadura

4.6 Results

Using the iSOPARC tool, a total of 164 people were observed using the park overall, across the different target areas. Out of these 164 people, 39% were female and 61% were male.

iSOPARC enables observers to record the level of physical activity among park users. Activity levels observed were classified as sedentary, walking or vigorous. Table 2 shows the numbers of observed people (male, female and total) for different activity levels. Figure 4 illustrates these numbers.

Table 2: Overall activity level for male, female and total (in numbers)

Gender	Sedentary	Walking	Vigorous	Total
Female	34	29	1	64
Male	28	56	16	100
Total	62	85	17	164

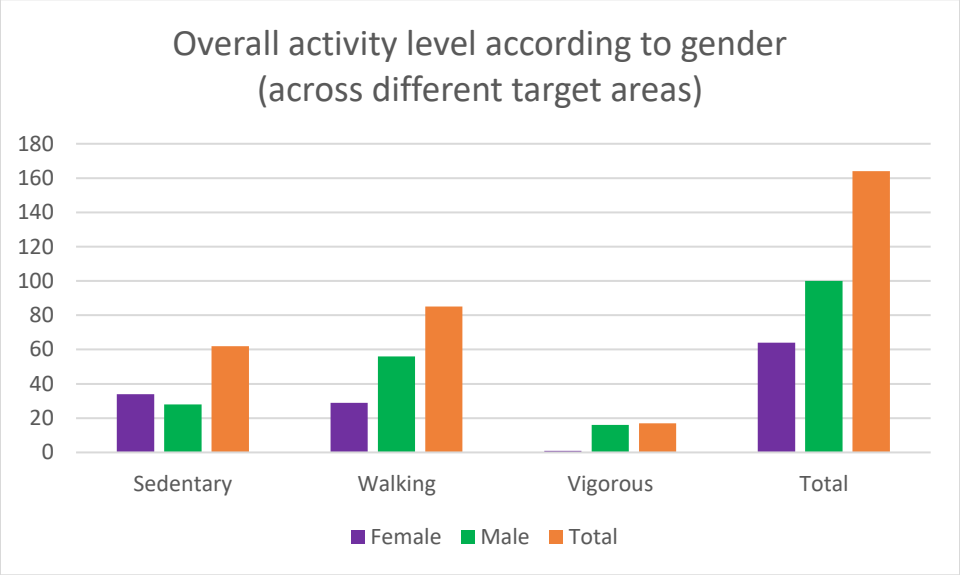


Figure 4: Overall activity levels for male, female and total (as table)

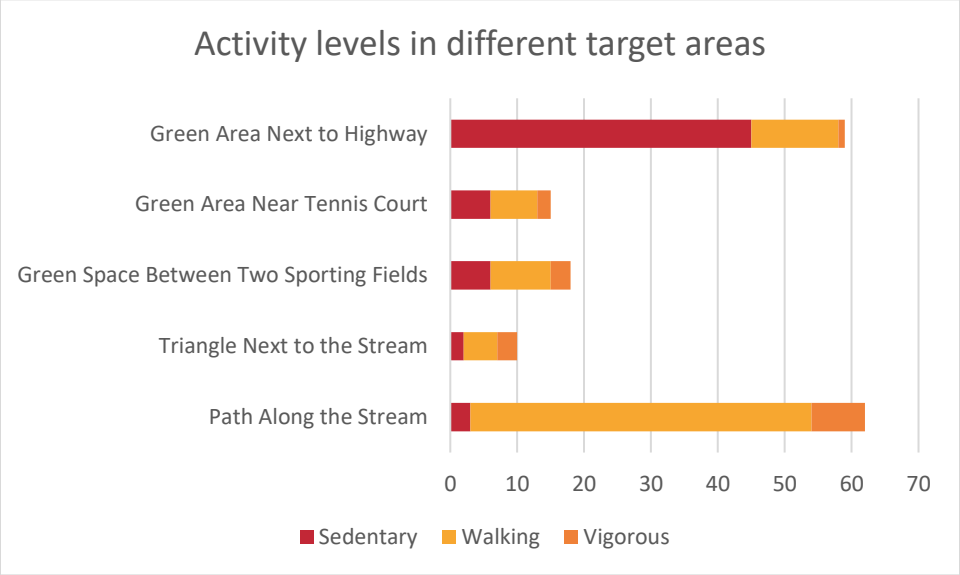
As can be seen in Table 2 and Figure 4, male users seem to be using the park more actively while female users were more sedentary. Only one female observed was engaged in vigorous activity. Of the total number of people observed, 38% (62) used the target areas in a sedentary way and 52% (85) were walking, whereas only 10% (17) engaged in vigorous activity.

We also looked into activity levels for the different park areas. Table 3 shows the numbers for activity levels at the different park areas; Figure 5 illustrates these numbers.

Table 3. Activity levels in different target areas (in numbers)

Target Areas	Sedentary	Walking	Vigorous	Total
Green Area Next to Highway	45	13	1	59
Green Area Near Tennis Court	6	7	2	15
Green Space Between Two Sporting Fields	6	9	3	18
Triangle Next to the Stream	2	5	3	10
Path Along the Stream	3	51	8	62
Total	62	85	17	164

Figure 5. Activity levels in different target areas (as table)



We observed that the different target areas triggered different kind of activity levels (Figure 5). For example, whereas most people observed in the "Green Area Next to Highway" were sedentary (45, 76%), the "Path along the stream" is used more actively: 51 observed people (82% of all people seen in this target area) were using it for walking; 8 people were using it for vigorous activity (13%).

Age Groups

We observed which age groups use the park and its different target areas. Table 4 shows the numbers for the different age groups for female, male and total; Figure 6 illustrates the same data.

Table 4. Age groups and gender of people observed from all sites (in numbers)

Gender	Children	Teens	Adults	Seniors	Total
Female	1	6	53	4	64
Male	13	9	44	34	100
Total	14	15	97	38	164

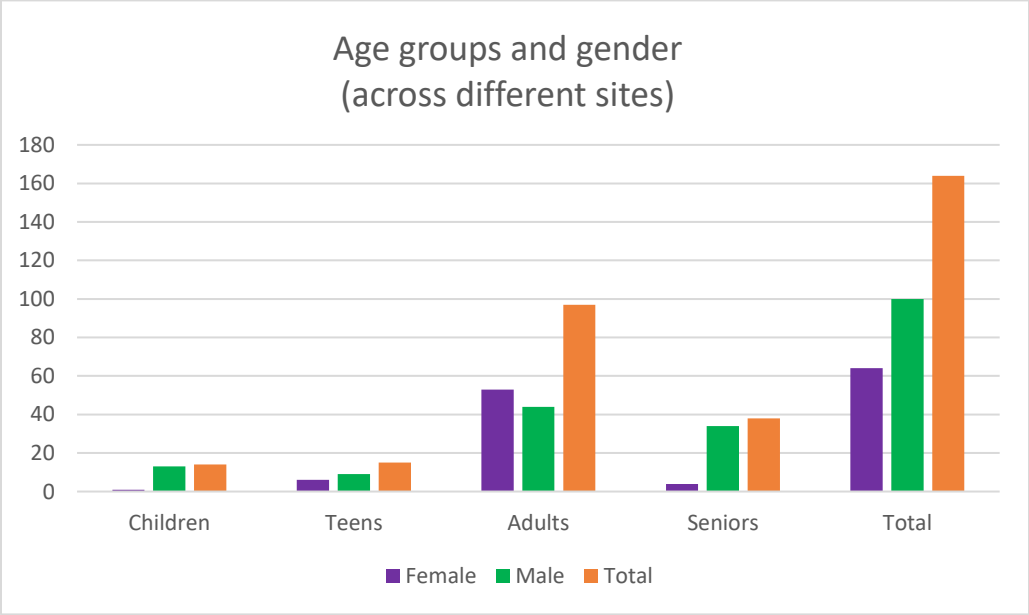


Figure 6. Age groups and gender of people observed from all sites (as table)

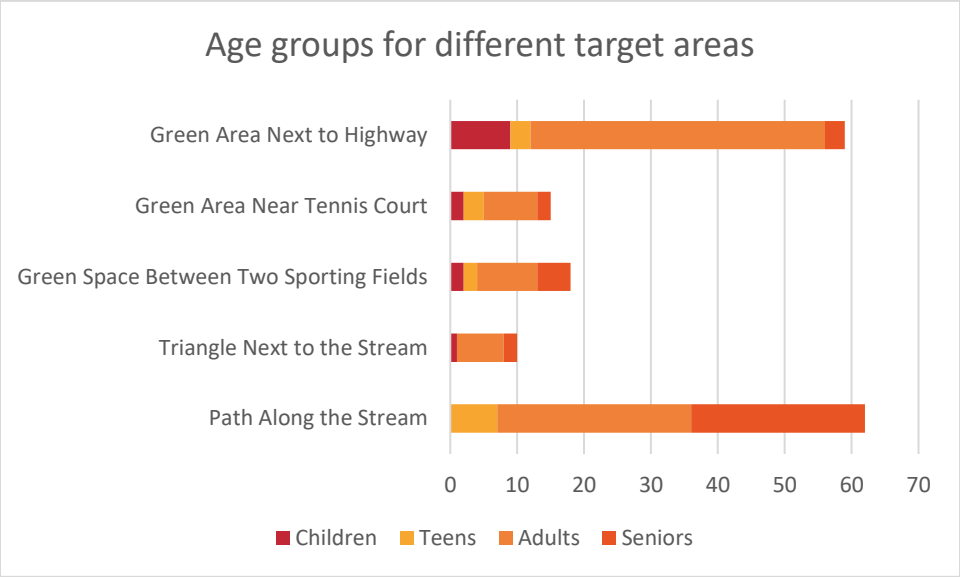
Of the people observed, 9% were children (14), 9% were teenagers (15), 60% were adults (97) and 23% were senior (38). Among children, teens and seniors there were more males observed than females, while only 45% of adults observed (44) were male whereas 55% (53) were female.

We also looked into how different age groups use the different target areas (Table 5 and figure 7).

Table 5: Age groups in different target areas

Target Areas	Children	Teens	Adults	Seniors	Total
Green Area Next to Highway	9	3	44	3	59
Green Area Near Tennis Court	2	3	8	2	15
Green Space Between Two Sporting Fields	2	2	9	5	18
Triangle Next to the Stream	1	0	7	2	10
Path Along the Stream	0	7	29	26	62
Total	14	15	97	38	164

Figure 7: Age groups in different target areas.



While only 14 children were observed overall, most of them (9) were observed in the "Green Area Next to Highway"; children comprised 15% of all park users observed in the area (59). In contrast to this, no children were observed in the "Path along the Stream". This area was mainly used by seniors (26, equivalent to 42% of all users of the area). The table illustrates that the different target areas are used differently according to age groups.

Main Activity

The iSOPARC tool also lets observers record the "main activity" – this is the activity that most people observed during a particular scan are doing. Since the number of people who are conducting this activity is not recorded, the numbers refer to scans. Table 6 shows the numbers and Figure 8 illustrates them in percentages (relative to the number of all scans conducted in a particular area).

Table 6: Main activity observed in different target areas in numbers (note the numbers do not refer to numbers of people but number of scans)

Target Areas	Jogging/ Running	Walking	Total
Green Area Next to Highway	1	31	32
Green Area Near Tennis Court	0	32	32
Green Space Between Two Sporting Fields	1	31	32
Triangle Next to the Stream	1	31	32
Path Along the Stream	0	32	32
Total	3	157	160

Figure 6: Main Activity for different target areas

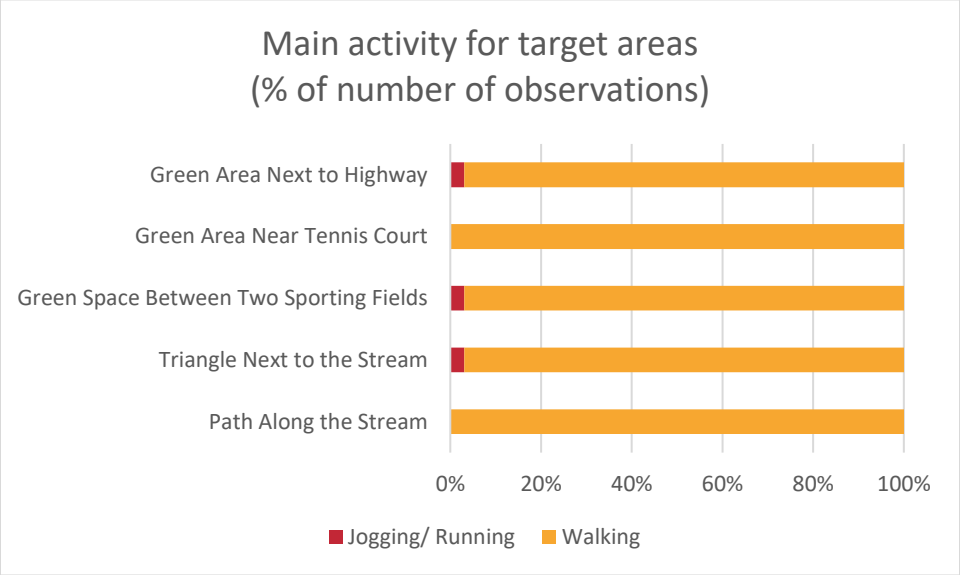


Figure 6 shows that the main activity observed in all target areas was walking. Only in a few scans, jogging/running was the main activity observed, and this only occurred in three of the five target areas (in each case it was observed in only one scan, which is equivalent to only 3% of the scans in the target area).

4.7 Discussion

The iSOPARC observers came to the conclusion that considering the high population density of the surroundings of Fadura, the usage of the green areas was relatively low. There are several possible reasons for this. Firstly, the project is not finished yet and consequently not all the areas are accessible to the general public; in some cases, the access to these areas is rather difficult. Secondly, at the time the iSOPARC observations were made, the green areas did not offer many facilities such as benches and outdoor gym equipment, which provide opportunities for physical activity. Furthermore, there are various

alternatives nearby to the green areas of Fadura. For instance, the beach of Getxo is around 2km away from Fadura and the hills and semi-natural areas of Berango town are fairly close.

In terms of gender ratios, the park seems to be used somewhat equally by both genders, with slightly more men being observed. Interestingly, only a single female observed was engaged in vigorous activity. The results show that different target areas trigger different kind of activity levels. In all target areas, around 50% of visitors were walking. However, more than 80% of those using the pathway along the stream were walkers and the rest joggers and cyclists. The age distribution found in Fadura among park users seems to be in line with the age distribution in Getxo, where the majority of people is between 18 and 65 years old. It is worth highlighting that no children were observed in the "Path along the Stream". This could be explained by the small sample size.

4.8 Limitations

The study has two main limitations that are important to take into account when interpreting the results. Firstly, the pilot was only partially implemented when the observations were made; the complete removal of the fence is expected to be done after the end of the INHERIT project. Consequently, when the iSOPARC observations were carried out there were some green areas in Fadura with difficult access or without access due to construction works. This study only focused on accessible areas. However, it is expected that when the construction work is finished the access will be improved and consequently the number of visitors will be higher than the number observed during the iSOPARC assessment.

The other limitation is related to the use of the iSOPARC tool at only one time of the year. The iSOPARC observations were carried on different days of the week and times of the day in order to represent the usage of the green areas. Nevertheless, since the usage of green areas varies throughout the year the observed usage in August 2018 might not be accurate enough to extrapolate an annual estimation of users.

4.9 Learning points for future research

The main learning points for future research are related to the first limitation described above. One key learning point could be the fact that the usage of green areas strongly depends on their accessibility, i.e. better access will increase people's visits. This could have a positive impact on equity since the economic cost of entering Fadura before the pilot implementation could be a barrier for many people living in poor socioeconomic circumstances. Since the pilot was not fully finished when the iSOPARC observations were made, future research could evaluate the usage of the green areas once the project is completely finished in order to obtain a more accurate estimate. Further research could also assess how people's usage evolves over time from the start of the project. This would be interesting for economic evaluations such as a cost-benefit analysis, where the estimation of the magnitude of the costs and benefits across time is essential to calculate the profitability of a given investment.

Another key learning point is the fact that green paths and corridors are usually preferred by visitors than relatively small green areas. In Fadura, a significant number of the green areas are relatively small. Small green areas are also devoid of any features and do not offer many opportunities for visitors in terms of use. Evidence also suggests that grass coverage is not significantly associated with landscape preference whereas tree canopy coverage is (Jiang *et al.*, 2015). Hence most users in Fadura are walkers, joggers or cyclists passing by and there are few users engaging with the landscape or doing sedentary activities.

Future research could evaluate the effect of the size and shape of green areas on people's usage. In addition, qualitative research, such as interviews with users, could enrich our understanding of user's motivations for using the park and satisfaction with the park and its facilities.

4.10 Learning points for potential scale up and transferability

There are numerous green urban areas in Europe where use is restricted to some sections of the population. This was the case of the sporting area of Fadura, where only members of the sporting club could use and enjoy the green areas. The case study of Fadura exemplifies how public sporting clubs can remove their fences and become accessible to the general public in order to increase societal usage of urban green areas. Thus, the Thinking Fadura pilot could be used to show the main positive and negative aspects of opening restricted green areas to the general public as well as different approaches used to quantify these aspects.

5. Restructuring Green Space, Breda

5.1 Background

Restructuring Green Space Breda concerns a green space intervention in a low-income urban neighbourhood in the city of Breda. In this neighbourhood, a green space in a residential area was restructured to improve the quality of the neighbourhood and increase the use of the green space. Green spaces can offer innovative ways to promote sustainable lifestyles by offering infrastructure for physical activity, social interaction, relaxation and community cohesiveness. One of the focuses in this approach was to involve the residents and give them opportunities to influence the design of the green space and its facilities. The selected neighbourhood is culturally diverse and has a large proportion of residents with a low socio-economic status; many of whom are also unemployed. Despite current health and social programs, many of the inhabitants struggle with health problems such as overweight and chronic disease. In addition, many feel alone and lack social networks and support.

5.2 Overall aims

Restructuring Green Space was chosen due to its potential to deliver on the triple win goals of health, environment and equity through improving green spaces for urban residents. The intervention has potential to improve both physical and mental health by supporting active lifestyles and social interactions. This initiative targets disadvantaged groups and involves them in the design and implementation of activities, which potentially creates a sense of ownership of the park and promotes social cohesion in the neighbourhood. Moreover, the intervention is multi-sectoral; actors from several sectors work together for healthier and more sustainable urban environments.

The quantitative evaluation reported below collected information on the use and activity levels in the restructured green space in Breda. In the discussion, we compare these results with baseline data that we collected earlier as a part of another Dutch project before the restructuring intervention took place.

5.3 Context

The entry point for action in Restructuring Green Space is to change the outdoor environment of a locality in accordance with the needs and desires of the local residents and involving them in the planning and implementation of the intervention. This way, the residents' exposure to activity-friendly green spaces that welcomes social interaction can be improved, which subsequently can create experiences of social inclusion and a sense of belonging. It also aims to offer a pleasant place for relaxation and may seduce people to conduct physical exercise. Thereby, the Restructuring Green Space intervention seeks to change behaviour by offering opportunities for more active and sustainable lifestyles and increased socialization with other residents, and it addresses issues of motivation through the facilitation of community involvement.

In general, restructuring green space in deprived urban areas has the potential to contribute to the triple win of improving health, environmental sustainability and equity at the same time - via proximal and distal pathways (Staatsen *et al*., 2017; van der Vliet *et al*., 2018; Kruize *et al*., *2019*). On the proximal pathway, health is possibly enhanced by increased physical activity, and social interaction and relaxation. This initiative might in the longer run result in improved population health by e.g. reduced obesity and loneliness/mental health problems and increased physical out-door activities. Equity is addressed through

improved access for people living in poor socioeconomic circumstances to green space areas and inclusive processes. It might reduce inequality by levelling-out opportunities for a healthy lifestyle. Sustainability is addressed by restructuring green spaces that may contribute to urban biodiversity and may enhance pro-environmental behaviour, although in the case of Breda we think this is less likely to happen to a large extent.

The restructuring project in Breda can be linked to (but was not part of) a broader national integrated Health-In-All-Policies approach for disadvantaged neighbourhoods in the Netherlands. The initiative was anchored in a wider neighbourhood strategy that aimed to empower the local community, improve the quality and attractiveness of the neighbourhood, and create social cohesion. The initiative also fits into the wider approach of the municipality of Breda to involve residents in neighbourhood plans. In addition, it had a link to the national JOGG program, stimulating young people to have more physical exercise, and several health and social programmes in the neighbourhood.

As a part of the design process, the municipality, in collaboration with an external process manager, organized three sessions with the residents, the residents' organisation, municipal health service, and professionals from the municipality (landscape architect, project leader), neighbourhood professionals (social and physical district administrator), a school, the Municipal Health Service, youth professional, sport coaches, and the housing corporation. Local decision makers (council members) were involved in the process. The project group was well integrated since they had been working together in the neighbourhood for some time, with the community centre as their central meeting place. The process around the redesign and interaction between the professionals and residents seemed to be satisfactory, and some activities have already taken place in the park. The first information evening on plans to restructure the green space with residents was in October 2014, and the reconstruction of the green space was completed in 2017 by the municipality of Breda.

Residents were also invited to organize and implement activities in the park, but only a few of them have taken place so far.

The intervention was evaluated for its potential to trigger positive behaviour change in residents. SOPARC observations were conducted to evaluate the use of the restructured green space. In addition, a focus group was organised to assess the value and contribution of inter-sectoral cooperation and user involvement in the planning and implementation of the restructuring (described in Report D5.1). The evaluation study was developed and conducted by RIVM in the Netherlands conducted in cooperation with research teams at UCL, England (Quantitative studies), and NTNU, Norway (Implementation studies).

Baseline data was collected before implementation as part of another Dutch project. A mixed method approach was used to collect the baseline data, consisting of qualitative observations, interviews with professionals and residents, and questionnaire survey. It was conducted by RIVM in cooperation with a research team at Wageningen University and Research (Alterra) (Kruize *et al*., 2018).

5.4 Research questions

- What can be learned from the processes of community involvement and inter-sectoral cooperation? (Results described in Report D5.1 report).
- How is the green space used, and what are the levels of physical activity in relation to different features of the green space? (Results described in this report).

5.5 Methodology

We observed activities in the green space in Breda using the System for Observing Play and Recreation in Communities (SOPARC). SOPARC is a tool for assessing physical activity (PA) level and characteristics of park or green space (McKenzie *et al*., 2006). The tool enables systematic observations in terms of the number of users, gender, age (child, teenager, adult, senior), type of activity and physical activity level (sedentary, walking or vigorous). Recordings were made in the i-SOPARC application developed for I-pad. INHERIT team members were trained by UCL in valid use of i-SOPARC.

The target area for the observations was the green space in Breda that had been restructured. For the purposes of the observations we subdivided this green space into 16 sub areas, based on the different uses (see Photos 1-4, Figure 1, and Table 1).

Photos 1-4: Impression of the Restructured Green Space Breda

Figure 1: Map of the restructured green space in Breda, including the 16 target areas

Table 1: Description of the 16 target areas (numbers of the target areas correspond with numbers in Figure 1)

Target area	Why selected	Physical description/ architectural features	Main purpose/main use	Positive/negative aspects
1. Court with flowers	Close to an elderly's home, close to main entrances to the park.	Paved road/court with a flowerbed, located at the right side of the park, with a bench in the centre.	Place to relax and meet and enjoy the beauty of the flowers	No shade
2. Field with trees	Part of the park, in an area designed as an elderly part, with a circle meant to become a rose garden for one of the neighbourhood's inhabitants	Grass, trees, stone path. The path was excluded from observations, but a bench on the path was included	Place to and enjoy the beauty of the trees, some people would walk their dogs there, and the bench was one of the few that provided shade, so in summer some people would sit there	The rose garden was not established there are no benches, only a grass field with trees
3. Dog walking field	Clearly marked and fenced area for dog walking	Grass, stone path around it, fence	Dog walking	Rarely used during the observation period
4. Open field	Could be used for playing, sports or dog walking	Two grass areas within paths	Playing, sports or dog walking	Rarely used during the observation period
5. Path 1	Recreational path across the park	Asphalt and cobblestones It has some height difference, in the middle it went down and up again.	Walking through the park	Due to the cobblestones it could not be used by people on a skateboard or roller skates
6. Open Field 2.1 (right) & 7. Open field 2.2 (left)	Grass fields suitable for recreational purposes	Grass fields	Sports	Rarely used during the observation period. During the autumn observations, a part of these fields were used by construction workers and not accessible for park visitors
8. Picnic and seating around pond	Distinct from the other areas. Place for relaxation, meeting place	Pond, picnic benches and tables and long stone bars on which people can sit	Relaxation, meeting place	There was no shade in this part. The pond was quite polluted during summer
9. Funicular	Play area immediately surrounding and related to the funicular	Grass field bordered by water on the east side, a path on the south side and the play area hill on the north west side	Playing area	Well-used; designed by the children and implemented by the municipality
10. Children play area	Play area for young children	Area bordered by paths at all sides. A play house and swings (with sand) are located in the grass field	Play area for children, and mainly children (younger ones) used it, often accompanied by parents	None

Target area	Why selected	Physical description/ architectural features	Main purpose/main use	Positive/negative aspects
11. Pedestrian lane south	Main walking path through the park	Two main paths that cross the park from west to east. It is made of tiles. It takes about 5 minutes to walk from one side to the other	Walking through the park	None
12. Soccer field	Play area for older children/youth	Grass field with two goals, bordered by paths on most sides. Includes also an asphalt play area, with a clock, for children to use for climbing and running over it	Soccer and playing	The asphalt play areas with clock was designed by the youth and implemented by the municipality. Positive is also the free of charge water tap, used often by children.
13. Paved road	Main road to cross the park from west to east, and it was both for pedestrians and cyclists	Asphalt, with benches to rest. It takes about 5 minutes to walk from one side to the other	Walking and cycling, crossing the park	Many people who went shopping at the mall on the west side of the park use the park as a way to get there and back. Good access, also people with babies in prams, people on skates or bicycles, or older people with walkers
14. Open fields	Large grass area that could potentially be used for dog walking or recreational activities	Open grass fields with some trees on the north side of the 13. Paved road sometimes separated by small (vertical on picture) paths	At some observation times, this area was filled with children, standing in the shade of the trees before stepping into taxies (5-8) that were waiting on the road next to the trees. Besides that, this area was not used much.	None
15. Slide and water on hill	Play area	Grass hill with sand, slide and water pump, and bench at opposite side of the path	Play area for children, and mainly children (younger ones) used it, often accompanied by parents	Used often. Some signs of vandalism near the water pump. At hot days the slide would get too hot for children to play upon, and it was not much used then. The play area on a hill is located next to the water pond which does not have any fence
16. Field around the corner	Residents indicated this also belongs to the restructured green space area, and was therefore included	Grass field located on the east corner of the park.	Not clear	It was in a mediocre condition, not very inviting. We did not observe many people here, it was not really used. People would use the roads around it.

Observations were conducted during two periods: July 5-8th 2018 and Oct 19th- November 4th 2018. Before the first period, we had one test day (July 4th), on which we also defined the subareas and tested the tool in the target area. Each observation period included two weekdays and two weekend days. On each day, we observed during 3 time periods, and varied this a bit in order to get a more complete picture of use/users over time. Observations were conducted by 1 or 2 observers (Table 2). Two tablets were used to collect the data. The files were merged afterwards into one database.

Table 2: Description of observations with i-SOPARC in Breda

Date	Observer(s)	Week/weekend	Start Period 1	Start Period 2	Start Period 3
1st period					
5 July 2018	NvV (1) & colleague	Week	10.00 am	12.00 am	2.00 pm
6 July 2018	HK (2) & BS (3)	Week	10.55 am	1.00 pm	3.00 pm
7 July 2018	HK (2)	Weekend	9.00 am	11.00 am	1.00 pm
8 July2018	NvV (1) & colleague	Weekend	12.15 am	2.15 pm	4.00 pm
2nd period					
19 October 2018	HK (2)	Week	12:50 pm	2.45 pm	4.35 pm
20 October 2018	HK (2)	Weekend	9.45 am	11.30 am	1.25 pm
24 October 2018	NvV (1)	Week	12.20 pm	1.45 pm	3.15 pm
4 November 2018	BS (3)	Weekend	12.30 pm	2.20 pm	4.00 pm

5.6 Results

We present the results of the i-SOPARC tool, combined for both periods. In total, 531 participants were observed using the i-SOPARC tool across the different target areas. 302 of them (57%) were male and 229 (43%) were female. The park seems to be used relatively equally by both genders with slightly more men using it.

Activity level

We were interested in the activity level displayed by the park users to understand how the park (and its different target areas) is used in more or less active or passive ways with regard to activity levels. Activity levels observed were classified as sedentary, walking or vigorous.

Table 3: Overall activity level for male, female and total (in numbers)

Gender	Sedentary	Walking	Vigorous	Total
Female	75 (33%)	84 (37%)	70 (31%)	229 (100%)
Male	105 (35%)	90 (30%)	107 (35%)	302 (100%)
Total	180	174	177	531

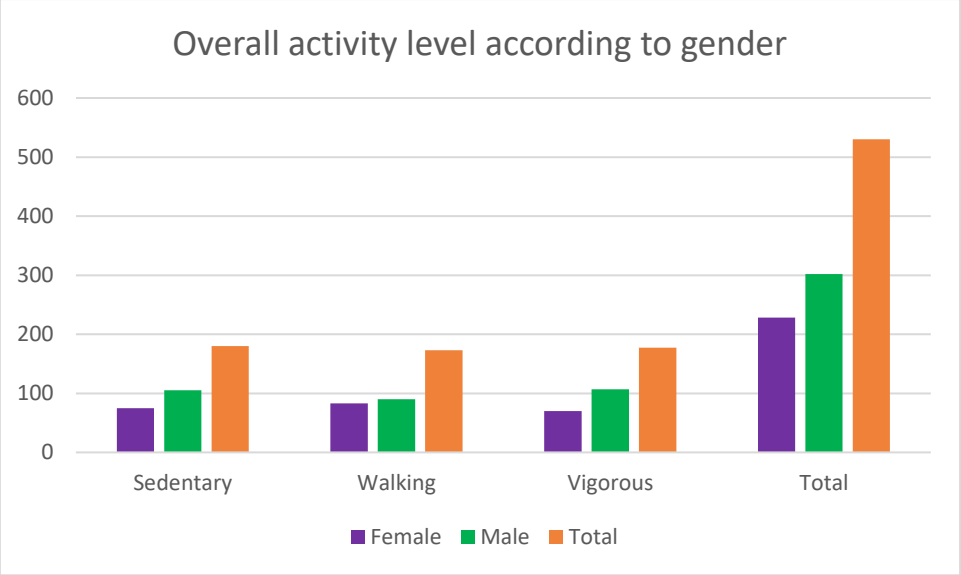


Figure 2: Overall activity level across for male, female and total (in numbers)

While there were more overall activities observed with men than women (302 vs. 229 observations), the profile with regard to activity level seems to be quite similar for men and women, although we observed slightly more men conducting vigorous activities than women (35% vs 31% of all observations per gender), and slightly less men walking compared to women (30% vs 37% of all observations per gender).

We also looked into activity levels in different areas of the park. Most people were observed on paved road followed by the soccer field and pedestrian lane (see Figure 4 and Table 4).

Table 4: Activity levels in different target areas (in numbers)

Target Area	Sedentary	Walking	Vigorous	Total
Court With Flowers	2	7	1	10
Field with trees	3	0	0	3
Dog walking field	0	0	0	0
Open field	0	2	0	2
Path 1	3	12	13	28
Open field 2.1	8	0	0	8
Open field 2.2	0	0	3	3
Picnic and seating around the pond	5	1	0	6
Zip line	0	2	13	15
Children Play Area	11	3	15	29
Pedestrian Lane South	9	37	19	65
Soccer Field	45	10	39	94
Paved Road	48	95	64	207
Open Fields	34	4	1	39
Slide and water on the hill	9	0	9	18
Field around the corner	3	1	0	4

Target Area	Sedentary	Walking	Vigorous	Total
Total	180	174	177	531

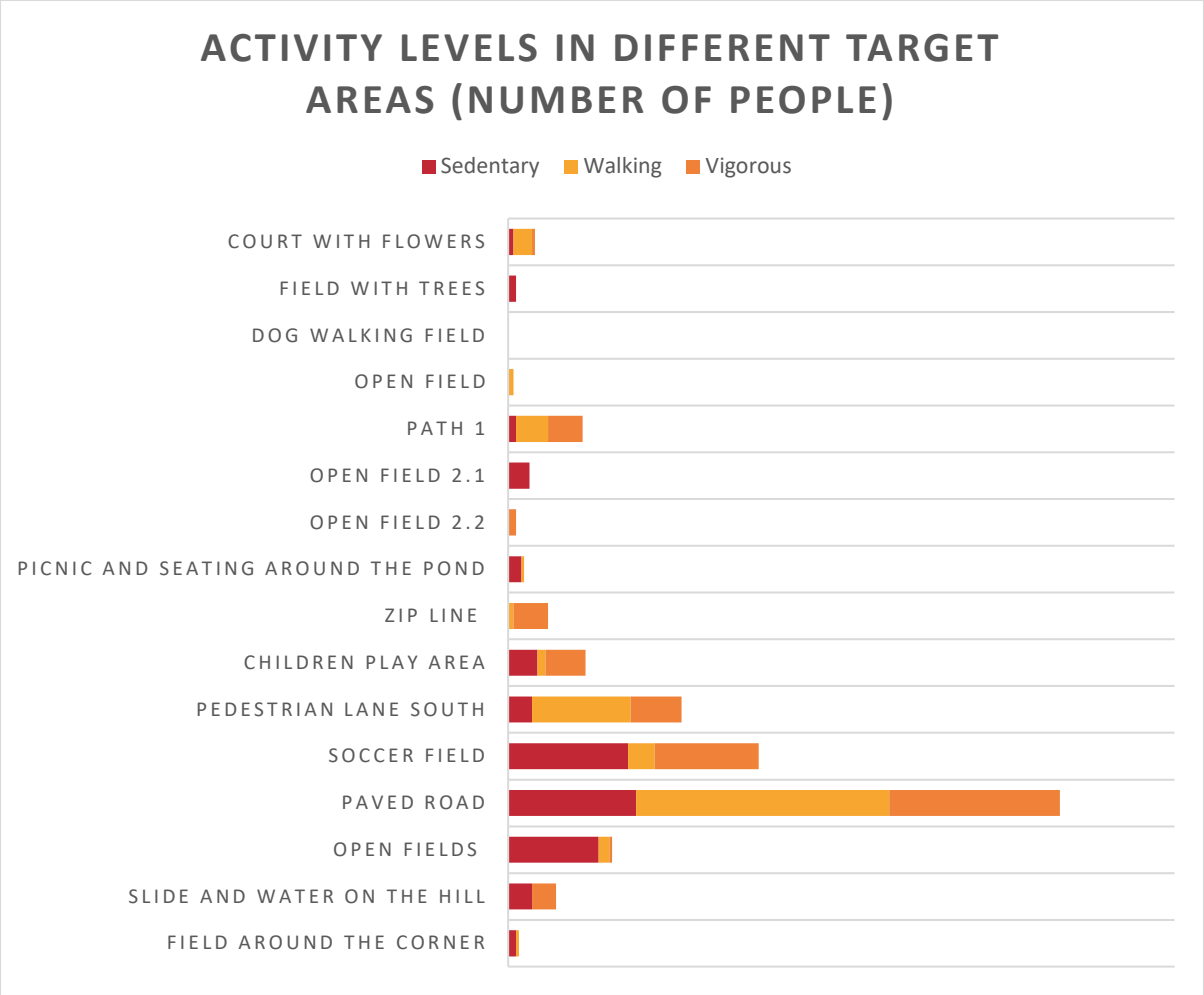


Figure 3: Activity levels in different target areas

From Figure 3 it becomes clear that the different target areas triggered different kind of activity levels. For example, “Path 1”, “Zip line”, “Children Play Area”, “Pedestrian Lane South”, “Soccer Field” and “Slide and water on the hill” were all areas that triggered relatively much vigorous activity. These are the areas that people use to move from A to B, and were children play. Other areas such as most of the fields and the Picnic and seating area around the pond were used in a much more sedentary way, to meet people or walk the dog.

Age Groups

Furthermore, we were interested which age groups use the park and its different target areas to what extent.

Table 5: Age groups and gender of people observed from all sites (in numbers)

Gender	Children	Teens	Adults	Senior	Total
Female	92 (40%)	25 (11%)	93 (41%)	19 (8%)	**229 (100%)**
Male	196 (65%)	28 (9%)	68 (23%)	10 (3%)	**302 (100%)**
Total	288	53	161	29	**531**

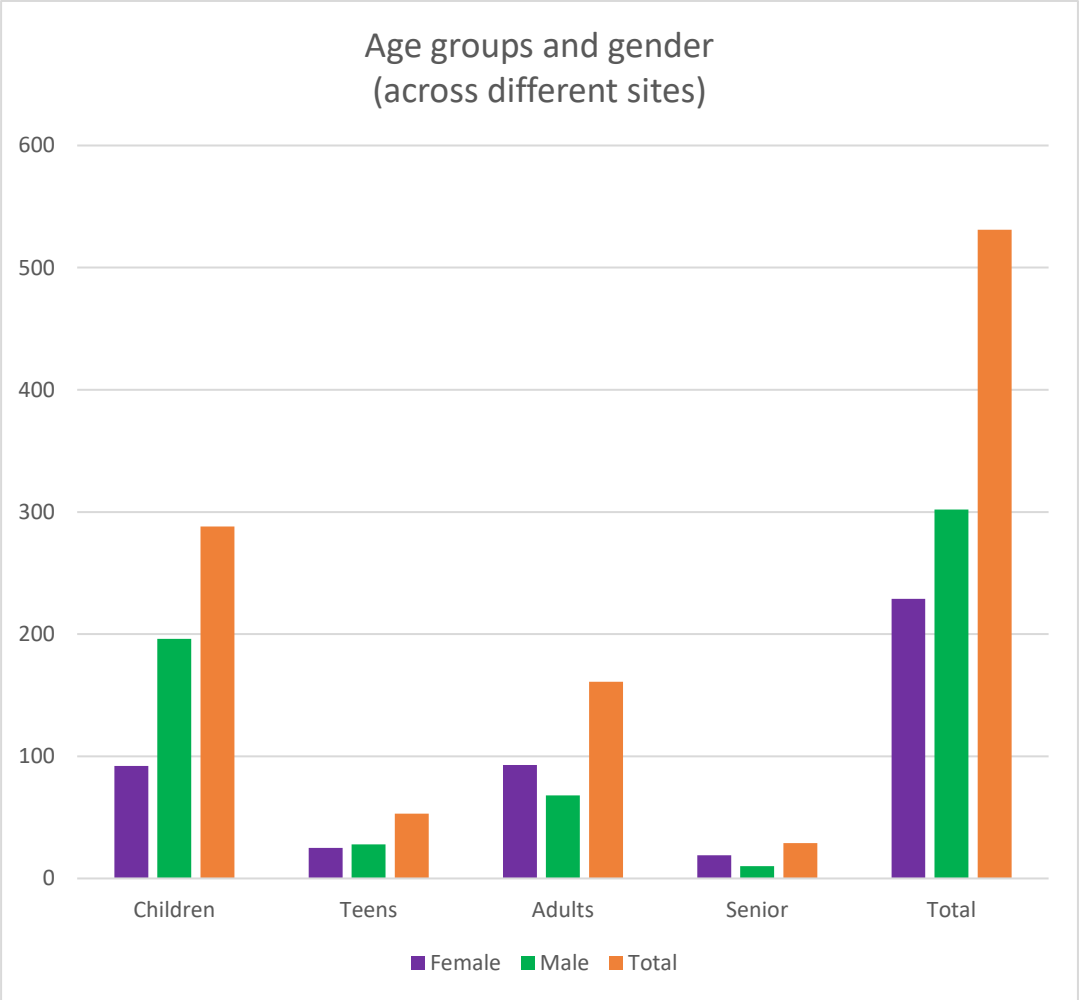


Figure 4: Age groups and gender of people observed from all sites (in numbers)

The park is used by all age groups, which the municipality also aimed for in the design. Children were the biggest group of people observed in the park with 288 (54%), followed by adults (30%), then teens (10%) and the smallest group were seniors (only 5%). In the two younger groups (children and teens), there were more male than female observed, whereas for the older groups (adults and senior) there were more females.

We also looked into the use of the different target areas according to age group (Table 6 and Figure 5).

Table 6: Age groups in different target areas (in numbers)

Column1	Children	Teens	Adults	Senior	Total
Court With Flowers	3	0	7	0	10
Field with trees	0	0	3	0	3
Dog walking field	0	0	0	0	0
Open field	0	0	2	0	2
Path 1	15	4	9	0	28
Open field 2.1	7	0	1	0	8
Open field 2.2	2	1	0	0	3
Picnic and seating around the pond	3	0	3	0	6
Zip line	14	0	1	0	15
Children Play Area	22	0	8	0	30
Pedestrian Lane South	22	11	28	4	65
Soccer Field	84	1	9	0	94
Paved Road	67	36	80	24	207
Open Fields	33	0	5	0	38
Slide and water on the hill	15	0	3	0	18
Field around the corner	1	0	2	1	4
Total	288	53	161	29	531

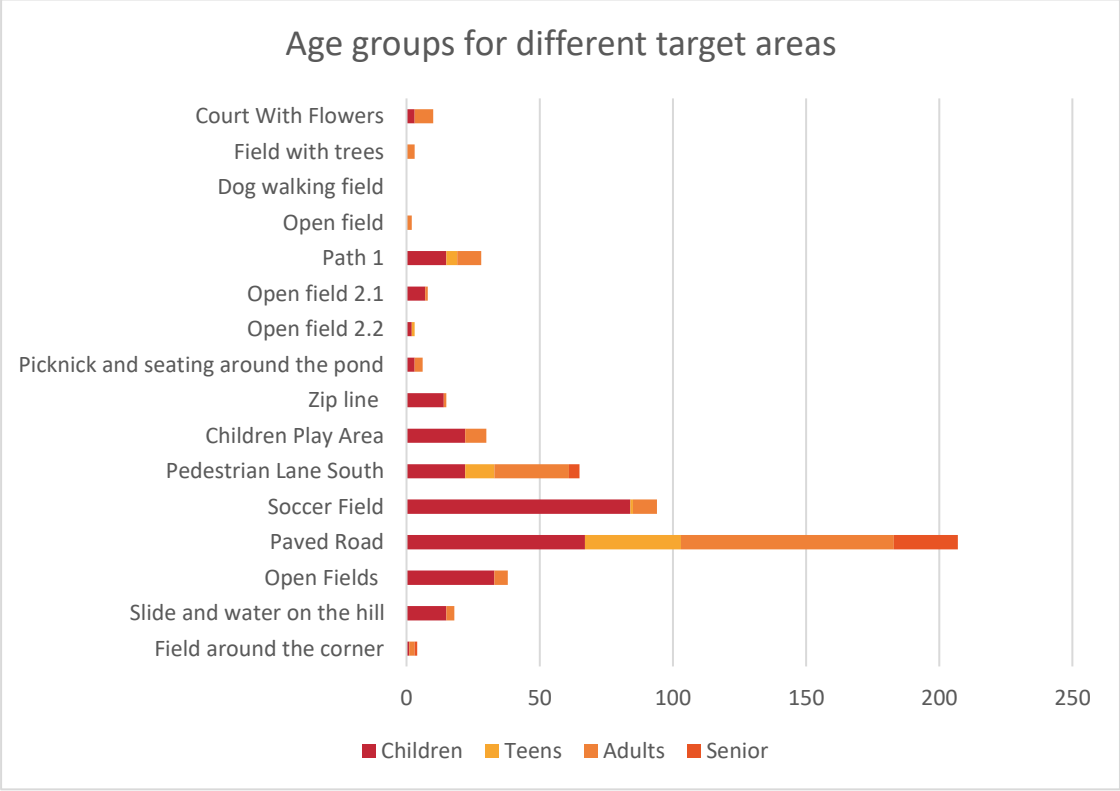


Figure 5: Age groups in different target areas (in numbers)

Children used the area in a most diverse way. They were predominantly seen in areas that offer some facilities to play at, for example the “Children Play Area”, the “Slide and water on the hill”, the “Soccer Field” and the “Zip line”. However, they were also observed frequently on the “Paved Road”. Seniors on the other hand were not seen in many areas – mainly on the “Paved Road” and on the “Pedestrian Lane South”. They seemed to use these paths to go for a walk or go from there home to the shopping centre. These paths are made easy accessible, also for people with a walker, and there are many benches for their convenience. We did not observe seniors in the court with flowers or field with trees that was designed especially for them. Teenagers were mainly seen on the “Pave Road”, “Pedestrian Lane South” and “Path 1”, moving from one place to another. Most adults were seen on the “Paved Road”, and the “Pedestrian Lane South”, but also on the soccer field and children’s playing area, to supervise children playing there.

Ethnicity

Observers also recorded the perceived ethnicity of park users (Table 7 and Figure 6).

Table 7: Ethnicity observed in different target areas

Target Area	Western	Moroccan and Turkish	African or Surinam	Other
Court with flowers	6	4	0	1
Field with trees	1	1	1	0
Dog walking field	0	2	0	0
Open field	1	0	0	0
Path 1	3	17	7	0
Open Field 2.1	0	12	0	0
Open Field 2.2	3	0	0	0
Picnic and seating around pond	2	3	0	0
Zip Line	4	14	5	0
Children Play Area	7	10	5	5
Pedestrian lane south	22	27	12	2
Soccer field	32	43	20	3
Paved Road	87	68	30	5
Open Fields	10	20	14	2
Slide and water on hill	5	6	2	2
Field around the corner	3	0	0	0
Total	186	227	96	20

We observed a variety of ethnicities in the park. People with different ethnic backgrounds co-used the park and the facilities. Moroccan and Turkish people were observed most often in the park, followed by Western people. The different target areas seemed to be used similarly by the different ethnic groups. We observed only some slight differences. Western people were observed more often in the court with flowers and on the paved road, and less often on “Path 1” and near the zip line.

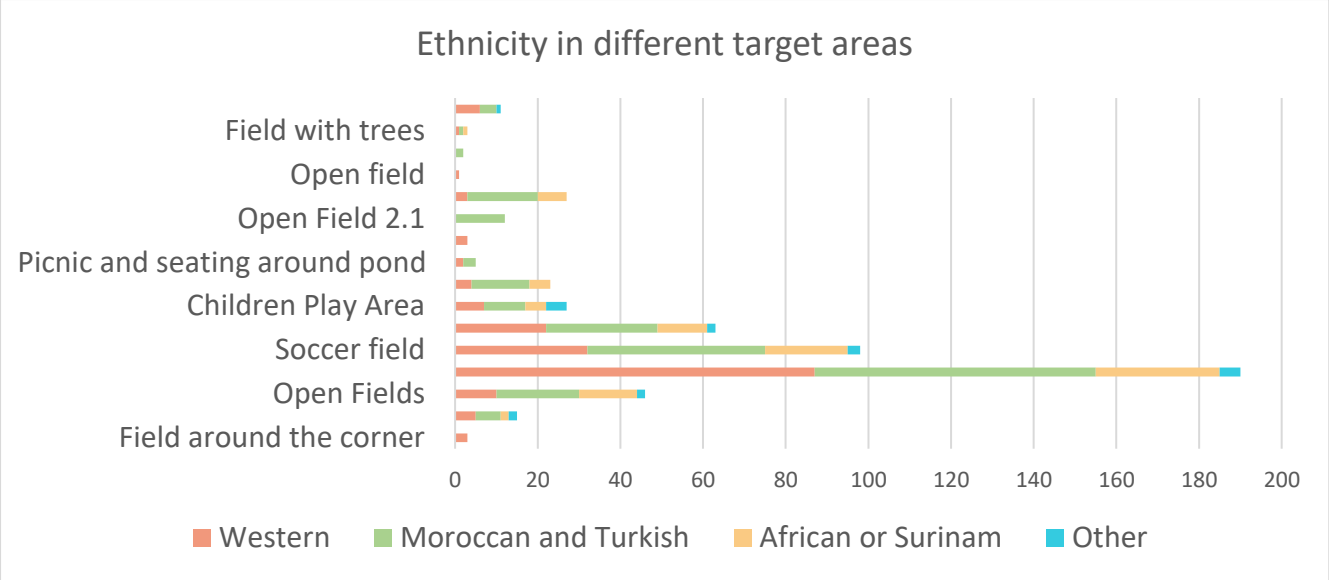


Figure 6: Chart for ethnicity observed in different target areas

Main Activity

The SOPARC tool also lets observers record "main activity" – this is the activity that most people were engaged in as observed during a particular scan. Since the number of people who are conducting this activity is not recorded, the numbers refer to scans.

The sixteen target areas differed hugely with regard to main activities. For most target areas, no activity was observed on the majority of scans, which also has to do with the observation method (see Discussion section). In the dog walking field, we did not observe anybody. Only for the "Paved Road" and the "Pedestrian Lane South", there was activity observed in the majority of observations. The most observed main activities there, but also in general, were walking and jogging/running/cycling. "Climbing/sliding" was also a relatively frequently mentioned activity. In the areas were children play, sitting has also been reported as a main activity, probably referring to the adults who supervise their children.

Photos 5-6: Activity areas

Table 8. Main activity observed in different target areas in number of observations

Target Areas	Jogging/ Running/ Cycling	Walking	Football	Climbing / Sliding	Tag/ Chasing game	Lying down	Picnic	Reading	Standing	Sitting	No activity	Total
Court With Flowers	0	4	0	0	0	0	0	0	0	0	40	44
Field with trees	0	0	0	0	0	0	0	1	1	0	42	44
Dog walking field	0	0	0	0	0	0	0	0	0	0	42	42
Open field	0	2	0	0	0	0	0	0	0	0	42	44
Path 1	5	4	0	0	0	0	0	0	0	0	33	42
Open field 2.1	0	0	0	0	0	0	0	0	0	2	40	42
Open field 2.2	1	0	0	0	1	0	0	0	0	0	40	42
Picnic and seating around the pond	0	0	0	0	0	0	0	0	2	2	38	42
Zip line	1	1	0	4	2	0	0	0	0	0	32	40
Children Play Area	0	2	0	12	1	0	1	0	1	2	25	44
Pedestrian Lane South	7	15	0	0	0	0	0	0	1	1	18	42
Soccer Field	0	1	7	2	0	0	0	0	3	2	29	44
Paved Road	13	19	0	0	1	1	0	0	2	0	4	40
Open Fields	0	1	0	0	0	2	0	0	0	2	35	40
Slide and water on the hill	0	1	0	5	0	2	0	0	1	4	31	44
Field around the corner	0	1	0	0	0	0	0	0	2	0	37	40
Total	27	51	7	23	5	5	1	1	13	15	528	676

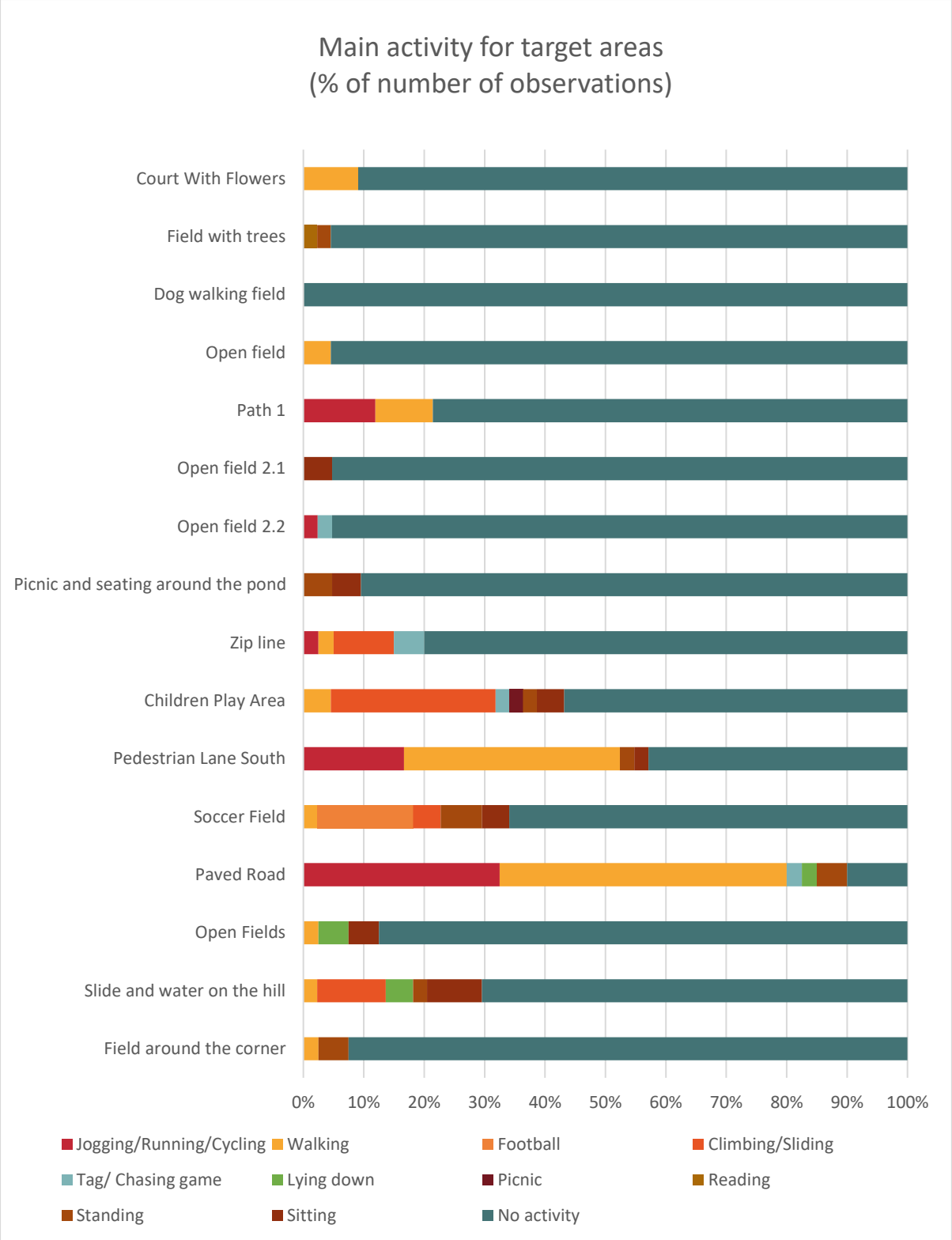


Figure 8. Main activity for different target areas (100% corresponds to number of total observations at the respective target area; see table 5 for the N of observations for different target areas)

5.7 Discussion

Main findings

From the results, some main impressions emerge that will be shared in this section.

Compared to the situation before restructuring - based on baseline data collected in a Dutch study (Kruize *et al*., 2018) - the variety in use and users of the park has increased. That is in line with what the residents expected to happen after restructuring. At baseline, residents were not satisfied with the design of the park and the possibilities it provided, but expected to use it more after the restructuring, in particular for sitting, sunbathing, meeting, and walking with or without a dog. The use of the green space thus has increased, but ownership seems to have decreased a bit, with some vandalism taking place in the park.

Now, after the restructuring, the park is used by a wide variety of people - by different age groups, genders, and ethnicities. This is what the municipality aimed for, by creating different subareas in the park meeting the needs of different users, as indicated by these potential users in the designing process. From our observations it appeared that main users are children, with a Western, Moroccan or Turkish background. We cannot make a robust comparison to what extent the users reflect the residential population of the neighbourhood. However, what we do know is that about half of the residential population in this neighbourhood are minorities, with about 75% of them having a non-Western background, and that we observed people with a mix of cultural backgrounds using the park together. Furthermore, we observed somewhat more often male than female users in the park. Teenagers and seniors were observed less often.

Photo 7: Writing on sidewalk

The observed activities were to a same extent sedentary, walking and vigorous, with men conducting somewhat more often vigorous activities than women. Most park users were observed on the paved paths. In other target areas, such as the dog walking field and the open fields without (paying) facilities, hardly any people were observed. Not surprisingly, vigorous activities more often took place on the paths and in the children's playing areas, than on fields without facilities and in the picnic area.

Main activities were walking and jogging/running/cycling on the paths, and “climbing/sliding” in the playing areas. The age groups did not always seem to use the target areas that were specifically developed for them. For example, in the court with flowers which was designed to be used by seniors, we did not observe seniors, probably because we observed on warm days, and there was no shade. There was shade in the nearby field with trees, but there are no benches at that location.

Photo 8: Shaded field

The main focus of i-SOPARC is physical activity, while in regard to health we know that green space may also e.g. have a positive effect on stress reduction and may stimulate social contacts and may lead to more social cohesion. Although we could derive some results from the overview of main activities (e.g. sitting, physical activity and playing may lead to stress reduction, and stimulate social contacts as well), the focus of i-SOPARC remains physical activity. For example, we observed a social activity in the park spontaneously organized by a local resident (artist) - painting with children from neighbourhood. In i-SOPARC this is registered as a sedentary activity of one adult and a couple of children, but one cannot derive from the results the impact of this on social contacts and social cohesion. Another example is about a man walking his dog in the children play area. A group of youngsters said he should not do that and that it was not allowed. This indicates a sense of responsibility for the area, which is an important observation in relation to ownership and quality of the neighbourhood.

5.8 Limitations

The i-SOPARC observational tool was used in this study because it is a validated tool used to provide reliable estimates of use and activities in parks and open spaces in communities. While the paper based SOPARC allows coding based on specific contexts, the coding available in the i-SOPARC application may not always be representative of activities in every context. For example, coding was not available for dog walking and cycling, two common activities in Dutch parks.

The 16 target areas observed in the park were selected to reflect the variety of different uses. However, observations on fewer larger target areas would enable more accurate recording of numbers of people using the park. From own observations and based on indications from

neighbourhood professionals and residents, it appeared that the impact of the restructuring of the park on use may be underestimated in this study. Additionally, we only observed the park at daytime, and not in the evening, and it was almost holiday during both observation periods. That may have impacted on park use and might not be representative of use at those time periods, in particular of specific age groups (e.g. teenagers may visit the park in the evenings) and of specific ethnic groups (e.g. many Moroccan people left the neighbourhood for a holiday in the first observation period).

It was sometimes difficult to assess the age group or ethnicity of a person. Furthermore, it was sometimes hard to say what the main activity in a specific target area was, due to the variation within the user group, for example, the children participated in vigorous activities, while the parents showed sedentary behaviour.

There were several other drawbacks with use of the app itself. The app slows down when many photos are taken. In addition, it was not possible to delete erroneous individual observations.

Observations from different devices cannot be integrated. Since data were recorded on 2 devices this may have led to some differences.

More in depth analyses can be made on specific subsets of i-SOPARC data, such as on the two different periods of data collection, or differences between week and weekend days. However, given the timeline of the project, that was not feasible for the present report.

We were not able, within time and resource constraints, to conduct a survey or interviews to gain broader insights on the impact of the restructuring on use and perception of the park. These might include impacts on stress reduction, social cohesion in the neighbourhood, and on the involvement of local residents and their sense of ownership and empowerment, or on changes towards more pro-environmental attitudes or behaviours. This would have been beneficial in order to make comparisons with the baseline data previously collected as well as to assess satisfaction with the restructuring of the green space.

Photo 9: Gathering in park

5.9 Learning points for future research

In the above we already made some suggestions for future research with regard to the use of i-SOPARC (selecting larger target areas, combining it with a questionnaire survey to gain a broader insight) and improvements of i-SOPARC itself. Another suggestion would be to discuss the results with local professionals, to understand better what is observed, and if this is a representative picture of the actual use. Furthermore, discussing the results with residents themselves may also improve insights in the use of the park, and if improvements are needed to increase the use and/or make people more satisfied. Finally, to get a better insight on the longer-term impacts of the restructuring, we recommend follow-up measurements.

5.10 Learning points for potential scale up and transferability

Restructuring of the green space with involvement of the stakeholders in Breda has increased the use of the green space, potentially leading to beneficial health effects. In addition, the park is used by a variety of population groups, with the potential to improve social cohesion in the neighbourhood and improving the health and living conditions of the low SES populations. Gaining more insight into the lasting effects of this intervention, requires a longer period of follow-up and repeated observations. This intervention has the potential to be transferred to other (European) regions. If others consider implementing it, it is recommended consider the wider context that made this intervention a success, also described in Report D4.1 (Implementing Triple-Win Case Studies for Living, Moving and Consuming that Encourage Behavioural Change, Protect the Environment, and Promote Health and Health Equity) and Report D5.1.

Restructuring green spaces could be scaled up for example as a part of EU funded nature-based solution programs, and as part of integrated national or local policies focusing on tackling health inequalities, but also linked to climate adaptation measures. The latter receives increasing attention in European countries, and green and blue spaces are often mentioned as ways to reduce heat stress and buffer extreme rainfall events. At the same time, they can serve as areas to improve health and living conditions of low SES populations, as shown here (co-benefits).

Another generic lesson is related to the observations of park use. These observations are important to evaluate the impact of green space evaluations, which is still rarely done. It can give park authorities, local residents/users, health professional and others information about how many people use a park at different times, the characteristics of park users (age, gender), level of physical activity, and main activity of users in relation to features or characteristics of the park. Such observations provide snapshots of park use, therefore information from observations should be bolstered by qualitative information gathered from park users, and/or community representatives to obtain more complete information. Evaluation of these data can be used to guide improvements in green spaces and encourage their use by people of all ages. It can guide improvements to suit the needs of residents, to encourage regular physical activity, and to provide space for rest, relaxation and social interactions.

6. Gardening with Green Gym and Meat Free Monday

6.1 Background

Gardening with Green Gym and Meat Free Monday is an innovative intervention designed as part of the EU-INHERIT consortium. Combined diet and physical activity (PA) school-based interventions (rather than only diet or physical activity interventions) are more likely to help prevent children becoming overweight in the long term (Brown and Summerbell, 2009). However, such interventions are relatively rare and therefore, well-designed evaluation studies of such interventions are needed. We designed an intervention within a primary school in Greater London which aims at improving children's health behaviour (PA and diet) and mental well-being in collaboration with the Conservation Volunteers [TCV, the organisation who runs Green Gyms (GG)] and Meat free Monday campaign, UK (MFM). The Green Gym® is an innovative way to get physically active and make a difference to the local environment with an emphasis on health and fitness. Anyone can join free outdoor sessions where volunteers are guided in practical activities such as planting trees, sowing meadows and establishing wildlife ponds. TCV also offered Green Gyms for schools – working with staff and parents to help pupils learn about their environment and how to care for it, grow plants and vegetables, and increase their physical activity. The implementation of the pilot intended gardening in the school grounds operated by TCV, engaging children and teachers in the process, and linking the gardening with the curriculum and with the school meals. In addition, children were offered one 30 minutes session on healthy eating and its impact on the environment by the Meat free Monday campaign manager. The school already had a meat free day (every Thursday) in place. Gardening activities in the school grounds included clearing the weeds, preparing the garden beds, clearing the path, making a fence, sowing seeds, learning to use gardening equipment, preparing the path to the greenhouse and other activities.

6.2 Overall aims

The study resonates with the overall aims of INHERIT, achieving triple wins of improving health, health equity and the environment through behaviour change. The aims and objectives were to

- Support children to include more plant-based foods in their diets, increase their physical activity and improve their well-being.
- Bring a change in the whole school environment i.e. improvement of the schoolyards with more usable green space leading to improvements in environmental sustainability with the involvement of Green Gyms.
- Improve children's pro-environmental behaviour through their engagement in gardening and activities for protection of their school environment organised by Green Gyms.
- Improve health and well-being across different socio-economic groups and among children with different learning abilities by promoting plant-based diets and knowledge of nutrition and environmental sustainability in longer term.
- Examine the impact of Gardening with Green Gym and Meat free Monday on children's physical activity, dietary behaviour, knowledge of nutrition and plant science, pro-environmental behaviour and well-being.

6.3 Context

Childhood obesity is a major public health concern in the UK (Public Health England, 2018). Today 30% of children aged 2 to 15 in England are overweight or obese (Conolly and Davies,

2018), and children who are becoming overweight or obese at earlier ages are likely to stay obese for longer (Johnson *et al.*, 2015). Inequalities in child obesity have been increasing among children aged 10-11; the gap in obesity prevalence between the least and most deprived areas among 10-11 year olds increased by 5% between 2006/7 and 2017/18 (NCMP, 2018).

Factors associated with overweight and obesity include limited intake of healthy diet (i.e. fruits and vegetables) and decline in physical activity (Han, Lawlor and Kimm, 2010; Gurnani, Birken and Hamilton, 2015). There is evidence that a sufficient intake of fruits and vegetables is related to decreased risk of non-communicable diseases (NCD) including type-2 diabetes, cardiovascular disease and cancer (Li *et al.*, 2014; Aune *et al.*, 2017). Childhood is considered to be an important period for the development of healthy eating behaviours including vegetable consumption, and children who adopt healthy eating behaviours at an early age continue to eat healthy diets into their adulthood (Craigie *et al.*, 2011; Gahagan;, 2012). World Health Organisation (2003) recommends eating at least 400g or five portions of fruits and vegetables per day to reduce the risks of NCDs. The European PRO-GREENS cross sectional survey of 8158, 11-year-old children from ten countries in Europe reported that the mean total fruit intake ranged between 114 and 240 g/d and vegetable intake between 73 and 141 g/d per day. The Health Behaviour in School-Aged children (HBSC) study indicates that only 39% of 11 year old children consume vegetable and fruits on a daily basis drawing on data from 44 countries in Europe and North America (Inchley *et al.*, 2016).

Again, benefits of regular physical activity (PA) for current and future health of children and young people (5-17 years old) have been well researched and acknowledged by the World Health Organisation. WHO (2010) recommends at least 60 minutes of moderate to vigorous physical activity for all children aged 5-17 years and inclusion of vigorous and resistance activities at least three times a week. Yet urban children are less active than the recommended levels in many countries including the UK (Griffiths *et al.*, 2013; Ucci *et al.*, 2015). According to the HBSC study, only 50% of the children participated in two or more hours of vigorous physical activity per week (Inchley *et al.*, 2016). Low vegetable and fruits intake and inadequate physical activity indicate the need for interventions for children that will encourage them to eat healthily and be more active on a regular basis.

Primary schools are typically the first formal institution where children spend most of their waking hours during term time. Hence, it is important that children have the opportunity to spend time outdoors and be active in this setting. UK Government's 'Childhood Obesity: A Plan for Action: Chapter 2' states *'We must ensure that schools are equipping children with the knowledge they need to lead healthy lifestyles and creating environments which encourage their pupils to eat healthily and be physically active'* (Department of Health and Social Care, 2018). Again physical activity and spending time outdoors is positively associated with mental health and academic performance (Sullivan *et al.*, 2017; Khan, McGeown and Islam, 2018; Khan and McGeown, 2019). Hence, a 'whole-school approach' would support children's health and well-being.

Different school-based programs introduced in the past decade to tackle childhood obesity focus on either dietary intake or improvement of physical activity. Interventions focusing on the promotion of healthy eating or improving physical activity have had limited effect on reducing childhood obesity. In contrast, complex interventions potentially addressing both diet and physical activity may show more promising results in tackling obesity (Brown and Summerbell, 2009; De Bourdeaudhuij *et al.*, 2011; Reiner *et al.*, 2013). Type of interventions included educational, environmental and multicomponent combining educational with environmental.

The effect of school-based interventions including only an educational component (i.e. classroom-based activities) or only an environmental component (i.e. fruit and vegetable distribution) on children's healthy eating is limited and not conclusive (Blanchette and Brug, 2005; Van Cauwenberghe *et al.*, 2010; Evans *et al.*, 2012). On the other hand, multicomponent interventions (including both educational and environmental components) show more promising results in increasing children's fruit and vegetable consumption (Blanchette and Brug, 2005; Van Cauwenberghe *et al.*, 2010; De Bourdeaudhuij *et al.*, 2011).

The experiential learning approach taken in this INHERIT case study by setting up a school garden incorporates both the environmental and educational components addressing both dietary intake and physical activity. The health and well-being impacts of school gardens on children's health and well-being are reported in the systematic review conducted by Ohly et al. (2016). School gardens can positively influence children's vegetable and fruit intake (Morris and Zidenberg-Cherr, 2002; Gatto *et al.*, 2012; Appleton *et al.*, 2017) and their physical activity (Wells, Myers and Henderson, 2014; Rees-Punia *et al.*, 2017). However, in many of these interventions, the gardening activities were not linked with their meals. The benefits of school gardening can be amplified by incorporating hands on learning of growing fruits and vegetables with curricular learning, making a connection of what children eat with what they could grow in their school gardens.

The INHERIT case study combined activities in the school gardens (run by Green Gym/ The Conservation Volunteers) with provision of a meat free meal (potentially plant based) (inspired by Meat Free Monday Campaign, UK) once a week. For more information on the implementation of the intervention please consult the INHERIT WP4 Implementation Report.

6.4 Research questions

Main research question:

- To what extent does the Gardening with Green Gym and Meat Free Monday influence children's health behaviour and well-being and their pro-environmental behaviour?

Sub research questions:

- To what extent does Gardening with Green Gym and Meat Free Monday influence children's health behaviour (healthy eating and physical activity)?
- To what extent does Gardening with Green Gym and Meat Free Monday influence children's well-being?
- Does Gardening with Green Gym and Meat Free Monday influence children's pro-environmental behaviour?

6.5 Methodology

A quasi-experimental mixed methods study was conducted in a public primary school in the London Borough of Redbridge in North-East London. The borough is diverse in its profile with 11 neighbourhoods amongst the 20% most deprived in England and another 11 amongst the 20% least deprived in England (London Borough of Redbridge, 2015). The borough is the 21st most deprived local authority in London and 15.5 % of children in this borough come from low income families. The children in the school also come from diverse backgrounds, where 4.2% come from the 10% most deprived families of the borough and 1.3% come from the 10% least deprived families of the borough. 12.3% children are eligible for free school meals (see Table 1).

In terms of the physical environment of the school, there is a tarmac playground with a playhouse, a shaded area with picnic tables, some seating areas, planters and a mound area. The mound area has 7 raised garden beds of different sizes, 2 compost bins, a small seating area and a small pond (see Figure 2 and 2). The school also has access to a vast green field and woodland adjacent to the school premises, however this area is not used on a regular basis. There is an outdoor classroom/seating area along a trail in the woodland (see Figure 3). Before intervention the mound area was overgrown with weeds and the children were not engaged in any outdoor learning sessions there.

Table 1: Background of children of the primary school based on the deprivation index (Source: Primary School)

0-10% most deprived	**4.2%**
10-20%	13.6%
20-30%	18.4%
30-40%	4.6%
40-50%	10%
50-60%	5.9%
60-70%	16.9%
70-80%	4%
80-90%	0.8%
90-100% least deprived	1.3%

Figure 2: Google earth image of the school showing the school premises and the surrounding area

Figure 3: Mound area

Figure 4: Outdoor seating in the woodland

Study Sample

Sixty children (9-10 years old) from Year 5 participated in the study where 30 children in one class were the intervention group (IG) and the other parallel class of 30 children acted as the control group (CG) (random group assignment). Children were randomly allocated to these two classes. The intervention group included two children on the autism spectrum and the control group included two children with hearing impairment. Children aged 9-10 were selected for two reasons. Firstly, the research methods used in this study would be developmentally appropriate for children of this age (i.e., questionnaires and focus groups). And secondly, the obesity rate among Year 6 children (10-11 years old) in England is of public health concern (NCMP, 2018). Therefore, identifying potential routes to obesity and overweight management among children closer to this age is crucial.

Intervention

The intervention included leading children outdoors for activities related to gardening, growing of food and environmental improvement and conservation every Monday afternoon during the school term for two hours. The intervention was planned to run for one school year, where the intervention group (IG) had access to the gardening activities outdoors run by the TCV for the first half of the year (September 2018 –February 2019) when the control group (CG) received their usual classes indoors. They (IG) also received one Meat Free Monday session run by the MFM UK campaign manager (30 mins) focusing on the environmental and health benefits of plant-based meals. For the second half of the year (February 2019 – July 2019), the CG children would get access to gardening activities and one Meat Free Monday session. This chapter reports on results based on the data collected after the first phase of intervention in February 2019. TCV led the outdoor activities based on their experiences and guided by evidence generated from previous Green Gym evaluation studies. The UCL research team did not design GG activities and MFM session and however facilitated the execution of the activities liaising with the school and ensuring access to resources needed.

Figure 5: Different activities on a Gardening with Green Gym session

The outdoor activities were led by a Green Gym community and outdoor education officer who introduced herself as a facilitator of the gardening activities rather than the leader. During the first few weeks, children mapped the outdoor area and suggested changes and improvements that could be made to the school ground (see Figure 6). The Green Gym activities in the school ground were then based around the suggestions made by children that included preparing raised beds for spring crop growing by weeding, covering and refilling with newly dug leaf mulch and compost from school grounds. Children also sowed seeds of cress and lettuce in toilet rolls in their green house to transport later on to the garden beds. Children worked on creating a dead hedge as a safety barrier by collecting, sawing, hammering and weaving the wood themselves. They also worked together to use slabs to create an accessible path to the garden shed, cleared the field path for the football players, removed small trees and relocated the mini-beast (insect) hotel and the compost bin. Children learned how to light small fires with no matches or lighter, collected twigs for fuel and lit kettles to heat the water for a festive hot chocolate treat before Christmas. They also tasted a wide variety of fruits and vegetables during one Green Gym session (see Figure 6).

In addition to the regular outdoor session every Monday, in their classrooms children reflected on what they learnt outdoors during Green Gym sessions. The outdoor sessions were particularly related to the Personal, Social, Health and Economic education (PSHE) curriculum for primary school children. PSHE provides teachers and schools the authority to tailor their local PSHE programme to reflect children's needs. Teachers found that children were learning hands on the elements of PSHE in their outdoor sessions. Children prepared posters in their classrooms on what they learnt in GG and MFM sessions (see Figure 7) and presented to the whole school in an assembly. Teachers used lesson plans from Meat Free Monday online resources and guided children in designing their meat free meals in their regular classrooms (see Figure 8).

Figure 6: Tasting session of fruits and vegetables

Figure 7: Poster on Green Gym and Meat free Monday made by children in their class

Figure 8: Meat free meals designed by children in their classroom

Data Collection Methods

Multiple methods were used to collect data to examine children's health behaviour and pro-environmental behaviour both at base-line and follow up (see Figure 9). These included use of

1) wrist-worn accelerometers to measure children's physical activity,

2) a questionnaire to compare children's self-reported attitudes to, frequency of, and preferences in eating fruits and vegetables, knowledge of plants and nutrition and overall well-being, and

3) children's drawings to measure pro-environmental behaviour.

In addition, 4) focus groups with children, and 5) interview with teachers and instructors were conducted to allow in-depth qualitative insights into the school gardening experiences and the interventions. Additionally, 6) participant observation of children during their green gym sessions was conducted throughout the school year.

The data collected during baseline (T1) and the 1st follow-up (T2) was analysed and is reported here. The 2nd follow-up data collection will take place in July 2019.

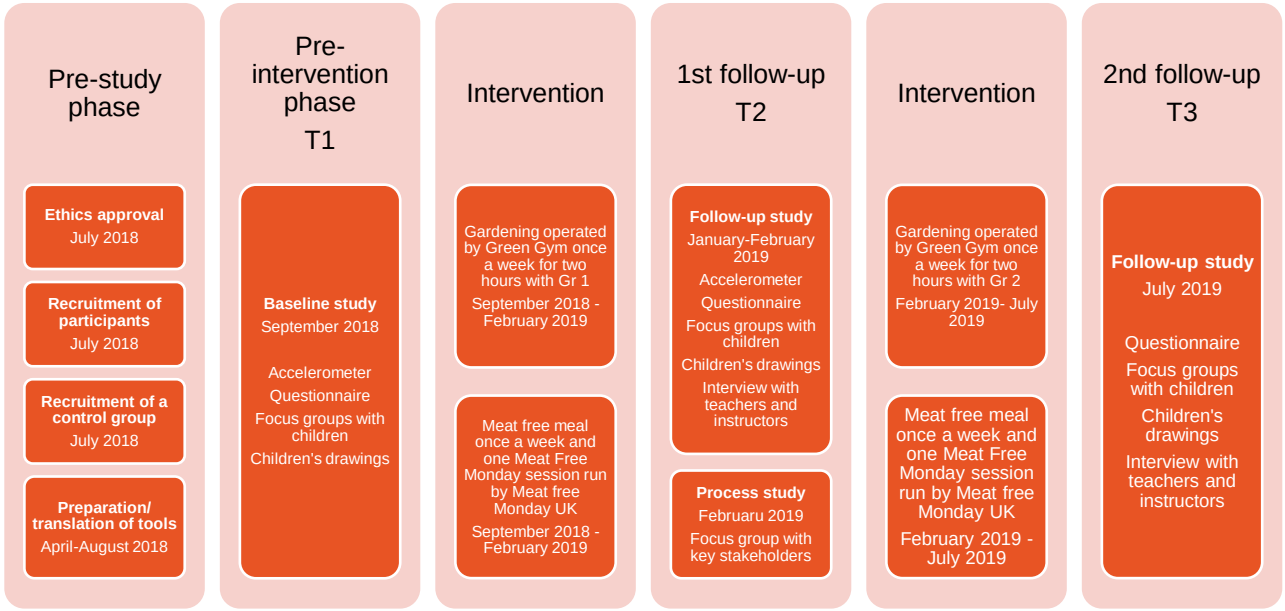


Figure 9: Evaluation plan for the INHERIT Gardening with Green Gym and Meat Free Monday

Accelerometers

Children were asked to wear a GENEActiv accelerometer (GAwrist, Activinsights, Cambs, UK) on the non-dominant wrist for seven consecutive days. Children were asked to wear the devices at all times including sleep and water-based activities. Devices were set to record at a frequency of 100Hz. GENEActiv wrist data were downloaded using the GENEActiv software version 3.2 and saved as binary files. Files were then processed in R following van Hees *et al.*, (2013).

Questionnaire survey

A self-reported questionnaire was used to measure children's attitudes to, frequency of and preferences in eating fruits and vegetables. This reliable and valid questionnaire was developed to assess dietary patterns associated with positive energy balance and food behaviours, attitudes, knowledge and environments associated with healthy eating among yr 5,6,7 children (Wilson, Magarey and Mastersson, 2008). As the current study only assessed attitudes to, frequency of and preferences in fruit and vegetable consumption, only these questions were kept in the questionnaire. The questionnaire further included items to measure children's knowledge of plant science and nutrition (used by Wells *et al.*, 2015) and their overall well-being (Stirling children's well-being scale developed and validated by Liddle & Carter, 2015). The

children completed the questionnaires in their regular classroom environment. Children were given instructions on how to complete the questionnaires to ensure sufficient understanding. For questionnaire items and response scale see Table 2.

Table 2: Questionnaire items and response scale

Category *Score (total items)*	Items in each score	No. of items	Response
Attitude			
Fruit (4)	*With regards to fruit, agreement with:* makes me feel healthy, tastes good, easy snack, I like tasting new fruits	4	Likert scale (1 to 5)
Vegetable (4)	*With regards to vegetables, agreement with:* makes me feel healthy, tastes good, I like tasting new vegetables, easy to prepare	4	Likert scale (1 to 5)
Frequency			
Fruit (1)	No. servings fruit consumed by you each day	1	Select from: none, 1 a day, 2–3 a day, 4-5 a day, 6 or more per day
Vegetables (1)	No. servings vegetables consumed by you each day	1	Select from: none, 1 a day, 2–3 a day, 4-5 a day, 6 or more per day
Preferences			
Fruit (19)	How much you like the fruits in the picture (19 fruit items that are easily available in the UK)	19	Select from: I like it a lot, I like it, It's ok, I don't like it, I don't like it at all, I have never tried it and I don't know what it is
Vegetable (19)	How much you like the vegetables in the picture (19 vegetables items that are easily available in the UK)	19	Select from: I like it a lot, I like it, It's ok, I don't like it, I don't like it at all, I have never tried it and I don't know what it is
Knowledge of plant science and nutrition			
Knowledge (7)	7 questions on what people and plants need to live, which nutrient supplies energy, which part of the plant we eat when eating broccoli, which nutrient do we want to see at a food label, which part of the plant uses the sun's energy, which item is not an ingredient for making compost and which part of the plant pulls water and other nutrients from the soil	7	Select one from four options
Well-being			
Well-being (12)	Agreement with questions about how you might have been feeling or thinking over the	12	Likert scale (1 to 5)

Category *Score (total items)*	Items in each score	No. of items	Response
	past couple of weeks; e.g. I can find lots of fun things to do, I've been in a good mood, I enjoy what each new day brings etc.		

Children's drawings

Children's drawings were used to gain insight into children's construct of the 'environment'. Children were asked to draw their favourite place using pencils on paper which could be any existing place, indoor or outdoor. On completion of this, children were asked to draw what they think 'environment' is. They were asked to add words and sentences to help explain what they had drawn. Children took around 30 minutes to complete the whole exercise.

Focus groups with children

In order to gain insight into children's attitudes to the environment and their experiences of gardening, qualitative information was sought through two focus groups with children before the intervention and three focus groups after the intervention at the first follow up. Each focus group comprised six to eight participants. The focus group discussion (FGD) was semi-structured; the baseline FGDs explored topics around children's general activities in the school ground, their favourite activity, teaching and learning outdoors, their experiences of places and children's views of the environment (using children's drawings of environment as props). The post intervention FGDs further asked about children's experiences of gardening outdoors, whether gardening helped or deterred their learning and connection with nature and whether or how gardening had any positive/negative impact on their behaviour, physical activity and attitudes to eating fruits and vegetable. FGDs also explored children's views of how the activities can be improved.

Structured questionnaire with teachers and instructors

Teachers and instructors from Green Gyms responded to a set of open-ended structured questions in written format. The questionnaire included ten questions asking their experiences of gardening, what went well and what did not go well and how the intervention could be improved further.

Participant observation

On site observation was conducted throughout the implementation period using field notes, photographs and video recordings of the activities in the school ground, conversations of children with GG instructor and their teachers and amongst themselves in order to understand the whole implementation process, what went well and what did not.

Data analysis

Prior to all analyses, all outcome measures were checked for normal distribution (skewness and kurtosis between -2 to 2). The data from all the children from two different groups have been explored together on each of the variables.. Descriptive statistics (using SPSS 24.0 for Windows) were computed to describe the sample characteristics. Independent sample t-tests were conducted at T1 to assess whether there was any difference between the two groups at

baseline. To assess the effectiveness of the intervention, parametric tests (one-way ANCOVA) were selected to compare the groups. In addition, a parallel samples t-test was conducted for the intervention group to measure any improvement between T1 and T2. The data from the focus groups and structured questionnaires with teachers were analysed using thematic analysis. Qualitative data analysis software Quirkos 2.4 was used for the analysis.

6.6 Results

This section primarily discusses the results in relation to health behaviour (healthy eating) based on the data collected at the first phase in February 2019. Quantitative results in relation to physical activity and pro-environmental behaviour were still being analysed at the time of writing the first draft in May 2019. The results section further includes the findings from thematic analysis of the qualitative data.

Baseline measures

The mean age of the sample was 8.92 years (range between 9 and 10 years old) and 39% were girls. There was no significant difference between the treatment group and the control group in sample characteristics in terms of age and sex. However, significant differences were found between the two groups in daily fruit consumption, the control group scoring high: daily fruit consumption (t(55)=-2.481p=0.02). The baseline measures can be found inTable 3.

Table 3: Mean score and standard deviations of baseline measures assessed in questionnaire survey

Measures	Total	Intervention group (IG) Mean (SD)	Control group (CG) Mean (SD)	p-value for difference between IG and CG
Age in years	8.92 (1.197)	9.07 (.254)	9.07 (.258)	0.97
Sex in % girls	39.0%	40%	37.9%	0.87
Daily vegetable consumption	2.88 (1.211)	3.07(1.152)	2.69(1.257)	0.24
Daily fruit consumption	3.56 (1.195)	3.18(1.156)	3.93(1.132)	**0.016***
Attitude to eating vegetables	13.74 (3.330)	14.18(3.692)	13.31(2.941)	0.33

Measures	Total	Intervention group (IG) Mean (SD)	Control group (CG) Mean (SD)	p-value for difference between IG and CG
Attitude to eating fruits	17.30 (2.686)	17.04(2.937)	17.55(2.443)	0.47
Preferences of vegetable	84.26 (22.08)	84.71(22.096)	83.83(22.448)	0.88
Preferences of fruit	106.51 (21.239)	102.82(23.174)	110.07(18.909)	0.20
Knowledge of nutrition and plant science	3.05 (1.586)	2.68 (1.389)	3.41 (1.701)	0.08

Intervention effects

There was no significant difference between the two groups at the 1st follow up using an independent sample t-test. In a parallel sample t-test no significant improvement was measured for the intervention group at T2 compared to T1.

Intervention effects taking into account baseline scores

In a one-way ANCOVA controlling for baseline scores, there was no significant difference between the intervention and the treatment group in any of the outcome measures (see Table 4). However, the mean for some measures (fruit consumption, knowledge of nutrition and plant science) for the intervention group indicates a positive trend compared to the control group. Individual measures are in further detail below.

Table 4: Mean and standard deviation of the follow up measures

	Intervention group (IG) Mean (SD)	Control group (CG) Mean (SD)	p-value for difference between intervention and control group	Effect size
Daily vegetable consumption	2.88 (1.092)	2.90 (1.145)	.346	.017
Daily fruit consumption	3.35 (1.071)	3.55 (1.021)	.728	.002
Attitude to eating vegetables	13.07 (4.760)	14.45 (3.355)	.085	.054
Attitude to eating fruits	16.61 (5.072)	17.45 (2.627)	.480	.009

	Intervention group (IG) Mean (SD)	Control group (CG) Mean (SD)	p-value for difference between intervention and control group	Effect size
Preferences of vegetable	77.96 (29.817)	86.55 (17.661)	.078	.056
Preferences of fruit	97.79 (33.05)	110.24 (17.49)		
Knowledge of nutrition and plant science	2.79(1.750)	3.24 (1.766)	.681	.003

Healthy eating

Daily vegetable and fruit consumption

Before the intervention 7.1% children from the intervention group (IG) and 13.8% children from the control group (CG) reported that they did not eat any vegetables. Interestingly, this number did not change much for the intervention group, while only 3.4% children from the control group reported that they did not eat any vegetable after intervention. There was an increase in the percentage of IG children eating one serving (28.6% to 29.6%) and 2-3 servings of vegetable per day (from 25.0% to 33.3%), on the other hand there was a decrease in the number of children who ate 4-5 servings a day (28.6% to 22.2%) and 6 or more servings a day (10.7% to 7.4%). In contrast, an increase was observed in all cases (except 4-5 servings) for CG children (see Figure 9).

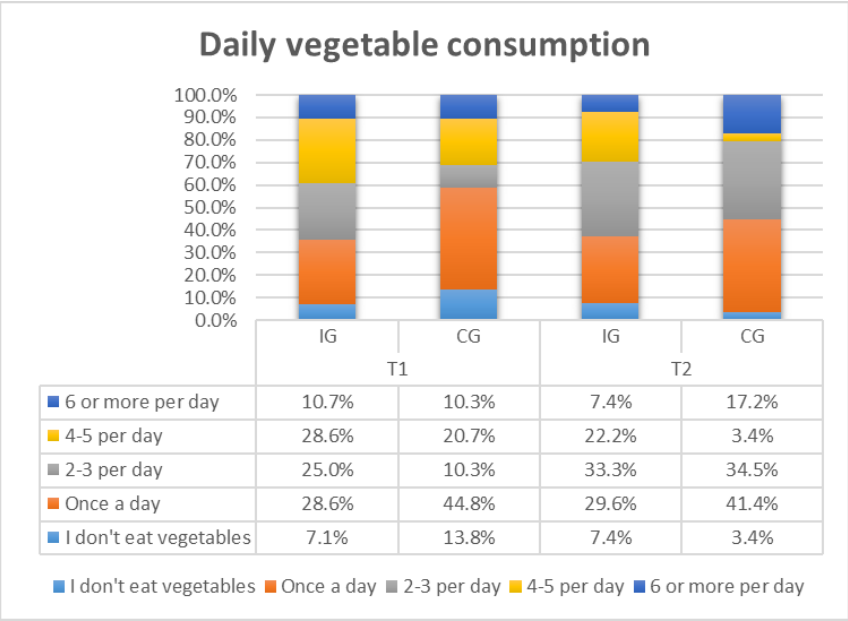


Figure 10: Daily vegetable consumption of children before and after intervention.

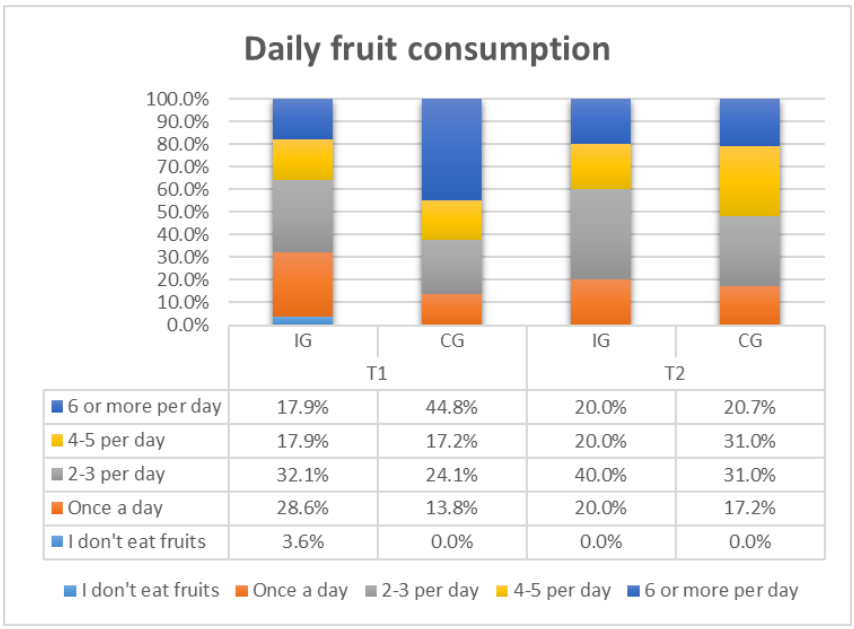


Figure 11: Daily fruit consumption of children before and after intervention.

There was an increase in IG children's consumption of fruits after the intervention, although this was not statistically significant (there was significant difference between the two groups at baseline, CG scored higher). After intervention, no children reported that they did not eat fruits whereas 3.6% of the IG children had reported not eating a single serving of fruit before the intervention (see Figure 10). The percentage of children eating more than two serving of fruit increased for IG children, however the percentage of children eating more than two serving of vegetable decreased for them (see Figure 12).

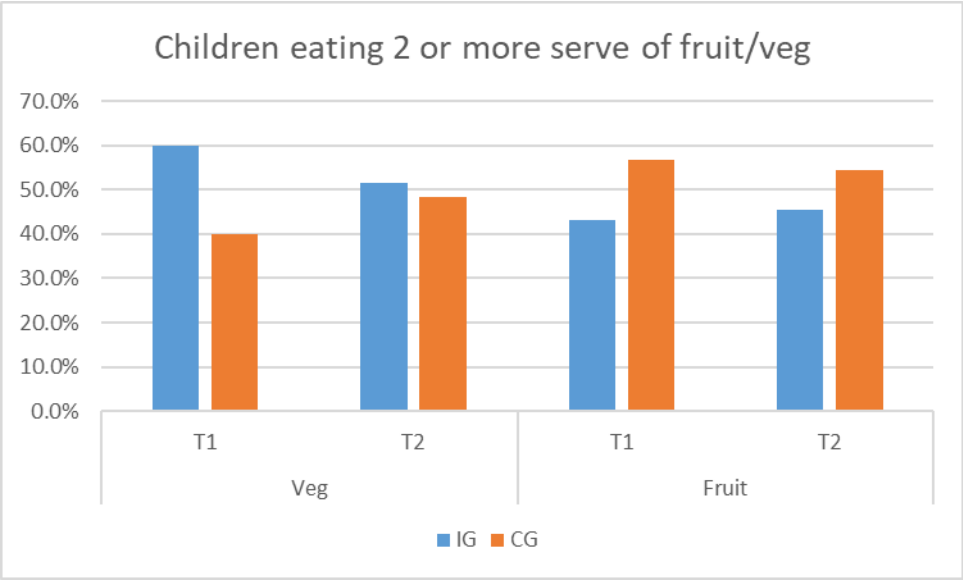


Figure 12: Percentage of children eating two or more serve of fruits and vegetables

Attitude to eating fruits/vegetables

No significant difference was observed between the two groups in their attitude to eating vegetables and fruits. There was a positive change among both the groups in their attitude to eating fruits, however, surprisingly, the mean for attitude to eating vegetables is higher for CG children after the intervention while it was the other way around before the intervention (see Figure 13).

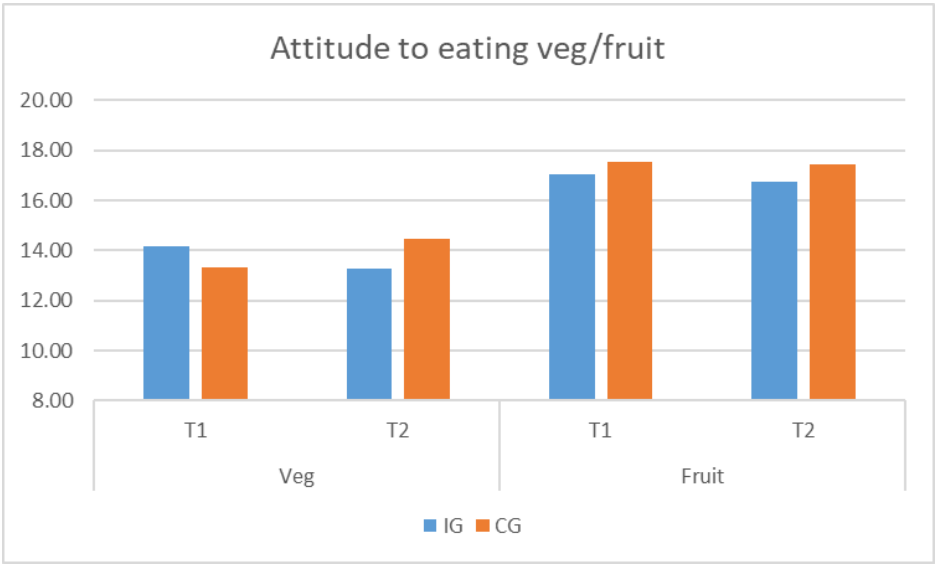


Figure 13: Attitude to eating fruit and vegetable before and after intervention

Preferences for vegetables/fruits

No significant difference was found among the groups in their preferences for fruits and vegetables. A slight decreasing trend in preferences for fruits and for vegetables was observed for the IG children (see Figure 14). However, IG children showed some levels of improvement in knowing new vegetables and fruits and making an attempt to try something new. Out of 531

counts of different preferences to vegetables, 24 recorded as ‘don’t know what it is’ and 81 marked as ‘never tried it’ at T2 in contrast to 37 and 102 at T1 (see Figure 15). For fruits, among IG children 9 and 40 responses were recorded as ‘don’t know what it is’ and ‘never tried before’ respectively at T2 in contrast 22 and 71 at T1 (see Figure 15: IG children’s preferences for vegetables before and after intervention

).

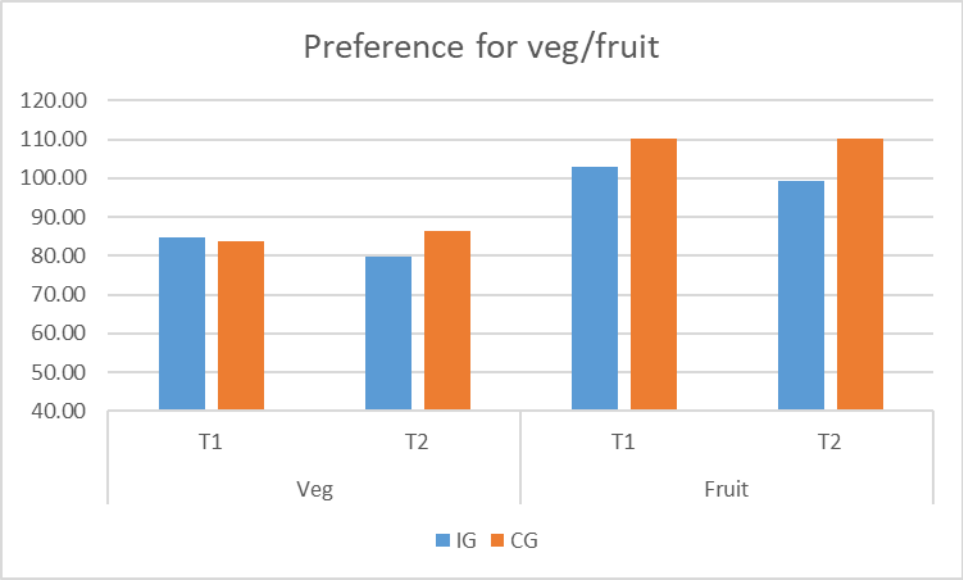


Figure 14: Preferences for fruits and vegetables before and after intervention

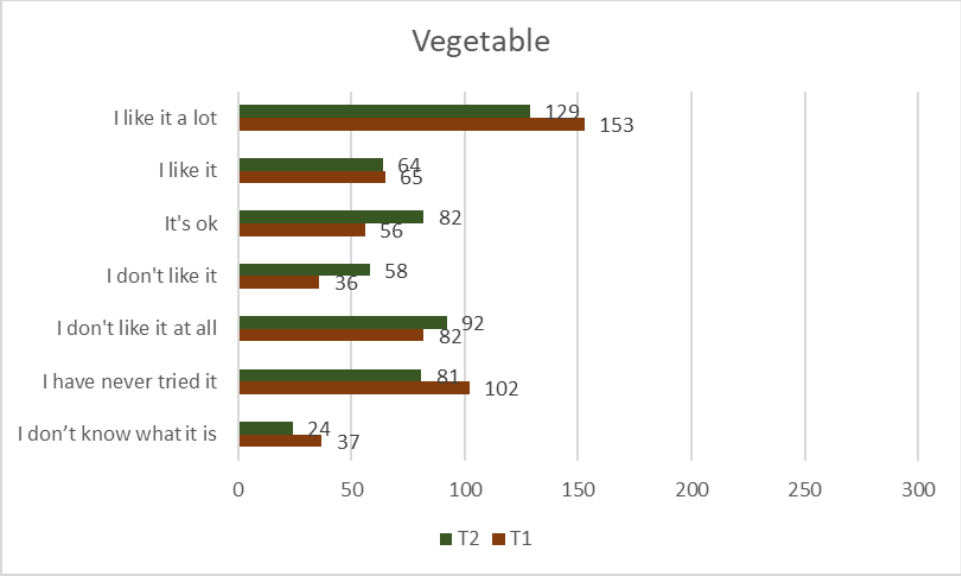


Figure 15: IG children’s preferences for vegetables before and after intervention

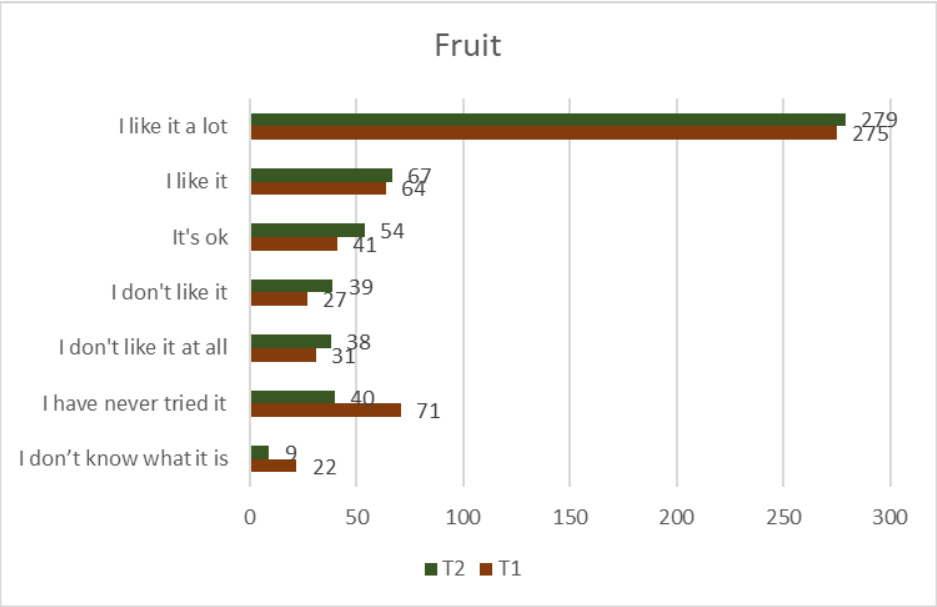
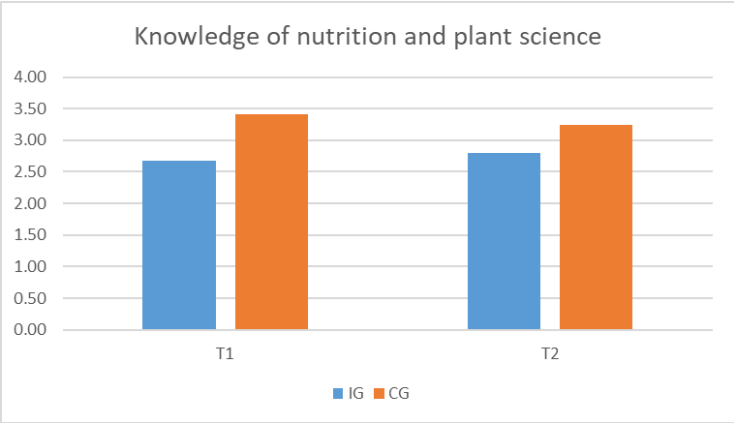


Figure 16: IG children's preferences for fruits before and after intervention

Knowledge of nutrition and plant science

No significant difference was found between the two groups in their reported knowledge of nutrition of plant science both before and after intervention. However, the mean for the IG group children is higher at T2 than T1 in contrast to CG children whose mean at T2 is lower than before intervention. Although not significant this indicates some improvement in IG children's knowledge of nutrition and plant science (see Figure 17).

Figure 17: Difference in children's knowledge of nutrition between groups before and after intervention



Well-being

The results from statistical analysis of the data on well-being are not presented here. This analysis is being prepared for publication in a peer reviewed journal.

Physical activity

The results from analysis of data collected using accelerometers were inconclusive, but are indicative of a positive change in children's moderate to physical activity and a reduction in children's sedentary behaviour. The results are published in a journal article (Khan and Bell, 2019).

Pro-environmental behaviour

The analysis of children's drawings to assess their pro-environmental behaviour is currently ongoing. However, results from preliminary analysis of focus groups indicate some improvement in children's connection with nature which is indicative of their pro-environmental behaviour (Geng *et al.*, 2015). A paper is now in preparation based on the results from qualitative methods..

Qualitative insights

The findings from the post intervention focus group discussion with children and interviews with teachers are discussed around the following three themes:

- Healthy eating
- Physical activity
- Equity

Healthy eating

In general intervention group children reported a change in their attitudes towards eating vegetables. Most children mentioned that they ate fruits on a regular basis but because of the intervention they were now eager to try vegetables even if sometimes they thought they did not like the vegetables, as evidenced in the following conversation:

Jack[3]: When like green gym wasn't in our school I wasn't really keen on vegetables, I wasn't keen on like, whenever I had a meal at a restaurant I'd be like 'oh mum can you eat my peas please cos I don't want them?'

Interviewer: Yeah

Jack: But now I'm like, my mum asks 'shall I take your peas?' and I'm like 'no I'm fine'

And also, here:

"Before green gyms started I used to love fruit but hate vegetables. And so, every time my mum put vegetables on my plate and I had something else with it, I'd just eat the other thing but then just leave all the vegetables away, but now if I look at them I won't throw them away, I'd eat every single thing that's on the plate and I wouldn't moan about it"

Some children also reported that there was not any change in their attitude to eating fruits and vegetables whereas some others mentioned that they would have tried new vegetables had they have the opportunity to plant them.

[3] All names used in the reporting of qualitative results are pseudonyms.

"I don't try food that much, but if I actually plant it, it might actually kinda make me try it."

"Imagine if you plant your own food and you taste it, and you think 'oh that's really nice' and eat more of that and eat less of like chocolate."

Some of them also mentioned about their dissatisfaction about the meat free options in the school menu.

"I think when Meat Free Monday came in I actually tried to do Meat Free Monday sometimes, but it's not going very well, because lunches on Monday is always meat, so there was sausages. I was going to go for the vegetarian ones, but I tried that last time and they were not very nice."

Physical activity

Children reported that they were more active in the school on Mondays than before the intervention. They also mentioned that they grew muscles as they were engaged in different kind of gardening activities, as evidence here:

"Because I've been walking around a lot and running so my legs are gaining muscle and my arms they're always moving like chopping, raking or using shovels, and sometimes with the shovels there's parts that are really hard but I push on and I'm able to get it up."

Children also reported that they were eager to explore more outdoors as they started spending time outdoors with Green Gym.

"Cos I live in a house and I have a dog we usually just take her out in the garden but since green gym like when I get home from school 'I'm like mum can we go walk the dog now?' and she'd be like 'yeah one minute' and before I wouldn't ask to walk the dog."

Equity

While equity in terms of differential effects on children from different socioeconomic backgrounds was not investigated, on site observation explored how Gardening with Green Gym impacted children with learning difficulties. Preliminary findings from field notes, photographs and video recording indicate that gardening activities benefitted children with autism as indicated in their teachers' words:

"I have not seen Aoife and Adel as engaged and animated before" on the day children tasted new vegetables on a Green Gym day. The teacher also mentioned on another occasion, *"Allen who has autism does not want to touch anything, says 'it's dirty and bugs are not nice', and he's now got a pair of gloves on and he is digging around, he is finding the sticks for the bug hotel. All of the children have got a job and they seem to be really enjoying it."*

Gardening with Green Gym is particularly beneficial for underachieving children.

"Few weeks ago I said to two of the boys that they needed to make more of an effort. Today one of them is the leader who does not necessarily perform well in class, he really struggles; and he has come out here today and he has been guiding all children and he just fully thrown himself into it. And the other child as well, he is just interacting with everything, clearing the weeds, digging things up, moving rocks and logs and all of that, engaged with all the different insects."

6.7 Discussion

The present study investigated the impact of a gardening intervention aided with a Meat Free Monday session on children's health and well-being and their pro-environmental behaviour. Regarding health the study focused on healthy eating, physical activity, knowledge of nutrition and plant science and well-being. Although the existing literature indicated that school based complex interventions and experiential learning approaches are more effective in influencing children's health eating (Jaramillo *et al.*, 2006; Kavanaugh, 2017; Van Cauwenberghe *et al.*, 2019), the findings of the study indicated no effects on children's vegetable consumption and attitude to eating vegetable. This finding resonates with the findings from a recent study by Huys et al., (2019) however contradicts the findings from the above mentioned studies. This finding also did not indicate any significant impact on fruit consumption, attitudes to and their preferences in eating fruits. However, children have shown some interest in tasting new vegetables e.g. Brussel sprouts, beetroot and leeks and new fruits e.g. tangerine, kiwi and peach.

The focus group conversations with children indicated that they were more motivated to taste vegetables, that in many cases they thought it was acceptable to eat some vegetables, and that the taste was somewhat acceptable in more cases after intervention than before. The intervention only lasted for half the school year mostly in autumn and winter and therefore children did not have much opportunity to plant and grow vegetables. It was also indicated in the focus group conversations with children that if they had opportunity to grow fruit and vegetables, and taste them in the school gardens, that might have had an impact. This resonates with the findings from the qualitative study by Sarti, Dijkstra, Nury, Seidell, & Dedding, (2017) that explored children's perspectives on school gardening and vegetable consumption where children stated that they ate vegetables because they had grown them with their own hands.

The findings from the study indicates some improvement in children's knowledge of nutrition and plant science because of the intervention, however the difference is not significant. The positive impact on children's knowledge is harmonious with previous studies (Jaramillo *et al*., 2011; Morris & Zidenberg-Cherr, 2002; Wells *et al*., 2015).

Regarding well-being, the focus group conversations provide insights that indicate a positive impact of school gardening activities which is in agreement with the systematic review by Ohly *et al*., (2016). Ohly's study indicate a positive impact on children who did not excel in the classroom that aligns with the finding of our study as well. Several children who did struggle in the classroom environment were found to be engaging more in the outdoor environment and showing some leadership qualities.

The qualitative findings from the study indicate a positive impact on children's physical fitness, children reported being more active than before, building muscles and improving their gross motor skills. This aligns with findings from previous studies (Wells, Myers and Henderson, 2014; Rees-Punia *et al.*, 2017) that reported that children moved more and sat less on days when they were gardening.

Regarding pro-environmental behaviour, for now we are only relying on the findings from preliminary analysis of qualitative methods that indicated that children had more opportunities to connect with nature and showed more friendliness to the wildlife in the garden

Regarding equity, findings indicate that school gardening is beneficial to children with learning difficulties and underachieving children who struggle with work in the classroom (Block *et al.*,

2012). Gardening has always been found to be therapeutic for children with disabilities (Moore, 1996; Hussein, 2009; Hickman, 2017).

The study found no significant effects of the intervention on healthy eating (in quantitatively measured outcomes) which could be attributed to the fact the practical gardening activities were not developed by the research team. While the activities are evidence based and based on previous evidence-based projects of TCV, Green Gym activities in the school were primarily directed towards conservation of the environment, with less focus on growing fruit and vegetables, especially as the intervention was carried out in Autumn and Winter. Linking theory, research and practice can increase the effectiveness of nutrition education programs as suggested in evidence (Contento, 2008). It may be possible that effectiveness could have been increased when the activities were designed using social cognitive theory. Evidence shows that the majority of successful school garden projects used social cognitive theory (e.g. programs by Morris and Zidenberg-Cherr, 2002; Morris *et al.*, 2002; Morgan *et al.*, 2010).

Furthermore, the program was entirely led by the Green Gym outdoor education officer. Although two teachers were present there for supervision of children and supporting the Green Gym officer, they did not actively engage in the design and planning of the gardening activities and linking them with curriculum whereas integration in the curriculum is one of the most important success factors for school gardening programs (Ohly *et al.*, 2016). In addition, involvement from the Meat Free Monday campaign was limited to one interactive session. Although online lesson plans were available on the Meat Free Monday website, more time from teachers for direct involvement in planning and design of activities and having some training on outdoor learning could have improved the quality of the implementation. This would also be important for later implementation and potential upscaling.

Another factor possibly playing an important role in the lack of measurable effects is the fact that parents or the community were not involved in the project. Parents play a key role in children's vegetable consumption and involvement of parents in school-based programs is as important as involvement of teachers(Van Lippevelde *et al.*, 2012) and can potentially contribute to the success of the program (Blanchette and Brug, 2005; Davis *et al.*, 2015). Before the project started parents were invited to a meeting, however only four parents were present. As a result, involvement of the wider parent community could not be pursued further.

The intervention was implemented only in colder periods of the year when not many vegetables and fruits grow, therefore children did not experience the whole growing process and were not able to grow and harvest vegetables and fruits. This also made it difficult to create any link between the curriculum and hands on learning in the garden. Although programs as short as 10-weeks showed measurable changes in preferences for vegetables (Morris and Zidenberg-Cherr, 2002), an intensive program of one whole school year could have been more effective in adequately addressing all the areas of gardening from preparation of the site to harvesting and management.

While the quantitative measures provide limited evidence of effectiveness of the intervention, qualitative findings indicate positive changes in many areas. Adaptations in the activities and program can substantially contribute to increasing the effectiveness of similar projects in the future.

6.8 Limitations

To our knowledge, this is the first study in the UK that combines gardening activities (provided by GG) and awareness building for meat free meals (provided by MFM) and is evaluated for triple wins- health, environment and equity. However, this study has several limitations. First, there was a short implementation period which makes it less likely to observe changes in children's attitude to, frequency of and preferences in vegetable and fruits as it might take a substantial amount of time to bring about change in children's health behaviour (Kelly and Barker, 2016). The implementation is still going on with the control group children and a follow up data collection is scheduled to happen in late June 2019. Ideally, the intervention group should have received the treatment i.e. gardening activities for the duration of one school year and then the same for the control group requiring two years overall. However, the intervention could only be funded for one school year and supported by Green Gym without any cost for the duration of one school year. Second, generalizability is limited as the pilot project could only be implemented in one school in Greater London. Third, the program was implemented by the conservation volunteers (TCV) that resulted in the non-random assignment of the school to receive the intervention that could have caused selection bias. Ideally the control group should have been from another school, however no other schools in the borough were interested in acting as a control school. Furthermore, although the two classes in the school were randomly allocated to intervention and control groups, the two groups were different at baseline with the control group scoring higher in most of the constructs. Fourth, although the questionnaire used in the evaluation was based on a validated questionnaire, data were self-reported which increased the likelihood of socially desirable answers particularly for the control group children who were waiting to receive the intervention. Fifth, although the intervention was designed to improve children's health by improving physical activity levels while also teaching them about gardening and nutrition, it was implemented by Green Gym, who placed more emphasis on the former in the context gardening. It may therefore be possible that activities that also emphasized improving knowledge about fruits, vegetables and their nutritional aspects wold have a more significant impact on the outcomes associated with healthy eating.

6.9 Learning points for future research

Qualitative studies reported here show that the intervention was perceived positively by schoolteachers and children and showed positive impacts on children's connection with nature, social relationships and leadership skills, in addition to aspects related to health-related behaviour.

Although previous research found several positive effects of school garden programs on health behaviour and wellbeing, the current intervention has not yielded any statistically significant results on any of the outcomes analysed so far (30th May 2019). Analysis of all available data on pro-environmental behaviour (paper in preparation) could give a holistic picture of the benefits of the intervention.

The lack of significant quantitative effects with regard to healthy eating can be explained by the short-term implementation of the program, the short-term nature of the implementation and the fact that the emphasis was put on engaging children in environmental protection and increasing their physical activity levels, rather than on learning about nutritious foods. In addition, time and human resource constraints and the related lack of involvement from teachers in the co-design and planning of the programme also affected the outcomes. It is important to consider that this project was conducted as a pilot study and future research

projects should address these aspects (season, time and resources) in designing such interventions. Longer intervention periods and follow-up periods are necessary to capture the full effectiveness of school gardening programmes. Implementation of the study at a wider scale can give credibility to results and generalisability of the findings.

6.10 Learning points for potential scale up and transferability

This intervention was designed to address children's low levels of physical activity, low consumption of fruits and vegetables, and disconnection with nature over the short term. Over the long term this type of school-based intervention could potentially, as part of a wide scale multi-sectoral and whole of society approach, help to reduce obesity and contribute to environmental sustainability. To encourage scale up and transferability, there is a need to create awareness across all levels including policy makers, school administrations, teachers and parents that these kinds of activities in schools can potentially have multiple beneficial effects.

The project was implemented as a pilot, and while quantitative analyses have not provided statistically significant findings in several outcomes, preliminary findings from questionnaire and qualitative data indicate some improvement in children's physical activity levels, their knowledge of plants and nutrition, and opportunity to connect with nature and take care of their surrounding environments. The project also exposed children to and made them interested in vegetables and fruits; children are more likely to want to eat vegetables and fruits. Being aware of the multiple benefits can help motivate and enable school administrations, teachers, parents to engage more with such programmes and to participate in them, which is the key to their success.

For potential and scale up of the project it is important to acknowledge the barriers and challenges namely the lack of time and resources. Co-design and planning of the whole intervention with participation from teachers is important for building confidence among teachers in sustaining the activities developed in the school that needs time. Experiential outdoor learning if integrated with the national curriculum can enable capacity building of teachers, improving their motivation and creation of more opportunities within the school environment for such interventions to be generated and sustained. Furthermore, involvement of the parents and the community might support the effectiveness of the intervention and provide support for management and maintenance of the garden area. For more information on barriers and challenges in relation to intersectoral collaboration and potential solutions, please consult Report D5.1

7. PROVE

7.1 Background

PROVE is a programme in Portugal that promotes closer links between consumers and farmers of agricultural products. It was designed to foster local sustainable production of fruits and vegetables. It provides tools, training, and partnerships to empower small scale farmers in organized local networks for direct commercialization of local seasonal fruits and vegetables, based on collaborative work and Information and Communications Technologies (ICT). New tools and training are provided to farmers to learn how to work in collaboration and provide to consumers a subscription-based service of seasonal and locally produced fruit and vegetables baskets.

7.2 Overall aims

The evaluation is based on INHERIT's transdisciplinary and comprehensive theoretical framework, and on the intersection of quantitative and qualitative perspectives. It is intended to contribute to a broad discussion involving different stakeholders.

The PROVE evaluation pilot aims to study the key impacts and processes of the PROVE programme that can contribute positively to the environment, health and equity. The evaluation design is theory-driven, based on the INHERIT Common Analytical Framework and in an extensive literature review on health and sustainable food behaviour. It includes two studies: PROVE consumers study and PROVE farmers study.

7.3 Context

PROVE was created by ADREPES (Association for Rural Development of the Península de Setúbal) under an EQUAL Community Initiative and developed three actions (needs assessment, development, dissemination) consolidated under the scope of PRODER (Rural Development Programme 2007-2013). PROVE was triggered by a survey developed in a rural and economically-deprived area showing that some farmers were facing great difficulties in the disposal of products, mainly due to lack of planning, organization and poor supply diversity. The PROVE initiative was then created to address these difficulties.

Since its start, PROVE has grown to a nation-wide programme, comprising 120 small scale farmers organised in 108 local groups across the country, and more than 4000 consumers in this commitment for more sustainable production and consumption. PROVE has been an ongoing project for more than 10 years. PROVE promotors and users are geographically dispersed across the country. The multiple local units act interdependently. The PROVE website aggregates all local groups, displays indicators related to the project functioning and allows direct contact between consumers and farmers. ADREPES is the key implementer of the project and an important collaborator in the evaluation research.

Consumers, health and environment: The connections between diets, health and environment, have been acknowledged in academic and political domains. There is convincing evidence that relates high intake of vegetables with better health, less chronic conditions and lower risk of non-communicable diseases, such as cardiac diseases and several types of cancer (e.g. Boeing *et al*., 2012). Fruit and vegetables intake is also a key component of an environmentally sustainable diet patterns: studies show

that replacing calories from meat or animal products by plant-based foods decreases the environmental footprint of diets (e.g. Aleksandrowick *et al*., 2016).

Farmers, empowerment and green farming: PROVE promotes participation and collaborative networks among small scale farmers fostering the social empowerment of participants. The empowerment of lower status groups contributes positively to social and material wellbeing (e. g. Zimmerman, 1992). Hence, the PROVE FARMERS study explores social empowerment patterns and possible connections with sustainable farming practices. Among PROVE programme, organic farming is promoted, with additionally environmental benefits, related to increase in biodiversity and avoidance of agrochemical use, but these aspects could not be evaluated in the scope of this study.

7.4 Research Questions

The evaluation of PROVE investigated aspects of behaviour among PROVE consumers and PROVE farmers. We describe the research questions for these two studies separately below under the respective headings.

PROVE consumers

PROVE enrols consumers in a regular subscription of baskets of fruit and vegetables. The Consumers' study explores the role of PROVE in shaping consumer´s diets, with a special focus on the intake of fruit, vegetables and red meat.

Based on a literature review on behaviour change in eating behaviour, the theoretical pathways on how PROVE could possibly influence diets are based on the three components of the COM-B model: capacities, opportunities and motivations (Michie *et al*., 2011). Briefly, concerning the capability to make healthier and more sustainable choice, in this study we considered both the role of more cognitive factors (such as knowledge, behaviour beliefs and attitudes) and volitional aspects (e.g., self-regulatory skills, such as self-efficacy or perceived behaviour control) (e.g. Ajzen, 1985). Motivational aspects included intentional (planned intentions) and non-intentional (habits) triggers to action (van't Riet *et al*., 2011). Finally, regarding the study of the opportunities offered by the context, we analysed environmental features that shape the opportunities for healthier diets, including both social and physical features (Story et al. 2008; Giskes *et al*., 2010; Bowen *et al*., 2015).

In this study our goal was to understand in what way belonging to a project such as PROVE may affect consumer's eating patterns. Specifically, our aim was to compare PROVE consumers with non-PROVE consumers, while also exploring the different mediating factors that help to explain possible differences between these two groups.

The following research questions are addressed:

- Does the PROVE subscription influence diets among consumers?
- Have PROVE consumers higher capabilities for healthy eating?
- Have PROVE consumers higher motivations for healthy eating?
- Have PROVE consumers more opportunities for healthy eating?
- Are PROVE consumers' diets healthier?
- Are PROVE consumers' diets more sustainable?

PROVE farmers

The PROVE programme promotes the empowerment, participation and creation of collaborative networking of farmers involved in the project. This may have a significant impact on their material living conditions, and perceived health and mental wellbeing, while also promoting more positive attitudes towards sustainable and local agricultural practices.

Based on empirical studies of empowerment, community participation, mental wellbeing and farmer's sustainable practices we developed a theoretical model, associating each component of Michie's framework (Michie *et al*., 2011) to a set of determinants that may explain the influence of PROVE on enhanced participatory and collaborative work amongst farmers.

For the capability for network collaboration, this model highlights the role of:

- Individual empowerment, which comprises intrapersonal dimensions like leadership competence and policy control (Miguel, Ornelas & Maroco, 2015);
- Influence, or agency, as a capability to make choices and influence collective decisions towards desired actions and outcomes (Friis-Hansen & Duveskog, 2012);
- Operational capability, which is the knowledge to use available resources (e.g. Nelson, 1994).

On the opportunities dimension, material resources ensured in the PROVE programme and opportunities given by the social context, concerning leadership, participation in the decision-making process and positive group norms (Fielding *et al*., 2008; Terry & Hogg, 1996; Jetten *et al*., 2017) are important features to foster network collaboration. Finally, the motivation dimension, comprises the alignment of the individual identity values with the values of PROVE (affective commitment) (Mowday, 1979; Dewettinck *et al*., 2011), and emotional connection (identification) to be group (Hogg and Hains, 1996).

PROVE programme design can be related to all these determinants that are expected to lead to an increased level of participation, collaborative work among PROVE farmers, with benefits in a long run for health and wellbeing (via life conditions improvement) and environment (via sustainable farming practices).

The following research questions are addressed:

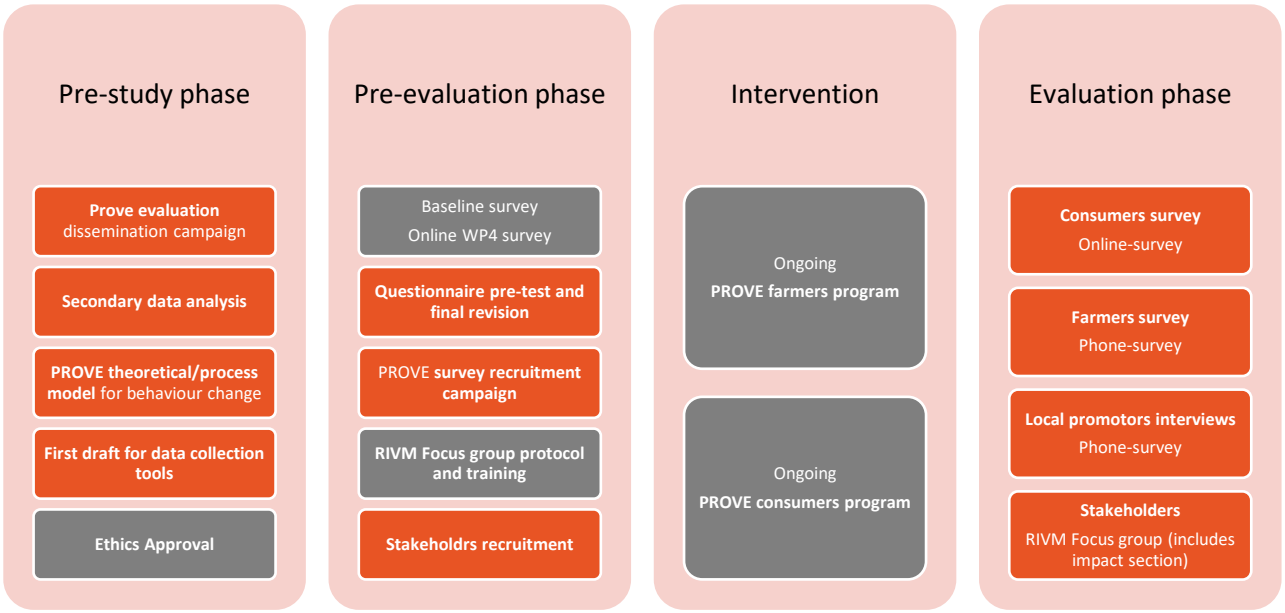
- Have PROVE farmers high levels of personal capability for collaborative work?
- Have PROVE farmers opportunities for collaborative work?
- Have PROVE farmers high levels of motivation for collaborative work?
- Does PROVE influence farmers personal capability for collaborative work?
- Does PROVE influence farmers' material living conditions?
- Does PROVE influence farmers wellbeing?
- Does PROVE programme influence farming practices?

7.5 Methodology

The evaluation plan included a pre-evaluation phase in which data collection instruments were developed and pre-tested, and procedures for the recruitment of participants for the surveys implemented. This was possible after the development of the theoretical model to understand PROVE influence in the behaviour of its users and a generic overview of PROVE process, based on interviews of key informants and the consultation of information shared by the implementers. The evaluation phase itself included a consumer

on-line survey, the collection of farmers' phone surveys and the conduction of stakeholder focus group 4 (Image 1).

Image 1: PROVE Evaluation plan



In this section the methodology for the consumer study and the producer study are described separately, beginning with the consumers study methodology.

Methodology for consumers study

PROVE evaluation study follows a mixed method research framework. The quantitative evaluation of PROVE concerning consumers experiences relies on a survey-based study. Data from two online surveys are considered:

- The INHERIT five country survey, targeting a representative sample of Portuguese people with ages between 18 and 65 years old;
- PROVE online survey, targeting PROVE consumers (conducted November-January 2018). PROVE consumers are compared with a matched sample of the INHERIT five country survey (considered as a control group) in a quasi-experimental design.

PROVE stakeholders' perceptions, collected within the scope of a focus group that occurred in January 2019 in ADREPES to support interpretation of the findings.

Instruments

Three data collection instruments support this study:

[4] Additionally, a set of interviews with key PROVE partners were also conducted to support the understanding of PROVE process.

1. INHERIT five country survey: The questionnaire for the INHERIT five country survey was developed based on an extensive literature review and on a pre-test and pilot survey procedures (see five country survey report for a detailed description). The final version was structured in 10 sections. For the quantitative evaluation of PROVE we considered four sections of this initial survey (Sampling questions; Eating: Dietary recommendations; Environmental concern and behaviours; Socio-demographic information). The Portuguese translation of the INHERIT five country survey was approved by ISCTE-IUL's Ethical Committee on November 29, 2017 (formal opinion 24/2017). Data collection was conducted by a marketing company in the period from July to November 2018. After data quality procedures, 1650 valid responses were considered, from which the sample of 571 respondents is selected.

2. PROVE consumers questionnaire: PROVE consumers' questionnaire was created in close articulation with the Portuguese version of the INHERIT five country survey conducted by INHERIT CUNI team (Zvěřinová *et al*., 2017). The PROVE CONSUMERS's survey mimics selected indicators in the INHERIT five country survey, concerning format and order of the questions, with only a few differences[5]. The final version of the questionnaire was organized in 5 sections (SECTION 0. Sampling questions and wellbeing measures; SECTION I: PROVE experience. SECTION II: Eating: Dietary recommendations; SECTION III. Environmental concern and behaviours; SECTION IV. Socio-demographic information). The final PROVE evaluation survey and procedures were also approved by ISCTE-IUL Ethical Committee of ISCTE-IUL in October 10, 2018 (formal opinion 20/2017). Data collection was conducted by the ISCTE-IUL team, recruiting participants in an online campaign using PROVE communication channels (between July and November 2018). 518 answers were collected. After the data screening processes 294 responses were considered valid. By data screening processes 294 responses were considered valid[6].

3. INHERIT focus group: The original script for the recruitment and moderation of the Focus Group with PROVE stakeholders was developed by the RIVM INHERIT team (see Report D5.1 for details). Following the first part of the focus group discussion on collaboration between partners in implementing PROVE, a section was then added to address perceived impacts for PROVE consumers (e.g., in which ways do you think PROVE can influence consumers? What other impacts do you perceive?). The Ethical Committee of ISCTE-IUL also validated the instruments and procedures concerning the qualitative data collection with a positive decision in October 10, 2018 (formal opinion 19/2017). The focus group was conducted on January 8, 2018, and included six participants (the key PROVE implementer, a consumer, a producer, representatives from two municipalities and a regional development agency).

Measures

COM-B Variables

In accordance with the theoretical model, attributes for capability, opportunity and motivation to healthy eating were measured. These factors were expected to have a significant influence in diet options.

Capabilities: Most indicators refer to the Theory of Planned Behaviour (TPB) (Beliefs, Self-efficacy, Social norms, Intentions) and therefore the measures included follow the standard wording recommended by Ajzen (1985). Beliefs about local food are also considered (authors adapted by Zvěřinová *et al*., 2017). Indicators concerning knowledge and abilities to eat a healthy diet included: self-rated diet healthiness,

[5] Additional sections concerning PROVE consumers' modalities and PROVE perceptions were included. The pre-test based on phone interviews (N=6) showed the need to shorten the questionnaire, leading to the omission of some indicators.

[6] Selecting individuals that reached the end of questionnaire, excluding speeders (according to Mitchell, 2014; responders that take less than 40% median time to respond, specifically less than 12 minutes) and excluding responders that took more than 3 times the median respond time.

the use of health as criteria to choose food, the perception of behaviour control in a change for a healthier diet, behaviour beliefs and attitudes related to consequences of a change for a healthy diet.

Motivation: For the motivation dimension, intentional and automatic motivational triggers were considered. Intentions to follow a recommended diet in the future were measured following TPB theory (Ajzen, 1985). The strength of healthy and unhealthy habits were measured based on a short version of the Self-Report Habit Index (Verplanken & Orbell, 2003), considering the consumption of fruit or vegetables and of dessert in main meals on weekdays and weekends.

Opportunity: The physical availability of fresh fruit and vegetables was measured by the household availability scale originally adapted from the Home Food Assessment tool (Nepper *et al*., 2014) – the scale describes the degree of fruits and vegetables that is readily available in the household. Material opportunities was also assessed by the criteria used when buying food and by the frequency of shopping seasonal, organic and convenience food (Zvěřinová and collaborators, 2017). Social opportunities were assessed by indicators concerning the normative beliefs supporting the change for a healthier diet and the perception of the impact of contextual barriers to healthy eating in terms of fruits and vegetable availability (Ajzen, 1985).

Diets

A standardised 15 items Self-Reported Food Frequency Questionnaire (Food Frequency Questionnaire, FFQ) was used to collect diet information (Cleghorn *et al*., 2016 adapted by Zvěřinová *et al*., 2017). To account for the role of PROVE in promoting healthier and more sustainable diets, differences between the INHERIT and PROVE consumer's samples concerning fruit and red meat intake were considered.

Distal correlates: wellbeing, health and environment diet scores

Measures of self-reported health, life satisfaction, and happiness were included based on one item scales validated by several international survey to assess wellbeing (e.g. ESS, 2015). Diet scores for health and sustainability are estimated based on the FFQ:

- A dietary quality score, according with averaged scores collected by Cleghorn *et al*., 2016);
- Dietary type average CO2 emissions (omnivorous, vegetarian), according with Tilman and Clark (2014).

Other variables

Socioeconomic and demographic variables (potential controls): Eleven indicators were considered to describe socioeconomic features of the two samples (gender, age group, education group, region, urban/rural, income tercile, perceived economic difficulties, size of the household, children in the household, marital status, employment status).

PROVE experiences: Indicators were collected to describe PROVE experiences, in relation to the following.

(1) PROVE modalities (In what district are you located? To which local group do you belong? When did you start to be a PROVE consumer? How regularly do you buy the PROVE basket (check the most frequent one)? What percentage of the total vegetables and fruit consumed weekly in your household is composed by the products in the PROVE Basket? Where do you usually buy the remaining vegetables and fruits?).

(2) satisfaction levels (Using a scale from 0 to 10, where 0 = extremely dissatisfied and 10 = extremely satisfied, how do you rate your degree of satisfaction with PROVE? Using the same scale, please evaluate

your satisfaction with PROVE website usefulness, PROVE website relevance, PROVE recipes and information usefulness, Local group organization, Baskets pickup point).

(3) perceived impacts (Please indicate on the scale from 1 to 7, how much you agree or disagree with the following statements. PROVE supports an agriculture that uses few fertilizers and pesticides. PROVE contributes to improving the income of local farmers. PROVE promotes the local economy. PROVE contributes to reducing food imports. Being a PROVE consumer allows you to eat healthier. People in the area where I live believe PROVE is a good project to be part of. Many other people would like to be part of PROVE.).

Analysis

The analysis is organized in four steps.

(1) First, descriptive analysis of the PROVE consumers' sample was conducted regarding socioeconomic features, consumer modalities, satisfaction levels, and perception of impacts.

(2) The second step concerned the comparative study between PROVE consumers and non-PROVE consumers. By increasing consumers' commitment to a regular subscription of fruit and vegetables, PROVE is expected to have a significant influence in their diets. We studied this hypothesis by testing if PROVE consumers presented better chances to eat (i) 5 portions a day of fruits and vegetables (WHO recommendation for health), (ii) less than two portions a week of red meat (Wheel of Five, recommendation for health and sustainability). Logistic regression models were applied separately to each outcome (dichotomous variable: 1: follows recommendation; 0: do not follow recommendation). Sample identification was introduced as an independent variable (1: PROVE, 0: WP4 Survey). Sample identification coefficients provide information on the relative chances of PROVE consumers to report more healthy and sustainable diet options.

(3) In the third step, possible explanation for the differences between samples are studied, testing the mediation role of the capability, motivation and opportunity indicators in the association between sample (PROVE sample versus INHERIT five country survey sample) and consumption. Individual mediation effects are tested using the coefficient comparison approach (MacKinnon and Dwyer, 1993).

(4) The fourth step of the study consists of the thematic content analysis of the focus group section dedicated to the perceived effects of PROVE among consumers.

Methodology for farmers study

PROVE evaluation study was designed following a mixed method research framework. The quantitative evaluation of PROVE concerning farmers experiences relies on a survey-based study. Data from two online surveys are considered:

- European Social Survey (ESS) (wave 8), targeting a representative sample of Portuguese people over 16;
- PROVE farmers online survey, targeting PROVE farmers.

PROVE farmers are compared with matched samples of the ESS (considered as a control group) in a quasi-experimental design. Findings interpretation are supported by the PROVE stakeholders' perceptions collected in the scope of the focus group that took place in ADREPES.

Instruments

Three data collection instruments support this study:

1. European Social Survey: The European Social Survey includes measures of attitudes, beliefs and behaviours across European countries. For this study variables concerning health and wellbeing (self-perceived health, life satisfaction, happiness), social empowerment (work environment influence) and material conditions (income adequacy) from wave 8 were considered[7].

2. PROVE farmers questionnaire: PROVE farmers questionnaire was developed based on the CAF model, COM-B model (Michie *et al*., 2011), and the theory of empowerment (Zimmerman, 1992). The final version of the questionnaire was structured in five sections (SECTION 0. Sampling questions and wellbeing measures; SECTION I: PROVE experience. SECTION II: Capabilities and motivation; SECTION III. Opportunities and Farming practices; SECTION IV. Socio-demographic information). The Ethical Committee of ISCTE-IUL validated the data collections instruments and procedures concerning the quantitative data collection for PROVE evaluation with a positive decision on October 10, 2018 (formal opinion 20/2017). Data collection was conducted by the ISCTE-IUL team. Phone interviews were conducted using the list of contacts provided by PROVE local groups (November 2018) (WP4). The complete list of the contacts publicly available was used: from 120 participants only 69 active phone contacts were available (often, only 1 phone contact is available by local group). First contact was made by SMS, with a brief presentation of the project and survey. Scheduling the moment for survey completion was challenging mainly due to farmers' often busy day activities). In the end, 36 interviews were conducted reaching 77% of the local groups (the sample corresponds to 32% of all farmers; and 54% of the listed farmers).

3. WP5 Focus group: The script for the recruitment and moderation for the focus group with PROVE stakeholders was developed by RIVM team (Report D5.1). A section was added to address the perceived impacts for PROVE farmers (In which ways do you think PROVE can influence farmers practices? What other impacts do you perceive?). The Ethical Committee of ISCTE-IUL validated the data collections instruments and procedures concerning the qualitative data collection for PROVE evaluation with a positive decision on October 10, 2018 (formal opinion 19/2017). The focus group was conducted on January 8 and included six participants.

Measures

COM-B Variables

In accordance with the theoretical model, attributes for capability, opportunity and motivation for social empowerment and network collaboration related with PROVE programme were included in this study.

Capabilities: Skills and knowledge for network collaboration in PROVE were measured concerning interpersonal empowerment, influence in the work environment, and operational capacity in PROVE. Interpersonal and interaction empowerment was assessed by 5 items from a known empowerment scale (Miguel *et al*., 2015). Influence was measured based on two indicators from the European Social Survey (In a scale of 0 to 10, in which 0=I have no influence at all and 10=I have much influence, how much do

[7] Housing problems and mental health indicators were selected from wave 7 questionnaire. For parsimonious reasons results are reported elsewhere.

you feel you have influence on: Managing your daily routine. The decisions related to PROVE's activity). Operational capacity was measured by self-report assessments regarding the use of PROVE tools and decision-making processes.

Motivation: Motivation variables included the assessment of affective commitment with PROVE (from Dewettinck and Van Ameijde, 2011: In a scale of 1 to 5, in which 1=totally disagree and 5=totally agree, how much do you agree with the following statements: I am proud to tell others that I am part of PROVE. I really care about the fate of PROVE) and group identification with PROVE (from Fielding *et al*., 2008: I identify myself with PROVE. I feel I belong to PROVE).

Opportunities: Material opportunities were evaluated by self-reported evaluation of access to training technical support, management tools, and social support in PROVE. Social opportunities for participation and collaborative work were measured by adapting items from the Leader Empowering Behaviour Questionnaire (Konczak *et al*., 2000), Organization Justice Measure (Colquitt, 2001) and items for measuring group norms as proposed by Fielding and collaborators (2008).

Collaboration and participation

Participation was measured based on a set of questions concerning PROVE' initiatives frequency of participation and collaborative work by addressing the frequency of contact among PROVE collaborators (farmers, partners, technicians, consumers) and the size, composition and satisfaction with the farming network – a concept based on personal social network in SHARE.

Distal correlates: wellbeing, health and material circumstances

Measures of self-reported health, life satisfaction, and happiness were included based on one item scales validated by several international survey to assess wellbeing (e.g. ESS). Material circumstances are described with socioeconomic indicators and information on housing problems and perceived income adequacy as measured in the ESS.

Other variables

Socioeconomic and demographic variables (potential controls): Eleven indicators were considered to describe socioeconomic features of the two samples (gender, age group, education group, region, urban/rural, income tercile, perceived economic difficulties, size of the household, children in the household, marital status, employment status).

PROVE experiences: A set of indicators devised to describe the different PROVE experiences were included to account for:

(1) farmers modalities (In which district is located your local group? To what local group do you belong? How many farmers are in your local group? For how long have you been a PROVE farmer? What's the size of your farm? Is agricultural production your only paid activity? Considering your work hours, how much time (in percentage) do you spend in your agricultural exploration? The workforce of your exploration is: Exclusively family (non-paid). Mostly family. Mostly paid workers. Other situation. In 2018 how many baskets did you sell per month (on average). In one year, what percentage of your income results from selling PROVE's baskets?).

(2) satisfaction levels and attitudes (Using a scale of 0 to 10, in which 0=extremely unsatisfied and 10=extremely satisfied, how do you rate your level of satisfaction with PROVE?; Based on your own

experience as a PROVE farmer, please indicate how much do you agree with the following statements: Local and sustainable production is a desirable goal. It is good for society to have many small-scale farmers. PROVE's consultants and experts can tell me what I need to know to be a successful farmer).

(3) perception of impacts (In a scale of 1 to 5, in which 1=totally disagree and 5=totally agree, how well do you think the following statements describe your reality: Since I have been a PROVE farmer I … Diversified the production of vegetables. Reduced the amount of fertilizers in vegetables. Reduced the amount of pesticides in vegetables. Produced more local varieties. Shared agricultural knowledge with other farmers. Learned new agricultural knowledge. Shared local/traditional seeds with other farmers. Reduced the route distance to sell products. Have less waste of agricultural products. Used water in a more efficient way).

Analysis

The analysis comprises four steps:
(1) First, we did a descriptive analysis of farmers' answers, concerning socioeconomic and demographic characteristics, farming modalities, satisfaction levels and attitudes to PROVE, and perception of impacts in farming practices.

(2) The second step concerns the comparative study between PROVE farmers and non-PROVE farmers. By ensuring the tools and knowledge for network collaboration, PROVE is expected to influence farmers social empowerment, leading to better material circumstances and wellbeing (distal correlates). We study this hypothesis by testing if PROVE farmers present better scores in work environment influence (an indicator of capability for social empowerment), self-perceived health, life satisfaction, life happiness, and perceive income adequacy. Regression models were run separately considering each outcome. Sample identification is introduced as independent variable (1: PROVE, 0: ESS Survey).

To ensure that the differences between samples are not confounded by the different socioeconomic compositions from the two samples, PROVE farmers are compared with an exact match of the ESS[8] sample and relevant socioeconomic indicators are included in the regression models as covariates.

(3) In the third step, multivariate analyses are used to describe social empowerment profiles among PROVE farmers (Multiple Correspondence Analysis).

(4) The fourth step of the study consists of the thematic content analysis of the focus group section dedicated to the perceived effects of PROVE among farmers.

7.6 Results

In this section the results for the consumer study and the producer study are described separately.

[8]The variables selected to conduct the matching procedure in this case were gender, age group, education group, and income percentile (considered instead of information related with residence to ensure a better match of the samples in terms of socio-economic profiles). The procedure was supported by R software and the package MatchIt. The nearest neighbor method allowed select from the ESS8 a sample with the same exact features as the PROVE producers sample.

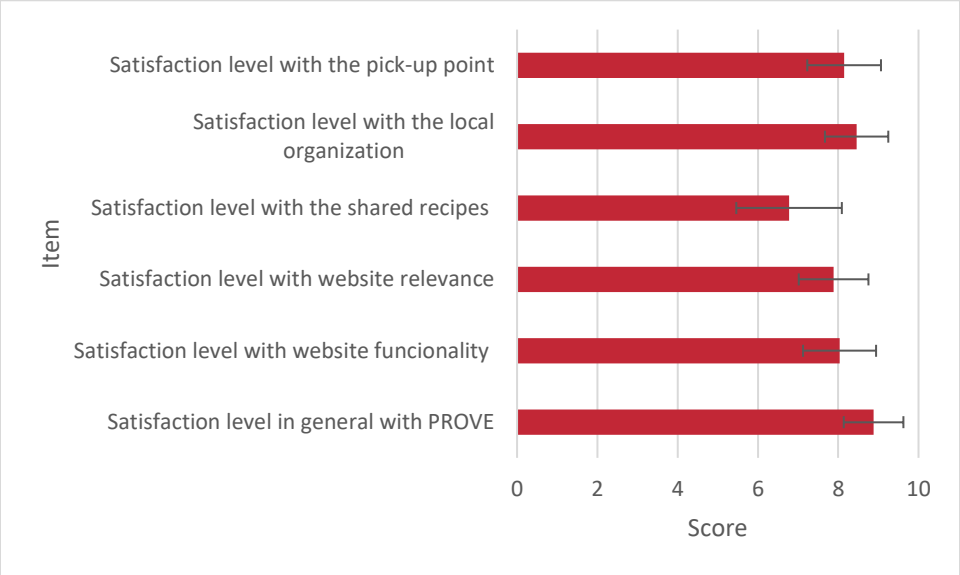
Results for consumer study

PROVE consumers: descriptive analysis

PROVE survey respondents' ages vary between 22 and 73 (M=44.5, SD=10.7), are mostly females (80%), have colleges degrees (87%), and live with a partner (79%) in urban regions (90%) from Lisbon (60%) or North region (34%). Around two thirds of the sample declare household incomes corresponding to the higher terciles of national income (>1500€/month) in Portugal. In terms of household composition, there is almost an equal distribution of people living in households comprising up to 2 persons (27%), 3 persons (30%), and 4 or more persons (33%). Participants tend to be fully employed (59%) or self-employed (35%). The survey reached consumers with varying subscription periods in PROVE – from 12 years to just a few months. The average subscription time is 1,5 years (M=2.5, SD=2.4); but half of the sample declared having a subscription for more than 2 years.

Consumers tend to order the PROVE service every two weeks (62%) or a weekly (32%). Fruit and vegetables bought with PROVE correspond to more than 50% of the total amount of fruit and vegetables consumed in the household for most responders (78%).

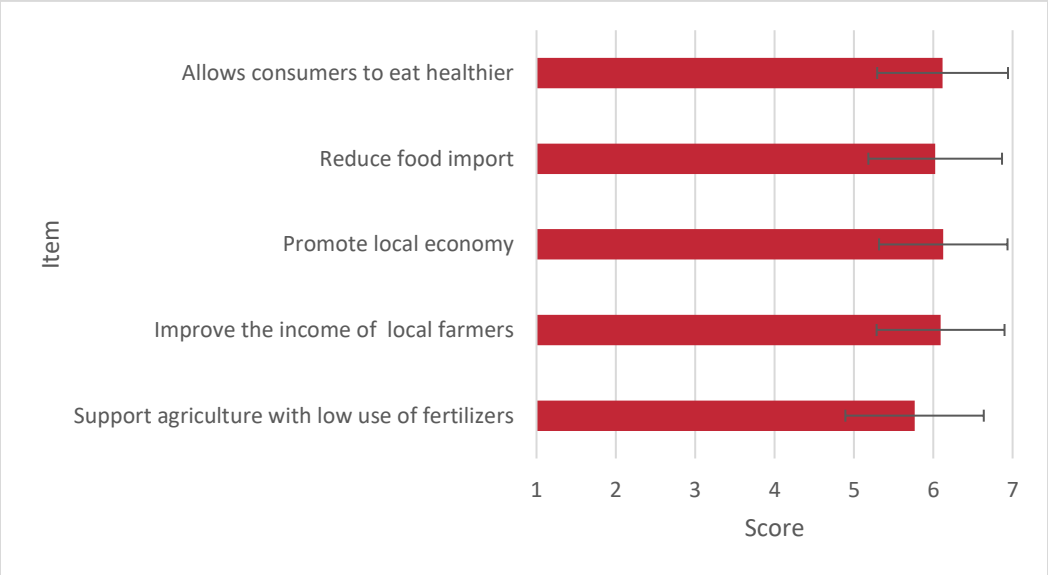
Users report high levels of satisfaction with PROVE – in a 1 to 10 scale average scoring in the sample levels of satisfaction are about 8.9 (SD=1.5). Users are particularly satisfied with the organization of the local group, the functionality of the website and the conditions of delivery sites, yet all dimensions were evaluated very positively (site contents, suggestions of the recipes) – in a scale from 1 to 10, all average scores are significantly higher than 6 (T-Student, p<.05) (see Figure 1).



Note: Average satisfaction scores (bar) and standard deviation (error bars).
Source: PROVE consumers survey.

Figure 1: Satisfaction average scores by item.

Consumers tend to agree that PROVE promotes positive changes for social empowerment of farmers, more sustainable food production, and healthier food consumption – in a Likert scale from 1 to 7, average scores are very close to 6 and significantly higher than 5 (T-Student, p<.05) (see Figure 2).



Note: Average agreement scores (bar) and standard deviation (error bars).
Source: PROVE consumers survey.

Figure 2: Perceived impacts (average agreement level by item)

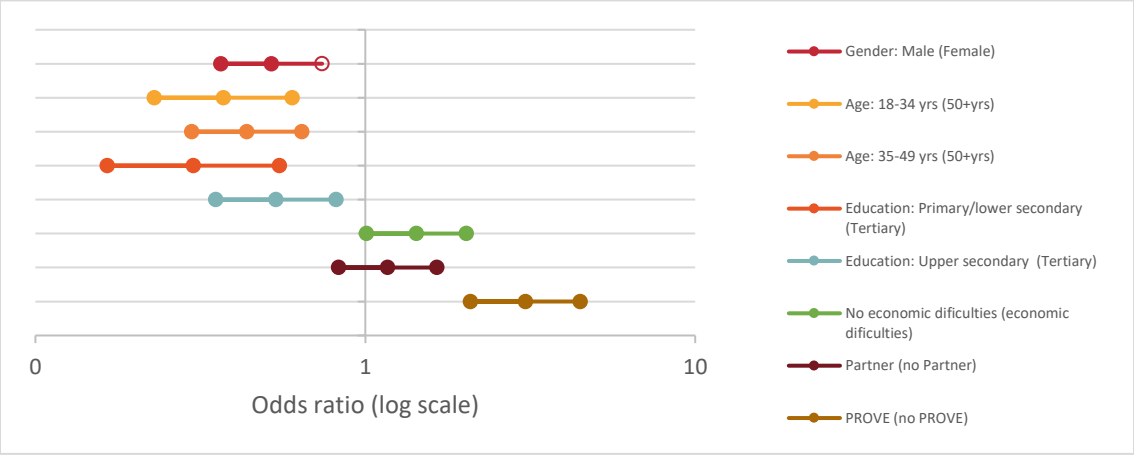
Differences between PROVE and non-PROVE consumers

Models to test differences between PROVE and non-PROVE consumers were devised, based on a pre-selection of socioeconomic and demographic indicators and on findings concerning the full sample of the Portuguese INHERIT household survey sample (N=1658) using unifactorial logistical regression models. Gender, age group, education group, and perceived economic difficulties were found to be correlated with the fruits and vegetables and red meat intake at a 0.05 significance level and partnership only with fruit and vegetable consumption[9]. This set of variables was included in the regression models as controls. To compare PROVE and non-PROVE consumers, sample identification is introduced as an independent variable (1: PROVE, 0: INHERIT five country survey) on regression logistic models composed also by the selected controls. Sample identification coefficients provide information on the relative chances of PROVE consumers to endorse each diet recommendation, independently of socio-economic and demographic variables.

Around 39% of the both samples combined (N=865) consumes at least 5 portions of fruits and vegetables a day. Regression models show that these chances are significantly higher among PROVE Consumers: Being PROVE consumer almost triples the chances of eating 5 portions a day of fruit and vegetables (OR=3,055, $IC_{95\%}$= [2,08 - 4,48], after controlling for the effects of age, education, gender, partnership and perceived economic difficulties[10] (Figure 3).

[9] Income tercile and town are omitted from final models due to missing values higher rates. Both are only correlated with the chances of eating less than 200g of red meat a week but not with the chances of eating at least 5 portions of fruit and vegetables a day.

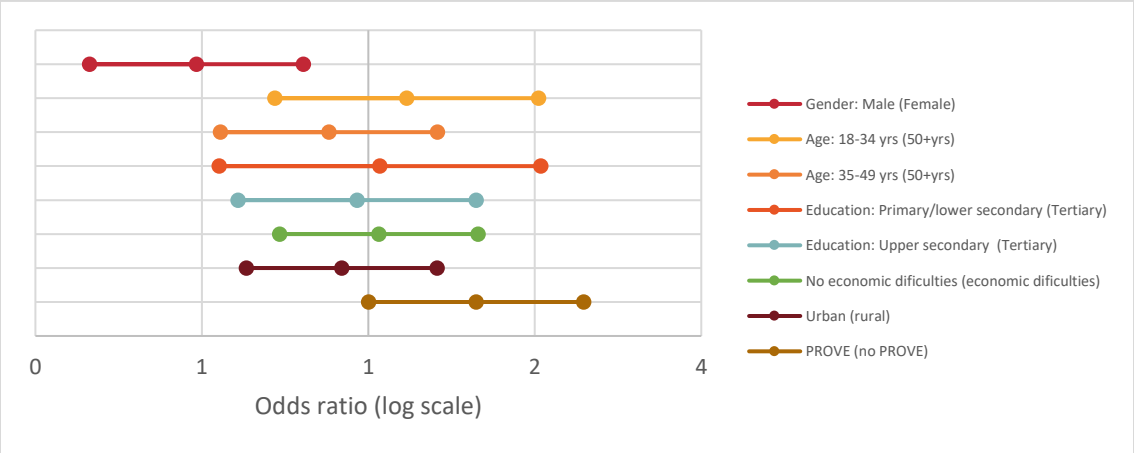
[10] $G^2_{(9)}$=128,016, p<.01, $X^2_{HL}(8)$=2,361, p>.05. R^2_{CS}= 0,141; R^2Nagelkerke= 0,192. N= 840. Model: age group, education group, gender, partner, economic difficulties, PROVE.



Note: Odds ratio and 95% intervals of confidence (error bar) by factor modelling 5 portions of fruits and vegetables a day.
Source: PROVE consumers survey.

Figure 3: Regression coefficients (odds ratio) for 5 portions a day of fruits and vegetables by variable

Circa 20% of participants (PROVE and non-PROVE) declared eating less than 2 portion (200g) of red meat a week. Again, significant differences are identified between samples: Being a PROVE consumer increases the chances of eating no more than 2 portions of red meat a week (200g), by about 55% (OR=1,567, $IC_{95\%}$= [1,002 - 2,451], independently of age, education, gender, partnership and economic difficulties[11] (Figure 4).



Note: Odds ratio and 95% intervals of confidence (error bar) by factor modelling no more than 2 portion a week of red meat a
Source: PROVE consumers survey.

Figure 4: Regression coefficients (odds ratio) for no more than 2 portion a week of red meat by variable

[11] $G^2_{(9)}$=25,013, p<.01, $X^2_{HL}(8)$=6,66, p>.05. R^2_{CS}= 0,141; R^2Nagelkerke= 0,047. N= 814. Model: age group, education group, gender, partner, economic difficulties, PROVE.

Capabilities, motivation and opportunities for healthier and more sustainable diets

A wide set of indicators concerning capabilities, motivations and opportunities for healthy eating were assessed for PROVE users and non-users. In a first step, the contribution of these in predicting adhesion to dietary recommendations (5 portions a day of fruit and vegetables, less than 2 portions a week of red meat) was studied to select possible explanation that account for the differences between samples (controlling the effects of age, education, gender, perceived economic difficulties).

For the capability dimension, multiple indicators concerning knowledge and abilities to eat healthily were included. Among these, diet perception (*From 1 = very unhealthy to 7 = totally healthy, how healthy you think your diet is*) and one perceived control item (*To what extent do you feel you have personal control to follow the recommended diet most of the time*) were shown to be correlated with the consumption of fruits and vegetables ($p<0.05$). Red meat recommendation adherence was shown to be predicted by higher perceptions of environmental impact related to a change to a recommended diet (*Following the recommended diet will decrease the negative effects on the environment*) ($p<0.05$).

For the motivation dimension, intentions to follow a healthier diet in the future and measures of the strength of habits at the end of the meals were included – measuring habit of eating fruits and vegetables. The two habits strength measures (fruit after meals Alfa de Cronbach = .913; dessert after meals, Alfa de Cronbach = .919) had significant correlations with the chances of consuming fruits and vegetables and red meat ($p<0.05$). An indicator concerning the intention to follow a recommended diet in the next 6 months was also correlated with red meat intake.

Finally, for the opportunities dimension, fruit and vegetables intake was found to be correlated with the household availability index (Alfa de Cronbach = .971) and the intake of red meat to the perceived social pressure to follow a recommended diet in the future.

Based on this pre-study, diet quality perception, perceived control in changing diet, household availability index and strength of habit of eating fruits and vegetables[12] after meals were selected as possible explanation for the differences between samples in the chances of consuming at least 5 portions. Overall, participants in the PROVE sample scored higher in the selected capability, motivation and opportunity variables than participants in the non-PROVE sample. Mediation studies were conducted to assess if the differences in these scores could explain the differences between samples (sample effect).

Table 1: Average scores of selected explanatory variables for PROVE and non-PROVE participants (diet perception, perceived control, strength of habit, household availability index)

Sample	Variable	N	Mean	Standard deviation
Non-PROVE	Diet perception	568	4,71	1,12
	Perceived control	569	5,68	1,33
	Strength of habit	570	4,80	1,67
	Household availability index	571	6,18	1,09
PROVE	Diet perception	289	4,96	0,97
	Perceived control	288	5,38	1,33

[12] To parsimonious reasons, the role of the strength of eating desserts after meals is not explored in the report.

Sample	Variable	N	Mean	Standard deviation
	Strength of habit	294	5,60	1,54
	Household availability index	292	9,44	1,02

Source: PROVE consumers survey.

Individual mediation studies were conducted for each of the explanatory variables identified, based on the methodology proposed by Kenny (2006) to calculate the indirect effect coefficients, significance and the percentages of effect mediated (that can be interpreted loosely as the proportion of the total effect that is mediated.). The procedure identified 17% mediated effect of the sample in the chances of eating 5 portions of fruit by *diet perception* (B=0.21, p<.05), 27% by *habit strength* (B=0.30, p<.05), and by 100%[13] (full mediation) by *household availability* (B=0.17, p<.05). The perceived control indicator revealed a non-significant mediation effect (p>.05). Differences in consumption between PROVE and non-PROVE consumers are completely explained by the differences in *availability of fruits and vegetables in the household*, supporting the hypotheses that PROVE ensures better opportunities to eat fruit and vegetables. *Healthier perception of one's diet and healthier after meal habits are also possible pathways to explain PRO*VE consumers advantages in the intake of fruit and vegetables.
The selected variables for the mediation studies concerning red meat intake are related with the beliefs on environmental impact in following a recommended diet, perceived social pressure to follow a recommended diet, and in the intention to follow a recommended diet in the future.

Table 2: Average scores of selected explanations for samples differences in the chances of eating no more than 2 portions of red meat a week

Sample	Variable	N	Mean	Standard deviation
Non-PROVE	Beliefs on environment impact	528	4,23	1,73
	Intention to follow a recommended diet	563	3,25	1,65
	Perceived social pressure	569	3,80	1,78
PROVE	Beliefs on environment impact	265	5,43	1,80
	Intention to follow a recommended diet	291	2,57	1,56
	Perceived social pressure	293	3,06	1,83

Source: PROVE consumers survey.

Mediation studies were conducted to assess if these disparities can contribute to the sample effect on the chances to eat no more than 2 portions of meat a week. Only two mediation effects were identified as significant (p<.05), the one referring to the intention to follow a recommended diet the other referring to the degree of perceived social pressure to follow a recommended diet.

PROVE consumers present lower intentions to follow a recommended diet and to perceived social pressure to change for a recommended diet. These differences only partially explain the differences

[13] this concerns the studies of the indirect effects individually.

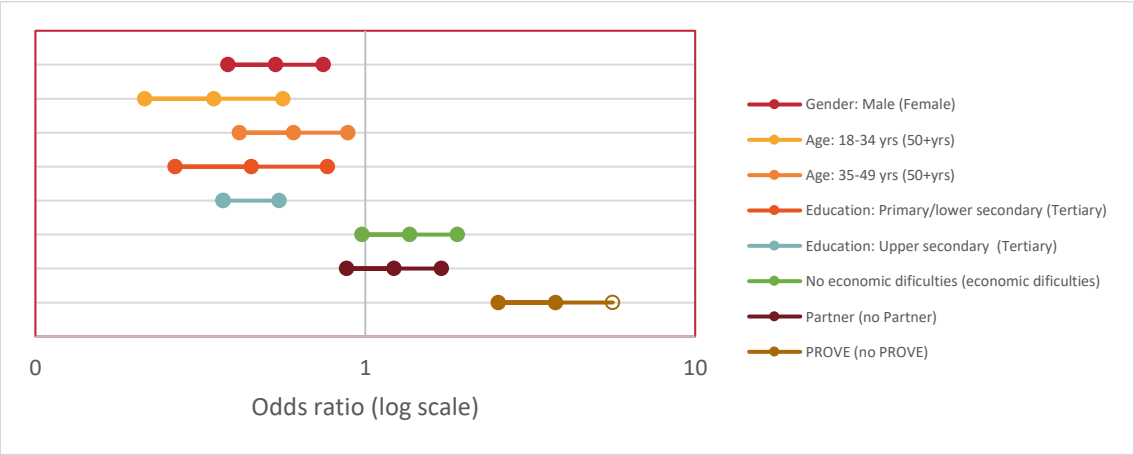
between the samples in red meat consumption, because the intentions to change diets are also negatively associated with the consumption of red meat in this sample (people with higher intentions to change diets are the ones that report higher consumptions of red meat). The variables measuring intentions and the perception of social pressure to change to a recommended diet appear not to be independent of the consumption of meat, hampering the interpretation of these associations.

Distal correlates: health and environment diet scores and wellbeing

Differences between PROVE and non-PROVE consumers were also assessed concerning diet health and sustainability scores and concerning measures wellbeing.

The Dietary Quality Score was calculated based on the declared intake in the FFQ and the recommendations for the intake of fruit, vegetables, oily fish, fat, and sugar (Non-Milk Extrinsic Sugar), according to Cleghorn *et al*., 2016. The procedure included estimating the amounts ingested of these categories based on the FFQ. Then a subscore is attributed to each component based on health recommendations (1 to 3). The health score of the diet results from the sum of the scores in the fruit, vegetables, oily fish, fat, and sugar components (Cleghorn *et al*., 2016) provide all material needed for the conversion from frequency intake to grams intake and the cut points needed to calculate the subscores in each diet components).

The Dietary Quality Score varied between 6 and 15 among participants, and higher scores indicated healthier diets. Samples are compared on the chances to score in the highest tercile of the index (33%). The sample coefficient shows the relative chances of PROVE consumers compared with non-PROVE consumers: being a PROVE consumer almost triples the chances for healthier diet scores (Odds ratio: 3.77, IC95%: [2,5-5,6])14 (Figure 5).



Note: Odds ratio and 95% intervals of confidence (error bar) by factor modelling heathier diets score.
Source: PROVE consumers survey.

Figure 5: Regression coefficients (odds ratio) for highest tercile of Dietary Quality Score by variable

To compare the samples in terms of overall sustainability of the diets, the chances of a vegetarian diet pattern versus an omnivorous diet pattern are assessed between groups, considering the significant

[14] $G^2_{(9)}$=137.19, p<.01, $X^2_{HL(8)}$=7.059, p>.05. R^2_{CS}= 0,151; $R^2_{Nagelkerke}$= 0,201. N= 840. Model: age group, education group, gender, partner, economic difficulties, sample.

differences in environmental impacts (Tilman and Clark, 2014). PROVE and non-PROVE consumer do not differ in the chances of being vegetarians (p>.05)15.

Finally, samples were compared in well-being scores, specifically comparing the chance to report high levels of happiness and life satisfactions (higher tercile). PROVE consumers presented higher chances of reporting higher levels of both happiness and life satisfaction, irrespectively of gender, age, educations, partnerships and perceived economic difficulties. Among participants, being PROVE consumer more than quadruples the chances for high life satisfaction scores (Odds ratio: 4.47, IC95%: [2.9-6.9]16) and triples the chances for high happiness scores (Odds ratio: 3.71, IC95%: [2.4-5.7]).

PROVE perceived effects by consumers and stakeholders

In the focus group with PROVE stakeholders (Report D5.1.) an additional section was introduced to collect perceptions of the programme impacts.
Several topics emerged in the discussion concerning consumers. Two key themes organize the perceptions: PROVE influence on eating habits (frequency, variety, quality of fruit and vegetables) and PROVE influence on the proximity with farmers and food production.

By adopting a regular subscription of fruit and vegetables, consumers introduce more fruits and vegetables in the family meals across the week ("*At the level of the habits: there is a change in eating habits*"). According to the stakeholders' perception, the change goes beyond the habit (amount and frequency) of consumption, in the sense that PROVE also contributes to increasing the variety of available food items. PROVE baskets are composed of seasonal fruits and vegetables that are chosen by the farmers (consumers have certain opt-out options), meaning that the composition of the basket changes throughout the weeks. Participants also mention that PROVE farmers cultivate local varieties that are unknown by the public ("*There is a recapture of local varieties that are singular products that were disappearing and now they are being recuperating*"). The introduction of recipes in the baskets was triggered by the need to inform consumers on the new variety of fruits and vegetables ("*How do we eat this?*"). The quality of food products that are consumed is also an issue raised. PROVE products are typically delivered on the same day that they are harvested, ensuring high levels of freshness and nutrition value that are rarely available to consumers by other distribution chains.

PROVE appears also to contribute to promoting close relations between consumers and farmers. Participants refer to the importance of trust. For example, on one hand, consumers trust farmers in ensuring the quality of the products and the low use of chemicals; on the other hand, farmers trust consumers' fidelity to the programme (that consumers will pick-up the basket that they ordered). Knowledge transfers are also an important part of the relations. These include information, for instance, on the process of food production, seasonality, changes in the appearance of fruits and vegetables and health and environment concerns. This information exchange is crucial to ensure PROVE´s success.

[15] $G^2_{(9)}$=13.152, p<.01, $X^2_{HL(8)}$=7.059, p>.05. R^2_{CS}= 0.016; $R^2_{Nagelkerke}$= 0.057. N= 8. Model: age group, education group, gender, partner, economic difficulties, PROVE.

[16] $G^2_{(9)}$=77.7, p<.01, $X^2_{HL(8}$=9.612, p>.05. R^2_{CS}= 0.097; $R^2_{Nagelkerke}$= 0.129. N= 764. Model: age group, education group, gender, partner, economic difficulties, PROVE.

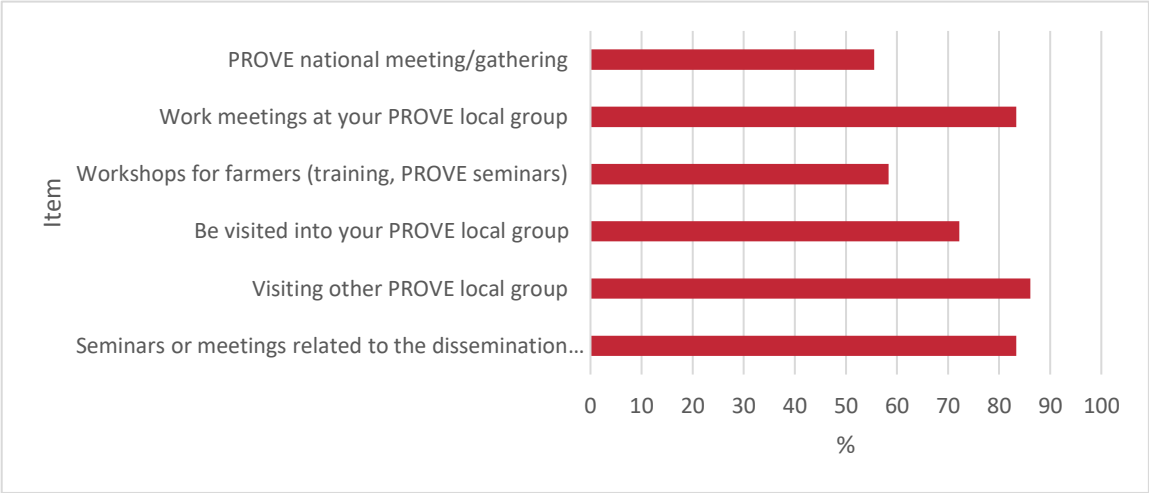
Results for farmers study

PROVE farmers: descriptive analysis

Thirty-six farmers participated in the PROVE farmers' study, representing a response rate of 52% from the listed farmers and corresponding to 30% of the total current farmers in PROVE17.

Participants 'ages vary between 26 and 75 (M=44.5, SD=10.7), 15 are male and 21 are females. The farmers tend to have a partner (78%), and almost half of the sample has children living in their household (47%). Around 2 thirds reported PROVE activity as their single economic activity (69%). Participants are distributed by education groups, with higher concentration in lower and higher level: Primary/lower secondary (36%,) Upper secondary (16.7%) and Tertiary (47.2%). Most participants are from North (44.4%) and Lisbon regions (38.9) and farming activities tend to be ensured by family or mostly family work (78%). In the sample, the size of farming fields varies from 0,3 hectares to 12 hectares, and over 50% report a farming area of 1 hectare of less. Local groups are composed from 1 to 10 farmers, even though most are quite small (70% composed by 1 or 2 farmers). Participants vary also in terms of the time they have been enrolled in PROVE. The sample includes farmers with very recent experiences and farmers that have been in the project since the start (From 2 months to 12 years with PROVE). On average the reported duration of PROVE membership is around 6 years (average: 6.6 years, SD=3.5); more than two thirds of the sample have been in the PROVE programme for 5 years or more (77%).

The sample is characterised by high levels of participation in PROVE´s initiatives, especially in work meetings, and visits and exchanges with other farmers (Figure 6).

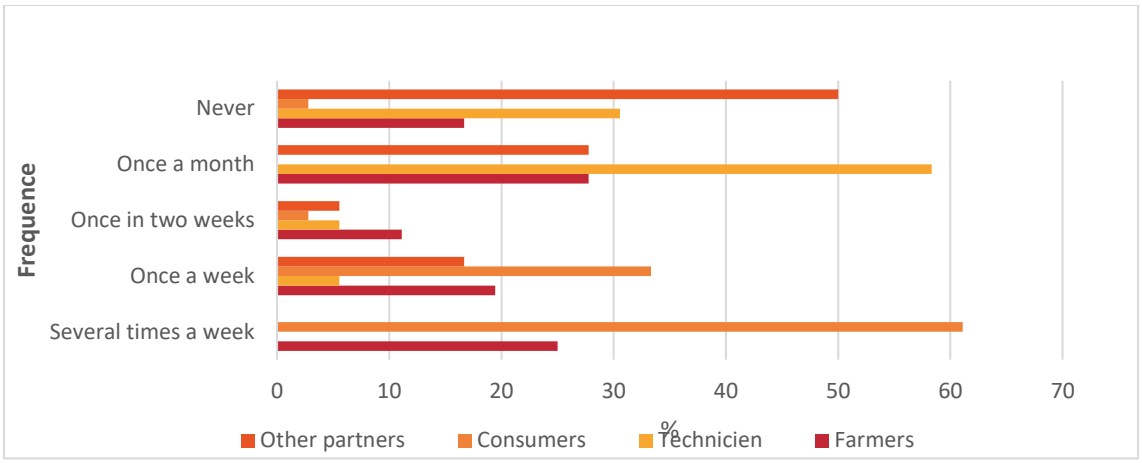


Source: Farmers survey.

Figure 6: Percentage of participation in PROVE activities (%)

During the programme, PROVE farmers are in close contact with their consumers, regular contact with other famers but not with other agents in the network (Figure 7).

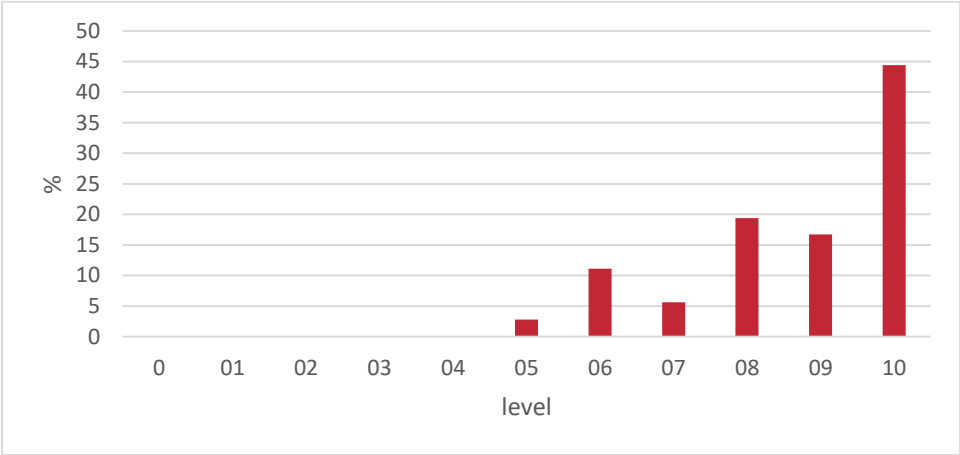
[17] PROVE involves 120 producers but only 69 are listed in the site. Due to the new regulation in data protection, the rest of the farmers were not included in the survey because their contacts were not public.



Source: Farmers survey

Figure 7: Percentage by frequency of contact in PROVE network (%)

PROVE farmers present very high scores of satisfaction with PROVE, with no farmers reporting lower than the medium point of the scale. In the scale from 0 to 10 points, the average score is around 8.7 (M=8.69, SD=1.50) and the median is 9 (Figure 8).

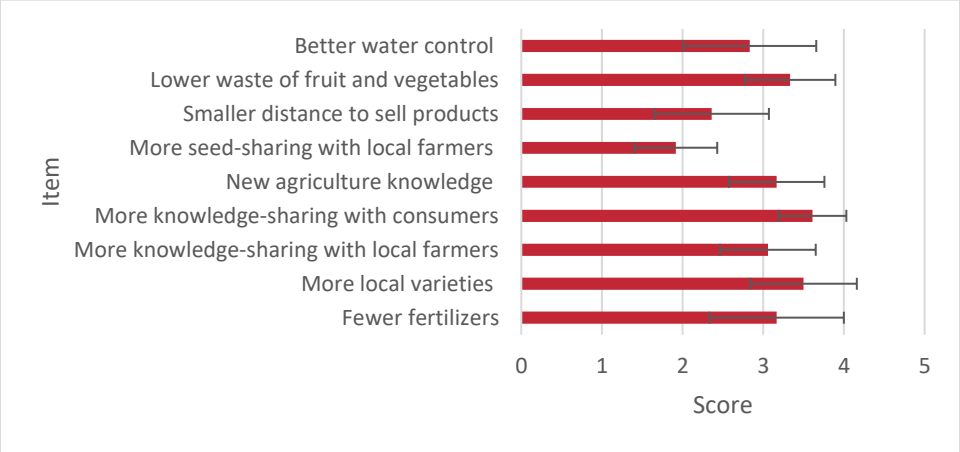


Note: Relative frequency of farmers sample by satisfaction level (%).

Figure 8: Distribution of satisfaction levels among farmers (%)

Concerning the perception of impacts on farming practices, farmers perceive higher impact of the project in the promotion of the production of local varieties and in the sharing of knowledge with consumers (median of scores higher than 3, referring to perceiving differences “a lot of times” or “always”). Sharing seeds among PROVE farmers and the decrease of distance in selling products are the items with lower satisfaction scores.

Among participants, the median scores show that farmers tend to feel that being in the PROVE program has "sometimes" contributed to reducing the use of fertilizer, sharing knowledge with other PROVE farmers, acquiring new knowledge, reducing agriculture production and water waste.
Additionally, the great majority of participants stated that PROVE improved their material living conditions (89%). This was only not the case for 4 farmers in the survey (Figure 9).



Note: Average frequency scores (bar) and standard deviation (error bars) for perceived changes by item.
Source: PROVE consumers survey.

Figure 9: Average perceived change frequency by item

Differences between PROVE and non-PROVE farmers

The PROVE farmers' sample was first compared to the sample of farming workers that participated in the eight waves for European Social Survey (ESS8). Only 39 workers in the sector "Crop and animal production, hunting and related service activities" participated in the ESS8. The socioeconomic and demographic composition of the sample was compared according to region, age group, gender, education group, household composition and marital status (if with partner or not) and household income and perception of economic difficulties, based on bivariate association tests between samples and each socioeconomic indicator (Qui-Square tests). The association tests suggest very different features between the samples: PROVE farmers tend to be more Lisbon-centric (ESS:15%, PROVE: 37%), younger (50+ ESS5:87%, PROVE: 44%), more educated (tertiary: ESS5:5%, PROVE: 47%), with more chances to live with children (ESS:23%, PROVE: 46%), to declare higher income (>1101€ ESS:12%, PROVE: 64%), and to perceive lower perceived economic difficulties ESS: 54%, PROVE: 17%)[18]. The size and composition of the ESS8 sample of workers from sector "Crop and animal production, hunting and related service activities" does not allow selection of a matched subsample to study the differences in the selected variables. Instead, PROVE farmers are compared with an exact match of the ESS8[19] total sample (not restricted to the workers of that specific sector) in terms of age group, education group, region, and income percentile.

[18] Region ($\chi_{(4)}$=13.960, p=.005), Age group ($\chi_{(2)}$=16.386, p=.000), Education group ($\chi_{(2)}$=17.973, p=.000), Children ($\chi_{(1)}$=4.226, p=.040), Income percentile ($\chi_{(9)}$=22.476, p=.007), Economic difficulties ($\chi_{(9)}$=16.108, p=.039).

[19] The selection was based on a propensity matching procedure. The variables selected to conduct the matching procedure are– gender, age group, education group, income quintile. The procedure was supported by R software and the package MatchIt. Different matching methods were

The two samples are compared in terms of the scores of perceptions of influence over their daily work and over policy decisions (considered a proxy for individual capability for empowerment), and wellbeing.

Table 3: Average scores of work influence, life satisfaction and life happiness.

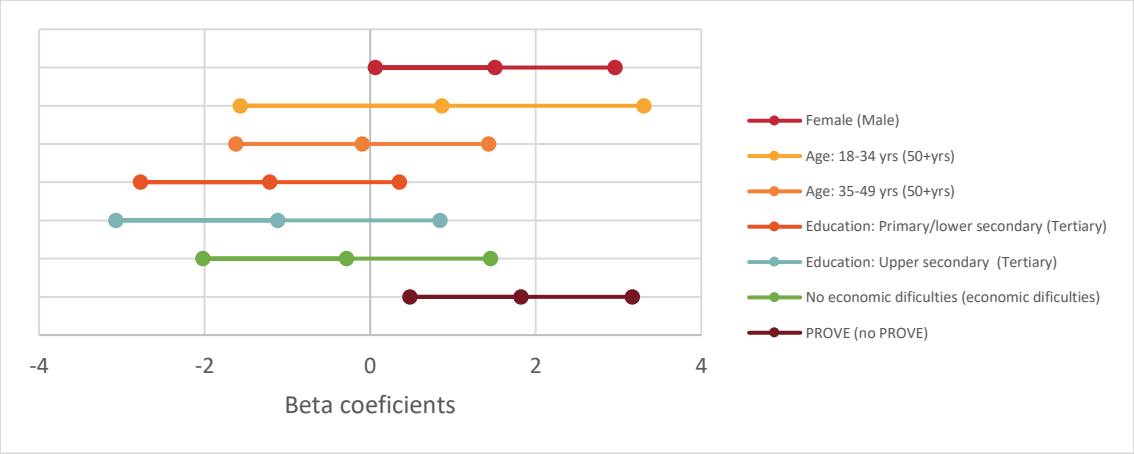
Sample	Variable	N	Mean	Standard deviation
Non-PROVE	Influence daily work	37	6,14	3,97
	Influence policy decisions	36	5,37	4,05
	Life satisfaction	36	5,62	2,94
	Life happiness	36	6,90	2,22
PROVE	Influence daily work	36	8,36	1,46
	Influence policy decisions	36	7,86	2,17
	Life satisfaction	36	7,58	1,32
	Life happiness	36	7,78	1,40

Source: Farmers survey and ESS8.

The score for perceived influence in work environment is measured in a scale from 0 to 10 and is treated in this analysis as an interval measure. Two indicators address the perception of influence in the work environment, one considering daily routine and the other considering the participation on policy decision related to local groups' activity. Controlling for the effects of age group, education group, gender, and economic difficulties, no differences are found for the first indicator ($p>.05$) but the groups significantly differ in the second indicator. Being a PROVE farmer is correlated with higher scores of perceived influences in policy decisions related to PROVE's activities – on average PROVE farmers score almost more 2 points higher in the scale ($B=1.822$, $p=.009$)20 than the non-PROVE sample (Figure 10).

considered. We chose to consider the result of the Exact technique, that allowed to select from the ESS a sample with the same exact features as the PROVE sample. For this procedure, missing values were replaced by the mode category in the producers sample.

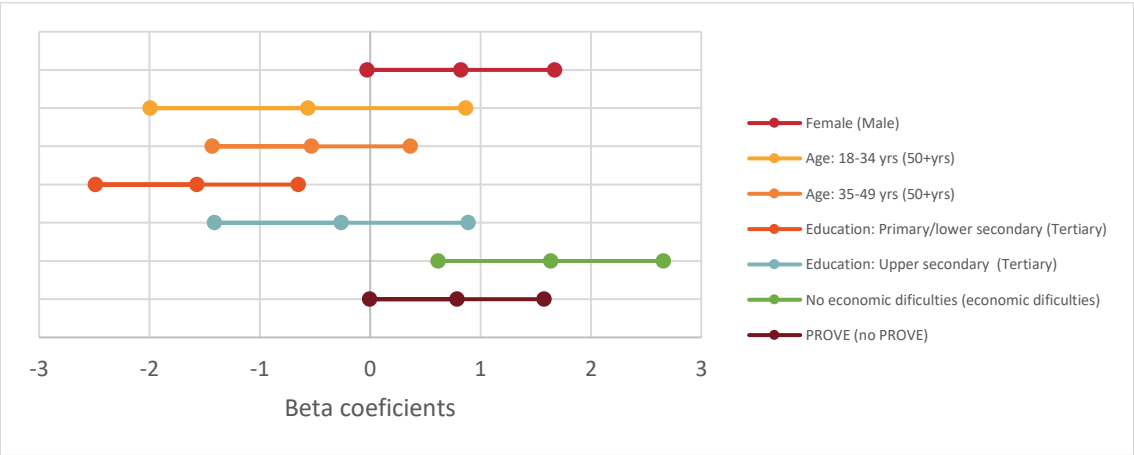
[20] $F_{(7,58)} = 2,119$, $p=.056$. $R^2=.204$. DW=1.843. Model: age group, education group, gender, perceived economic difficulties, PROVE.



Notes. Regression coefficients and 95% confidence intervals (error bars) modelling scores of perceived influences in policy decisions in the organization by factor
Source: Farmers survey and ESS8.

Figure 10: Regression coefficients (unstandardized betas) for perceived influence in policy decision in the organization by factor

Average scores of life satisfactions were also shown to be significantly higher among PROVE farmers. Treating the score as a continuous variable, on average, the PROVE farmers sample score almost one point more in the scale than non-PROVE farmers, even after controlling for gender, age group, education group, and perceived economic difficulties (Figure 11)[21]. No differences were found for life happiness scores[22].



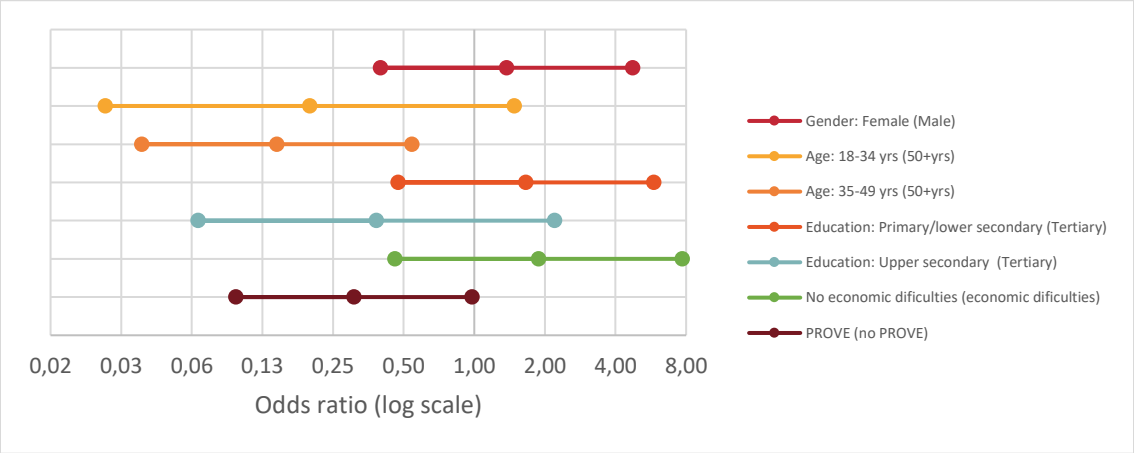
Notes. Regression coefficients and 95% confidence intervals (error bars) modelling scores of life satisfaction by factor
Source: Farmers survey and ESS8.

Figure 11: Regression coefficients (unstandardized betas) for life satisfaction by factor

[21] $F_{(7,60)}$ = 4.950, p=.00, R^2=.362 DW=2.265.. Model: age group, education group, gender, PROVE.

[22] *$F_{(7,60)}$ = 2.564, p=.02, R^2=.230, DW=2.526, B_{PROVE}=.525, p=.251. Model: age group, education group, gender, PROVE.

Turning to the study findings on self-perceived health, overall 20% of participants in the study report low self-perceived health. After controlling the effect of key sociodemographic indicators, the PROVE sample demonstrates lower chances to report bad health, by 30% less[23] (Figure 12.).



Notes. Regression coefficients and 95% confidence intervals (error bars) modelling chances of reporting poor or bad health.
Source: Farmers survey and ESS8.

Figure 12: Regression coefficients (odds ratio) for perceived poor or bad health

Samples did not differ in the chances of perceiving economic differences, after controlling the effect of age group, education group, and gender[24]. This result is not surprising considering that both samples are matched in terms of income percentiles (due to the impossibility to restrain to workers of the productive sector). In overall, economic difficulties are declared by 22% of the participants in the study.

Capabilities, motivation and opportunities for green social empowerment

A set of indicators were created to describe the levels of capabilities, motivation and opportunities (COM) of PROVE farmers based on Likert scale indicators informed by theory. Given the low dispersal of responses, all variables were dichotomized (i) higher than the midpoint of the scale; and ii) below and/or equal to the midpoint of the scale) and included in a Multiple Correspondence Analysis (MCA) to study the relation between COM indicators and the key features of participants. The MCA is a multivariate technique that support data reduction, allowing the identification of key vectors (dimensions) that structure sample variability in the selected indicators. Following the procedures suggested by Carvalho (2000), two dimensions were retained due to their prevalent role in describing sample variability. From the initial set, 7 variables are omitted from the final version of MCA due to their low discriminant power[25]. According to this analysis, PROVE farmers profile is structured by two dimensions represented in the figure below (Image 3).

[23] $G^2_{(6)}$=19.472, p<.01, $X^2_{HL}(8)$=3.750, p>.05. R^2_{CS}= 0.246; R^2Nagelkerke= 0.329. N= 76. Model: age group, education group, gender, PROVE.

[24] $G^2_{(6)}$=12,668, p<.05, $X^2_{HL}(8)$=3.750, p>.05. R^2_{CS}= 0.168; R^2Nagelkerke= 0.250. B_{PROVE}=-1.701, p=.236. N= 76. Model: age group, education group, gender, PROVE.

[25] One item related to capability (Influence in decisions related to PROVE's activity), three items related to social opportunities (At my PROVE local group all farmers are treated fairly; Farmers in my region think PROVE is a good project to be part of; Other farmers would like to be part of PROVE), and three items related to material opportunities (Have access to training suitable to my agricultural activity; Have access to technical consulting suitable to my agricultural activity; Can easily be in contact with my clients).

The first dimension (horizontal axis), has higher discriminant power and opposes:

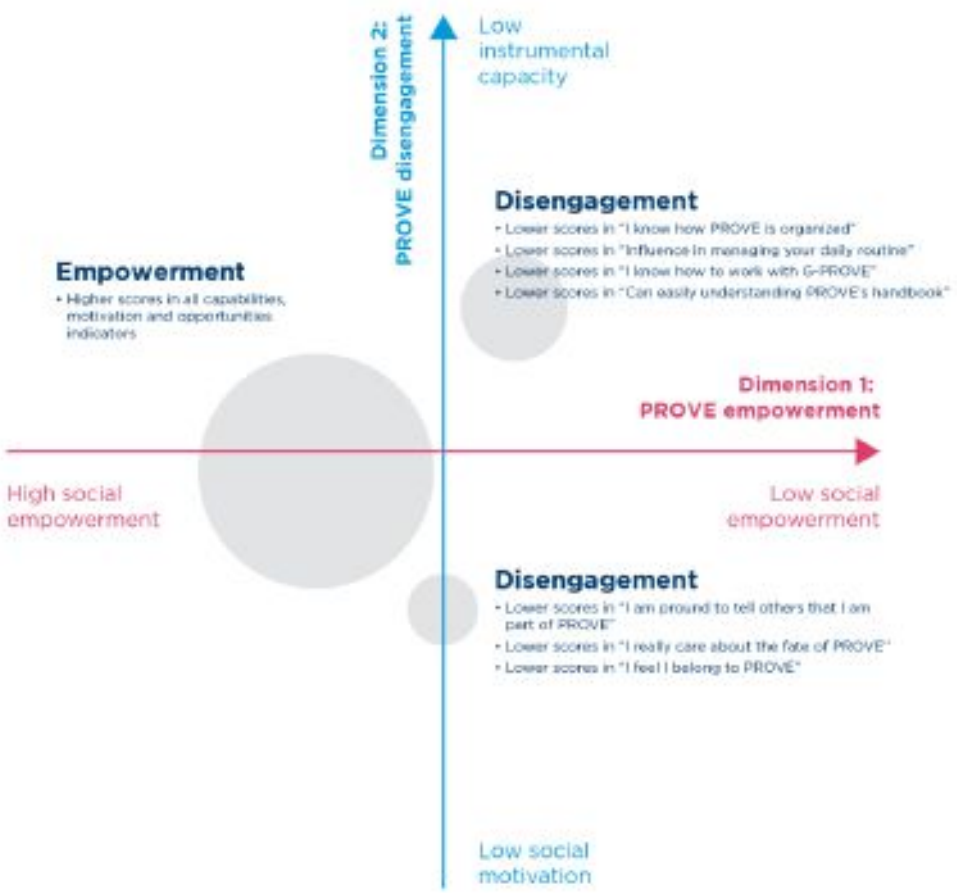
- Categories referring to high levels of social empowerment (on the left side of the axis)
- Categories referring to lower levels of empowerment (the left side of the axis).

Therefore, we can say that this dimension is differentiating different levels of empowerment (capabilities, motivations, opportunities) in PROVE.

The second dimension (vertical axis) opposes:

- Categories referring to low levels of instrumental capacity (upper side)
- Categories referring to low levels of motivation (group identification and affective commitment).

Based on this organisation it seems that Dimension 2 describes different modalities of disengagement in the PROVE programme.



Note. Systematic representation of the association between categories according to the MCA (N=36).
The grey spheres represent concentrations of cases.[26]

Image 3: Structural dimensions for PROVE farmers' profile (MCA)

When representing the subjects in Image 3 defined by the 2 dimensions of the MCA it is possible to observe key features of farmers' profiles.

[26] Higher capability categories : higher scores in the indicators referring to : working with others; organize people; solving problems, participate in decisions; understand how PROVE is organized; influence in managing your daily routine; knowing how to work with G-PROVE; understand PROVE's handbook. Higher motivation categories: higher scores in the indicators referring to: proud to be part, caring about the fate of PROVE, identifying with PROVE, belonging to PROVE. Higher opportunities categories: higher scores in the indicators referring to: access to communication tools, access to management tools, contact with other PROVE farmers; have someone who helps using G-PROVE; express opinions in decision making, influence over the decision making.

Most cases are concentrated in the quadrant related to high social empowerment. Only a few cases occupy the quadrant referred to low instrument capacity (N=~7), and fewer are in the quadrant related to low motivation.

PROVE perceived effects by farmers and stakeholders

An additional section was introduced in the focus group with PROVE stakeholders to collect perceptions of the programme's impacts. Several topics emerged in the discussion concerning farmers. Four themes are identified: economic gains, environmental gains, quality gains and consumers proximity.

In the discussion, stakeholders addressed the role of PROVE in ensuring a decent income for farmers. References were made to participants that were able to create a new income source from the fields they already owned, to individuals that were able to convert their qualifications to the agriculture sector, or how PROVE created an alternative route out of unemployment. Under this topic, the role of PROVE in promoting the local economy was also discussed. Stakeholders described PROVE as a programme that creates new income sources, and employment to support food production, and that it promotes rural development. Participants also considered that the programme contributed to the revitalization of the agricultural sector in some districts, providing tools and opportunities for small scale farmers – particularly relevant considering that small scale agriculture has little economic incentive, due to very competitive pricing in the sector, and it is socially devalued in Portuguese society. PROVE improved the prospects of getting a fair income in the sector, helping to establish local businesses, based on network collaboration, planning, direct selling and fair prices.

Stakeholders also described some perceived environmental gains related to PROVE. The consumer subscriptions allow for better management of the productions and harvests so that fewer products are wasted ("*There is a major advantage to the farmer that is the fight against waste. People know that what they harvest they will sell*"). The role of PROVE in promoting the cultivation of the fields (connected with the revitalization of the agriculture sector) is also referred to as a preventing measure for fires, by preventing the abandonment and desertification of rural areas and fostering good practices in land management. Participants also perceived the promotion of short-chain circuits as a manner to decrease the environmental footprint related to food production, reducing the distance between production and selling points (with fewer resources spent in transports and in the conservation of the products). Additionally, farmers are willing to re-introduce local varieties thereby promoting biodiversity.

The quality of fruit and vegetable production ensured by farmers is also mentioned. The PROVE programme introduced practices for local farmers to ensure a quality fresh product, harvested on the same day of consumer's purchases.

Finally, the connection with consumers was a very valued topic in the discussion, considered by many the key feature for PROVE´s success. Trust and recognition of efforts on both sides (consumers to farmers and farmers to consumers) were noted.

7.7 Discussion

The PROVE evaluation project included the perspectives of different agents connected with this practice, including the creator agency (ADREPES), a set of diverse stakeholders and key informants, and a wide sample of consumers and farmers. The evaluation study focused on theoretically relevant dimensions in which PROVE could contribute positively to the environment, health and equity.

PROVE consumers are mostly women with high levels of qualifications and income. They are very satisfied with the project and perceived positive impacts of PROVE in health (healthier diet), equity (empowerment of farmers) and sustainability (farming practices). These perceptions are validated by the issues raised in the focus group, which highlight the role of PROVE in ensuring quantity, quality and diversity of fruit and vegetables to consumers and a close relation with the farmers.
PROVE consumers are more likely to adopt dietary recommendations for more healthy and sustainable diets. Results suggest that projects such as PROVE can help consumers to eat more fruit and vegetables, mainly by ensuring availability of fresh fruits and vegetables in the household that help establish healthier meals habits. Even analysing the overall consumption of food, PROVE consumers present healthier diets than other consumers. A smaller effect was identified concerning the recommendation of eating no more than 2 portions a week of red meat. No differences were found between PROVE consumers and non-PROVE consumers in the chances of following dietary patterns with lower ecological footprint. It appears that PROVE's influence on diet is mostly beneficial for the health of consumers rather than for the decrease of environmental costs related to diets. Nevertheless, the environmental advantages of buying fruits and vegetables via PROVE compared with other distribution chains could not be properly assessed in this study. The reach of PROVE for sustainability may be stronger than reported.

PROVE farmers present diverse socioeconomic characteristics which differs from the sample of farmers in the ESS8, for example: among PROVE sample there is a higher percentage of people with high education, and a higher percentage of people who are younger than 65. PROVE farmers report high levels of satisfaction and positive perceived impacts of the programme on the improvement in their life conditions. The economic gains related to PROVE, both individually and collectively (rural development), are also mentioned in the focus group with stakeholders. Comparative studies suggest that PROVE may contribute to promote individual empowerment (perceptions of influence) and wellbeing among farmers. From the farmers' perspective, as found in both the survey and the focus-group, PROVE influences practices mostly by increasing the cultivation of more local varieties and the proximity with consumers. The shaping of other farming practices is perceived as less relevant by the farmers, because PROVE farmers already valued traditional agriculture, linked with natural cycles and with low use of chemicals, even before enrolling in this programme. The distance between production and distribution of the product did not reduce in many cases, because enrolling with PROVE promoted the expansion of the farming business. Nevertheless, from the stakeholders' perspective in the focus-group, in general PROVE is still considered as a project with the potential to strengthen short circuits in food production, saving in conservation, transportation and waste costs when compared with more conventional distribution chains. Overall, present PROVE farmers demonstrate a profile characterized by high capabilities, motivations and opportunities for network collaborations. These positive traits are crucial in the promotion of this initiative. Nevertheless, our study also showed that a few individuals reported a less positive pattern, with a decrease in operational capacity and low motivation. Despite their limited number, these cases should be followed up with caution in the future.

Findings indicate possible pathways under which PROVE influences health, equity and sustainability, congruent with initial research questions: PROVE consumers' diets are healthier and slightly more sustainable (lower intake of red meat). PROVE farmers enjoy high levels of capabilities, motivations and opportunities for network collaboration in PROVE, that promote short circuit chains and responsible farming. Combining the findings from the quantitative analyses and the perspectives from the qualitative analyses we find support for the identification of PROVE as a triple win practice and some clues to point to same strategies to upscale that effect.

7.8 Limitations

The PROVE evaluation case study devised an evaluation of the PROVE practice from the INHERIT perspective of understanding its impact on health, environment, and equity. The size, duration and extension of the PROVE project complexified the evaluation research. Given the time and resources available, a quasi-experimental design was proposed to study PROVE's effects based on a comparison of PROVE consumers and farmers samples and samples from other studies that covered issues under analysis. Some limitations of this strategy are outlined below.

Comparing users and non-users is not sufficient to demonstrate a beneficial effect of the PROVE programme, since the variables under analyses can be influenced by other factors. The effect of some of these cofounders are addressed: to ensure that differences of consumption patterns were not confounded with the differences in socioeconomic compositions, PROVE users are compared with matched subsamples of surveys that aimed to collect representative samples of Portuguese adult population and relevant socioeconomic indicators were included in the regression models as covariates. Even controlling for all important factors, the comparative studies cannot be understood as PROVE effects, since we do not have information about previous diet patterns of consumers to demonstrate that they changed with PROVE.

Another important limitation of this design concerns the sampling procedures. The samples of consumers and farmers supporting the study are not randomized samples. Given the constraints in data protection, it was not possible to access to the consumers' contacts list and recruitment was made using online recruitment. Only listed farmers were contacted to participate in the study and their participation was constrained by the timing of data collection. The generalization of the results from the samples to the populations is, therefore, to be made with caution.

Not discarding these limitations, it is important to stress that, the hypotheses tested were supported by validated models taken from the literature; measures in the comparative studies were validated by previous research and directionality of the association and overall conclusions from quantitative studies were triangulated by the findings from the focus group. These procedures should contribute to increase the robustness of these findings. Additionally, the research team will assess the robustness of the evaluation conclusions, by estimating differences between PROVE and non-PROVE sample using alternative methods in future publications.

7.9 Learning points for future research

The key findings and limitations of this evaluation process can contribute to providing important cues for future research. A few suggestions for future research are outlined.

Results suggest that PROVE's impacts on diets of consumers relate to habits after meals and availability of fruits and vegetables. Both dimensions refer to highly contextualized factors. A subscription for fruit and vegetables facilitates the opportunity to eat fruit and vegetables regularly, promoting the establishment of healthy habits like eating fresh fruits or vegetables after each main meal. These pathways were studied in samples that present a high socioeconomic profile, and we expect that high levels of education correlate with food and health literacy. Future research should address whether the key pathways for diet change are shaped by socioeconomic level. Would the subscription provide similar results on a lower socioeconomic sample?

According to the household survey report, the consumption of meat in Portugal is positively related to socioeconomic resources. Future research could explore if this social pattern is confounding the effect of

the subscription in the exchange of food calories to plant base options. Also, the low robustness of the correlations concerning red meat intake indicates the need to identify better predictors to this consumption (beyond the selected determinants for healthy eating).
Sampling bias constrains the conclusions of this research. The assessment of ongoing practices can also be enhanced if the survey includes information that allows controlling some bias related to the sampling procedures (for example information about internet use may help to control the bias introduced by on-line sampling procedures).

We identify also a need for better self-reported metrics for estimating environmental implications of consumers and farmers' behaviours. More survey-based methods should be validated by studies crossing observed measures with reported measures to support these kinds of evaluations.
Finally, in a scenario with less time and resources constrains, the dimension that would be very valued to explore in the future is the process of behaviour change. Ideally supported by the combination of longitudinal quantitative and qualitative data collections, following consumers after baseline measurements, would allow better understanding of how the PROVE influences behaviour, critical moments for change, or even the interplay of different determinants at the different stages of behaviour change.

7.10 Learning points for potential scale up and transferability

The beneficial effects of PROVE for diet healthiness is shown to be higher than for diet sustainability. This suggests that the scaling up of the effects of PROVE under an INHERIT perspective could be fostered by the promotion of the exchange of food calories from animal to plant-based options, for example by presenting vegetarian and vegan alternatives of the recipes typically distributed in the baskets. In fact, at the moment, although PROVE consumers eat more fruits and vegetables than non-PROVE consumers; they do not differ greatly in relation to consumption of meat. If recipes are offered proposing less consumption of meat in general, this could help promote not only more healthy but also more sustainable diets.

PROVE could also extend its impacts by diversifying the profile of consumers. The benefits of PROVE do not reach consumers from lower socioeconomic backgrounds. The features of the service may be less suitable and less attractive for these populations. PROVE could strengthen its role in promoting health equity by connecting with social catering services in schools and retirement homes. PROVE implementers have been exploring this possibility, identifying however many difficulties related to public procurement rules. Reinforcing awareness campaigns for PROVE targeting lower socioeconomic areas or among community organisations, such as schools, may contribute to widening the consumer base. In the scope of the research, the CIS-IUL team identified an opportunity to develop a programme, inspired by the PROVE network to promote collaborative behaviours and environmental attitudes in a public school (the “PROVE’scola” programme). Initiatives such as this, involving children and families, may help to promote the PROVE initiative across social groups.

Another strategy that could foster PROVE’s impacts concerns the issues that influence disengagement among farmers. Most participants present high levels of capabilities, motivations and opportunities for network collaboration and social empowerment. Disengagement among some farmers is characterised by lower levels of instrumental capacity or low connection with the group. This suggests a need to reinforce these components in the programme to prevent disengagement from PROVE among these farmers.

Promoting the conversion of farmers from conventional (low use of chemicals) to organic farming is highlighted as an additional strategy for fostering PROVE's impacts on environmental sustainability. This might be achieved by addressing farmers' perceptions about the cost and complexity of procedures for certification, and risk of crop loss.

PROVE has characteristics that make it a transferable programme across different settings. The flexibility of the process, the availability of the tools, the focus on the process, and the multilevel network (national/regional partners, local groups, farmers) helped to establish the PROVE initiative across regions whenever there was farming potential and possibilities for network collaboration. The implementers of PROVE advise including financial participation of the farmers in the common infrastructure in future projects like PROVE, to ensure funds are available in the long run for cohesive communication (brand consolidation) and for maintaining and improving online connection between farmers and consumers. The financial sustainability of PROVE in the future is an important challenge to consider and should involve the consideration of the input of all actors in the process.

8. Life style e-coaching

8.1 Background

Lifestyle e-coaching applications (apps) are known to have the potential to be successful in changing people's lifestyles (Stephens and Allen, 2013; Wijsman *et al.*, 2013). Presently, various systems and devices for lifestyle improvement are on the market, e.g. the FitBit and Samsung Gear wearables plus their accompanying apps. They guide people towards a more healthy lifestyle through measurement of relevant lifestyle parameters (e.g. activity level, food intake), and by means of personalized coaching messages. Also, they have been shown to be effective for the general public (Wijsman *et al.*, 2013). At the moment, the main way to obtain such a device is by buying it for a considerable price, making it a solution solely for people with the means to afford them. However, unhealthy behaviours are more common among people living in poor socioeconomic circumstances, among others, partly as a result of coping with the stress of their status (Dunn, 2010; Stringhini *et al.*, 2010). SES influences important determinants for healthy behaviour, including self-regulation (Dunn, 2010; Hagger, 2010) and executive functioning (Riggs, Sakuma and Pentz, 2007). Early childhood stress associated with experiences linked to poverty is likely to be detrimental to development of these processes (Dunn, 2010). However, little research on e-coaching in groups with lower SES has been conducted so far. This case study therefore investigates whether lifestyle e-coaching applications are also able to change behaviour in groups with lower SES.

8.2 Overall aims

This INHERIT case study aims to investigate whether a lifestyle e-coaching application can be effective in changing lifestyles among people facing socioeconomic disadvantages. In order to get an impression of the importance of the local context, the study took place in two countries: The Netherlands and Greece. The purpose was to motivate people facing socioeconomic disadvantages to engage in healthier and more active lifestyles with the help of a lifestyle e-coaching application including an activity tracker connected to a mobile application. By recording and analysing daily activities, users were encouraged to increase their daily active minutes and become more physically active. Additionally, the tracker could record levels of pulse, food and drink intake, km of cycling/walking, energy use, and sleep.

8.3 Context

Lifestyle e-coaching for behaviour change

The scientific rationale for this study is that there is currently limited research on the effectiveness of lifestyle e-coaching among diverse groups in society, even while interest in the potential of digital innovations for health improvements is rapidly growing. Lifestyle e-coaching is a form of persuasive technology that aims at changing peoples' behaviours without using deception or coercion (Fogg, 2003). However, it is not easy to change human behaviours as they depend on underlying motivations, such as attitudes or intentions, as well as capability and opportunity (Michie, van Stralen and West, 2011; Staatsen *et al.*, 2017). An important underlying assumption in persuasive technology is that people aim for cognitive consistency (Oinas-Kukkonen and Harjumaa, 2009); if attitudes and/or behaviours are not aligned, a person will become motivated to reduce this inconsistency (Festinger, 1989). Thus, to achieve sustained behaviour change, lifestyle e-coaching systems need not only to change the behaviour, but also the ideas about that behaviour. Once a change in behaviour has been achieved, it is important to maintain

this improvement for a longer duration, such that the new behaviour patterns are not just temporary, but a persistent change in lifestyle.

Research indeed shows that lifestyle e-coaching applications have the potential to successfully change people's lifestyles (Stephens and Allen, 2013; Wijsman *et al.*, 2013). However, these studies were mostly targeted to (motivated) people in the general public. This may have biased the results, as these people are already aware of the need for change and might already have the motivation to change their lifestyles indicated by their participation in the study. The effects might be different for different groups. Social, economic and environmental factors shape health and wellbeing both directly, and indirectly via health behaviours (Dunn, 2010; Stringhini *et al.*, 2010). Lifestyle e-coaching applications might be able to improve health for people with lower SES via that indirect pathway. However, social, economic and environmental factors can be expected to moderate the effects of lifestyle e-coaching on health and well-being. While it is becoming clear that health consciousness might be lower in groups with lower SES (Wardle and Steptoe, 2003), at the moment no information is available on the impact of lifestyle e-coaching for these groups.

Effectiveness of lifestyle e-coaching among people living in poor socioeconomic circumstances

Several reasons can be imagined why providing lifestyle e-coaching applications among people living in poor socioeconomic circumstances would be less effective, one of them being a lack of commitment to lifestyle improvement if the wearable is freely available. In the Transtheoretical Model (Prochaska and DiClemente, 2005) an important step in the process of (lifestyle) behaviour change is "contemplation", and persons who are simply given a device might have one less reason to contemplate their motivation for behaviour change sufficiently, which could have a negative impact on their final results. A second reason why e-lifestyle coaching in people with lower SES might be less effective is that people with lower SES might have to spend more of their (mental) resources to making ends meet in their everyday life and managing their limited economic resources for example in paying rent or feeding a family. Research indeed indicates that people with lower SES are difficult to reach with personalized lifestyle interventions (Dunn, 2010).

In a similar vein, several reasons can be imagined why lifestyle e coaching would be equally effective for different SES groups. Self-regulatory capacity and executive functioning differ between SES groups due to differences in their primary focus, childhood development, and the load on their mental resources (Dunn, 2010). Indeed, self-regulation and executive functioning are important for sustained healthy behaviours, but e-coaching applications might reduce the load on these resources for this particular behaviour change. Additionally, lifestyle e-coaching devices try to change behaviours by influencing underlying motivations such as attitudes, intentions or perceived behavioural control (Ajzen, 2006). Not all those factors are subject to socioeconomic status. This might suggest that e-coaching applications could be equally effective for different groups facing socioeconomic disadvantages.

8.4 Research Questions

The primary objective of the current study was to investigate whether a lifestyle e-coaching application can be effective in increasing physical activity (as primary outcome) in groups with lower SES, and whether such an increase in physical activity level (if present at all) is sustained after prolonged use of the lifestyle e-coaching application. The related hypothesis is that after 6 weeks of use of a lifestyle e-coaching application, the subjective physical activity level of the participants has increased significantly in comparison to that of a control group without lifestyle e-coaching, and that after a prolonged use of 3 further months this significant difference persists. The secondary objective was to investigate whether

within the community with lower SES the activity level improvement attributed to the intervention (if present at all) depends on the actual SES level.

8. 5 Methodology

Evaluation plan

To the best of our knowledge no studies are available that investigate whether the beneficial effects of lifestyle e-coaching can also be expected for people in lower SES groups. In order to investigate this possibility, we conducted this study on the effect of lifestyle e-coaching applications aiming to increasing physical activity levels. A certain amount of moderate physical activity per week (150-300 minutes) is generally advised to foster good health, but it is known that this threshold is not reached by a large percentage of the population (US Department of Health and Human services, 2018).The level of physical activity can easily be measured with wearable technology (Marshall *et al.*, 2009), which allows personalized e-coaching for physical activity enhancement. On the other hand, even only wearing such a device can already influence the level of physical activity of the user (Clemes, Matchet and Wane, 2008). Therefore in academic investigations often questionnaires are used for assessing physical activity level, for instance (the short version of) the International Physical Activity Questionnaire (IPAQ, 2005; Vandelanotte *et al.*, 2005). To achieve persistent behaviour change, e-coaching applications focus also on changing the psychological aspects that form these behaviours, such as attitudes and intentions towards it (Ajzen, 2006). Attitudes and intentions can be assessed via questionnaires related to various models of behaviour change. Even if the actual behaviour did not change, a lasting change in motivations can be considered an important step forward. In that respect, their levels over time are relevant for sustained behaviour change.

Trial design

The present study was a two-site (Athens in Greece and Eindhoven, Amsterdam, & Amersfoort in the Netherlands), two arm, parallel group, randomized controlled trial (following the study of Wijsman *et al.*, 2013) that proceeded in three phases over 19 weeks. Only the participants in the experimental group were given access to the lifestyle e-coaching system. Effect sizes from previous research (Stephens and Allen, 2013), indicated a sample size of 180 participants divided over 4 groups (NL|GR x control|experimental).

Participants

A random sample from the general population of each country after stratifying by age and gender. Inclusion criteria involved participants to have a low socioeconomic status defined as socio-economic ISEI score lower than 45 (according to the International Socio-Economic Index (ISEI) described by Ganzeboom, de Graaf and Treiman, 1992), an age between 18 and 65 years, and an estimated level of physical activity of less than 210 minutes of light activity per week (slightly higher than advised by Marshall *et al.*, 2009). For practical reasons, they needed to be in possession of an iOS or Android smartphone (versions 9.0 and 5.0, respectively), and willing to install the lifestyle e-coaching app and sign an informed consent. Exclusion criteria included pregnancy, a medical condition that required them to abstain from moderate physical activity, or if they were already logging their physical activity levels. In Greece, fifty (50) participants were recruited in the experimental group and 55 in the control group. In the Netherlands, 45 and 44 participants were recruited in the experimental and in the control group, respectively. Control

participants were reimbursed with 35 euros in the Netherlands and 25 euros in Greece, while experimental participants received 158 and 70 euros in the Netherlands and Greece, respectively.

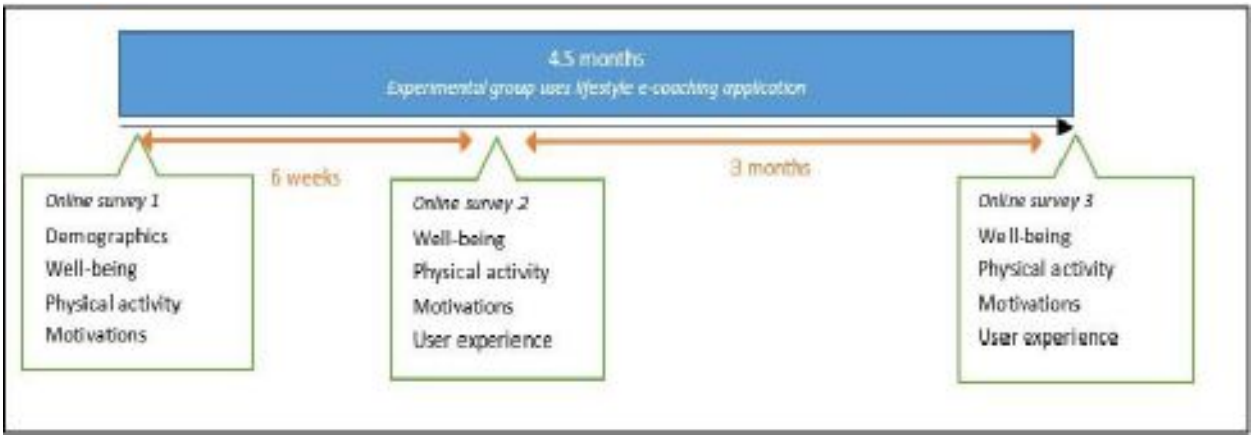


Figure 18: Experiment's procedure and measurements in each time period

Procedure

Participants were randomly assigned to experimental and control group, with the restriction that each batch per country should contain roughly equal numbers of experimental and control participants, preferably matched in age, gender and education. The experimental procedure lasted 4.5 months, e.g. 19 weeks. All participants were asked to report on their physical activity levels, mental well-being, and underlying physical activity motivations at the beginning of the experiment (intake), after 6 weeks, and after 3 more months (Figure 1). Demographic information was gathered at the beginning and user experience in follow-up questionnaires. Only the experimental participants were invited for an intake session, where they received the lifestyle e-coaching application and helped with personalized installation of the system. They were instructed to wear the activity tracker (during the day) for a period of 6 weeks, set an activity goal of at least 30 minutes per day, and allow the mobile application to send push notifications. They were free to increase the physical activity goal, or to add additional goals. At the end of the 6-week, the experimental participants were informed that they should keep the application until the end of the experiment, e.g. 3 months later. They were free to use it, but not obligated/required. At the end of the 19 weeks, the experimental participants had the option to keep the activity tracker instead of receiving the reimbursement. Experiment leaders were available the whole period to help with any problems with the lifestyle e-coaching application.

Materials

Lifestyle e-coaching application

Our lifestyle e-coaching application included an activity tracker, i.e. Samsung Gear Fit2 Pro, connected to a mobile application, i.e. Samsung S Health (Samsung Electronics Co., 2018). The activity tracker can track behaviours by measuring geolocation, heart rate via photo plethysmography and physical activity using accelerometry. Consequently, the activity tracker provides the mobile application with the relevant data for monitoring and coaching. The mobile application reports on these measurements, provides motivational messages based on activity insights. Coaching messages and summaries of behaviour also appear on the activity tracker. The system allows users to support and compete against each other in an

online community. As such, the lifestyle e-coaching application can support lifestyle changes in various domains, e.g. weight, consumption, sleep. In our study we will focus on daily active minutes.

Self-report measures

Socioeconomic status was assessed by means of the International Socio-Economic Index (ISEI) (Ganzeboom, de Graaf and Treiman, 1992). Additionally, demographic questions were asked, including age, gender, and family income. Subjective physical activity levels were measured using the short version of the International Physical Activity Questionnaire (IPAQ, 2005; Vandelanotte *et al.*, 2005), which measures different intensity levels of physical activity to estimate total physical activity in MET-min/week (Metabolic Equivalent of Task) and sedentary behaviour. Mental well-being was measured with the short version of the Warwick-Edinburgh Mental Well-being Scale (Stewart-Brown *et al.*, 2011). Underlying motivations of behaviour were assessed with a dedicated questionnaire based on the theory of planned behaviour (Ajzen, 2006) by measuring perceived behavioural control, the attitude towards and intention of behaviour change. A user experience questionnaire measured usage and experiences with the lifestyle e-coaching application in the experimental group. For the control group, a similar questionnaire inquired about the potential use of (other) activity tracking devices or mobile applications. All questionnaires were delivered in the local language and analysed as prescribed (IPAQ, 2005; Vandelanotte *et al.*, 2005; Ajzen, 2006; Stewart-Brown *et al.*, 2011).

Statistical analysis

The questionnaire scores at three points in time were used to calculate the change from baseline (CFB) for each measure, at 2 points in time, e.g., after 6 and 19 weeks. In order to overcome the problems concerning the normality of the scores, quantile regression for the median CFBs was employed. For the first comparison, e.g. baseline versus at 6 weeks, a quantile regression model for the median CFB was employed at the univariate level, and in a multivariate model adjusting for intervention group, the country, and the baseline scores. The statistical significance of the remaining participants' demographic characteristics and the interaction term between country, intervention group, and the baseline score was also assessed. A second model included participants' SES levels to determine whether the effectiveness of lifestyle e-coaching depends on the SES level itself (secondary research objective). In the CFB model about subjective physical activity the underlying motivations, e.g. attitudes, intentions PBC, were also included. In addition, a quantile regression model was also employed for the CFB at 19 weeks (as well as for the difference between the 6 weeks' and 19 weeks' scores) after adjusting for the potential CFB found at 6 weeks, while logistic regression was used to examine the difference between the two groups, concerning the likelihood of a positive CFB at 6 weeks, at 19 weeks, as well as a difference between the 6 and the 19-week scores.

8.6 Results

Sociodemographic information

In Table 1 we present participants' baseline characteristics in both countries separately for each intervention group. In Greece, there is no significant difference between the two intervention groups for all the baseline characteristics. Generally, participants had an average level of education, lived in a 3-member household without young kids and had a lower socio-economic status. At baseline the Greek participants in the control group seemed to be more physically active (**p= 0.033**) compared to the experimental group, while well- being, intention, attitude and perceived behavioural control scores were not significantly different between the two intervention groups. In the Netherlands, there was no statistically significant difference in participants' baseline characteristics between the two intervention

groups, except for socioeconomic status. Participants' socioeconomic index in the experimental group is significantly higher, compared to the control group (**p= 0.010**). Furthermore, at baseline all scores except for the participants' well- being (**p= 0.029**) are not significantly different between the two intervention groups. Concerning participants' physical activity level at baseline, in both countries the majority reported low or moderate physical activity levels in both intervention groups. Analysis controlled for baseline scores in the multivariate analysis, so as to adjust for potential differences.

Table 1: Baseline characteristics of the participants in both study sites (Greece, Netherlands)

	Greece (N= 105)			Netherlands (N= 97)		
	Experimental group (N= 50)	**Control group (N= 55)**	**p-value**	**Experimental group (N= 45)**	**Control group (N= 52)**	**p-value**
Participants' and household's characteristics						
Gender **[N (%)]**			0.391			0.770
Male	26 (52.0)	24 (43.6)		7 (15.6)	7 (13.5)	
Female	24 (48.0)	31 (56.4)		38 (84.4)	45 (86.5)	
Age **[Mean (SD)]**	39.4 (13.6)	40.2 (14.2)	0.769	42.9 (10.7)	42.0 (11.0)	0.674
Level of education [N (%)]			0.678			0.466
Low	1 (2.0)	1 (1.8)		7 (15.6)	4 (7.7)	
Middle	34 (68.0)	34 (68.0)		30 (66.7)	37 (71.2)	
High	15 (30.0)	15 (30.0)		8 (17.8)	11 (21.2)	
Ethnic minority **[N (%)]**	1 (2.0)	1 (1.8)	>0.999	5 (9.6)	5 (11.1)	>0.999
No. of people in the family **[Median (IQR)]**	3.0 (2.0-5.0)	3.0 (2.0-5.0)	0.981	3.0 (3.0-4.0)	3.0 (2.3-4.0)	0.948
Number of children (below 18 years old) in the family **[Median (IQR)]**	0.0 (0.0-1.3)	0.0 (0.0-1.0)	0.663	1.0 (1.0-2.5)	1.0 (1.0-2.0)	0.274
SES score [Median (IQR)]	35.3 (28.8-42.3)	39.0 (29.2-43.3)	0.081	41.0 (37.0-42.0)	38.0 (31.0-41.0)	**0.015**
Outcome variables						
IPAQ score **[Median (IQR)]**	1,065.8 (722.0-1,670.8)	1,413.0 (906.0-2,628.0)	**0.033**	1,798.8 (669.0-2,837.3)	1,087.5 (432.8- 2,455.9)	0.159
IPAQ score- categorized (%)						
Low	20.4	8.2	0.065	41.0	31.8	0.393
Moderate	69.4	67.3		43.6	40.9	
High	10.2	24.5		15.4	27.3	
WEMWBS score **[Median (IQR)]**	28.0 (26.5-29.5)	28.0 (27.0-30.0)	0.812	27.0 (24.0-28.5)	27.5 (26.0-28.8)	0.322
Intention score **[Median (IQR)]**	6.0 (4.9-6.7)	6.0 (4.7-7.0)	0.729	6.0 (5.2-6.7)	6.3 (5.4-7.0)	**0.029**
Attitude score **[Median (IQR)]**	6.7 (6.2-7.0)	6.6 (5.8-7.0)	0.248	6.0 (5.4-6.4)	6.2 (5.8-6.6)	0.123
Behavioural control score **[Median (IQR)]**	6.3 (5.0-6.8)	6.0 (5.3-6.5)	0.583	6.0 (5.3-6.5)	6.3 (5.5-6.8)	0.224

Note: Participants who withdrew after the baseline questionnaire were excluded from the final analysis. P-value is based on Pearson chi squared test for the categorical characteristics and on Mann-Whitney U test for the continuous characteristics (p-value in bold is less than 0.05). IQR= Interquartile Range and is presented as the 25th – 75th percentile of the characteristic's distribution. SD= Standard Deviation. SES= Socio-Economic Status. Concerning the level of education: Low= any sort of education until High school, Middle= any sort of education until university and High= any sort of education higher than the university. The categorization of the IPAQ score was based on the IPAQ scoring protocol.

Effectiveness of the lifestyle e-coaching application

Concerning the effectiveness of the lifestyle e-coaching application on participants' physical activity level (experimental group), a statistically significant improvement of the IPAQ score was found, at 6 weeks and at 19 weeks compared to baseline measurements. In the Netherlands participants' physical activity was significantly improved at 19 weeks compared to 6 weeks (**Table 2**). More specifically, at baseline in Greece, participants' IPAQ score was equal to 1,065.75 units on average, while after 6 and after 19 weeks it reached 1,344.00 units (**p= 0.015**) and 1,539.00 (**p= 0.002**) units, respectively. In the Netherlands, respective measurements were equal to 1,782.50 units at baseline, while at 6 weeks it was equal to 2,392.50 units (**p= 0.003**) and after 19 weeks equal to 3,232.00 units (**p< 0.001**). These findings show a trend in both countries suggesting that the longer participants participated, the greater the improvement of physical activity. In addition, it was found that the lower the physical activity at baseline, the greater the effect of participation, either after 6 or after 19 weeks. More specifically, in both countries for low physically active participants, a statistically significant improvement, both after 6 (**p= 0.005** in both countries) and after 19 weeks (Greece: **p= 0.018**, Netherlands: **p= 0.004**), was seen while for the highly active participants, there was no significant change, at 6 or 19 weeks.

Table 2: Descriptive characteristics for the participants' physical activity, as measured by the IPAQ score, at baseline, after 6 weeks and after 19 weeks in Greece and Netherlands

			Baseline	After 6 weeks	After 19 weeks	p[1]	p[2]	p[3]
GREECE	**Total sample**	**Experimental**	1,065.75 (722.00, 1,670.75)	1,344.00 (787.00, 2,350.50)	1,539.00 (869.00, 3,008.00)	**0.015**	**0.002**	0.125
		Control	1,413.00 (906.00, 2,628.00)	2,002.50 (991.13, 4,386.00)	1,386.00 (827.00, 2,128.00)	**0.012**	0.608	**0.030**
	Low baseline physical activity level	**Experimental**	357.00 (180.00, 674.25)	1,217.25 (897.75, 2,096.63)	1,257.00 (899.00, 3,066.00)	**0.005**	**0.018**	0.398
		Control	479.00 (60.00, 899.50)	1,452.75 (1,149.75, 4,658.63)	771.00 (591.00, 1,545.00)	0.068	0.068	0.273
	Moderate baseline physical activity level	**Experimental**	1,093.00 (884.75, 1,588.75)	1,344.00 (724.50, 2,025.50)	1,539.00 (869.00, 2,754.00)	0.140	**0.025**	0.102
		Control	1,226.00 (876.00, 1,542.00)	1,710.00 (893.00, 3,457.50)	1,290.00 (824.50, 1,928.50)	**0.004**	0.724	0.101
	High baseline physical activity level	**Experimental**	2,820.00 (2,233.00, 4,710.15)	2,646.00 (1,582.00, 6,870.00)	3,380.00 (1,022.50, 9,051.00)	0.893	0.465	0.715
		Control	4,386.00 (3,053.50, 5,089.50)	3,846.00 (2,022.75, 5,171.25)	1,542.00 (1,335.25, 3,276.00)	0.530	0.114	0.333
NETHERLANDS	**Total sample**	**Experimental**	1,782.50 (666.00, 2,670.00)	2,392.50 (1,503.75, 5,197.50)	3,232.00 (1,835.00, 5,196.00)	**0.003**	**<0.001**	**0.019**
		Control	854.50 (397.50, 2,455.88)	1,488.00 (984.00, 3,510.00)	2,475.00 (1,210.00, 3,880.00)	0.059	0.058	0.565
	Low baseline	**Experimental**	519.00	2,019.00 (957.75, 3,359.00)	2,520.00	**0.005**	**0.004**	0.814

			Baseline	After 6 weeks	After 19 weeks	p^1	p^2	p^3
	physical activity level		(301.50, 779.25)		(848.00, 4,018.50)			
		Control	397.00 (303.75, 590.63)	1,464.00 (836.25, 3,234.00)	2,437.50 (1,236.00, 4,668.00)	**0.007**	**0.008**	0.388
	Moderate baseline physical activity level	**Experimental**	1,866.00 (979.50, 2,100.00)	2,439.00 (1,575.00, 5,207.00)	3,232.00 (2,391.75, 5,133.00)	**0.017**	**0.001**	0.463
		Control	1,421.50 (918.00, 2,468.63)	1,440.00 (1,017.00, 2,666.25)	2,025.60 (1,083.75, 2,750.25)	0.182	0.328	0.859
	High baseline physical activity level	**Experimental**	3,396.00 (2,597.50, 5,823.75)	2,887.50 (1,596.00, 6,228.00)	4,992.75 (2,184.75, 8,103.58)	0.594	0.136	**0.003**
		Control	4,280.75 (2,152.75, 6,101.25)	3,865.50 (421.00, 5,631.00)	2,569.65 (597.97, 6,118.50)	0.173	0.345	0.917

Note: The results are presented in the form of Median (25^{th} – 75^{th} percentile). P-value is based on Wilcoxon signed- rank test and it tests the significance of the respective differences. p^1: Difference between 6 weeks and baseline, p^2: Difference between 19 weeks and baseline, p^3: Difference between 19 weeks and 6 weeks (p-values in bold represent the statistically significant differences between the time periods)

In addition, as seen in Table 3 in both countries almost 7 out of 10 participants in experimental group improved their physical activity after 6 weeks while 8 out of 10 participants had the same improvement after 19 weeks. Finally, participants presenting a sedentary lifestyle at baseline reported about 20% and 67% higher duration in daily walking and moderate activity such as cycling after a 6-week period of using the specific lifestyle e-coaching application (data not presented).

Table 3: Percentage of participants in each intervention group who improved their physical activity and their well- being, as well as, their intention, attitude and perceived behavioural control towards their future activity goals, for the total sample and separately in each study site.

		6 weeks- Baseline			19 weeks- Baseline			19 weeks- 6weeks		
		Experimental group	**Control group**	**OR (95% C.I)**	**Experimental group**	**Control group**	**OR (95% C.I)**	**Experimental group**	**Control group**	**OR (95% C.I)**
Total sample	**Physical activity**	70.8%	65.4%	1.28 (0.67, 2.44)	**81.3%**	**54.9%**	**3.56 (1.71, 7.38)**	**67.5%**	**45.2%**	**2.52 (1.31., 4.86)**
	Well-being	37.2%	40.0%	0.89 (0.49, 1.61)	36.2%	25.9%	1.62 (0.85, 3.08)	**45.7%**	**30.6%**	**1.91 (1.03, 3.54)**
	Intention	35.1%	25.6%	1.58 (0.84, 2.98)	36.2%	32.9%	1.15 (0.62, 2.14)	31.9%	35.3%	0.86 (0.46, 1.60)
	Attitude	29.8%	29.4%	1.02 (0.54, 1.94)	33.0%	24.7%	1.50 (0.78, 2.88)	39.4%	36.5%	1.13 (0.62, 2.07)
	Perceived Behavioural control	34.0%	36.7%	0.89 (0.49, 1.63)	40.4%	31.8%	1.46 (0.79, 2.70)	45.7%	32.9%	1.72 (0.94, 3.15)
Greece	**Physical activity**	72.9%	66.0%	1.39 (0.58, 3.34)	**78.9%**	**47.6%**	**4.13 (1.54, 11.07)**	**61.5%**	**34.9%**	**2.99 (1.21, 7.34)**
	Well-being	44.0%	45.5%	0.94 (0.44, 2.04)	48.0%	29.6%	2.19 (0.98, 4.91)	50.0%	31.5%	2.18 (0.99, 4.84)
	Intention	40.0%	40.0%	1.00 (0.46, 2.19)	38.0%	40.7%	0.89 (0.41, 1.96)	38.0%	29.6%	1.46 (0.64, 3.30)
	Attitude	32.0%	37.0%	0.80 (0.36, 1.80)	26.0%	31.5%	0.77 (0.33, 1.80)	36.0%	25.9%	1.61 (0.70, 3.72)
	Perceived Behavioural control	36.0%	50.9%	0.54 (0.25, 1.19)	44.0%	31.5%	0.76 (0.52, 1.13)	**44.0%**	**22.2%**	**2.75 (1.18, 6.44)**
Netherlands	**Physical activity**	68.3%	64.7%	1.17 (0.45, 3.08)	83.3%	65.5%	2.63 (0.86, 8.03)	73.2%	60.0%	1.82 (0.67, 4.97)
	Well-being	29.5%	31.4%	0.91 (0.35, 2.40)	22.7%	19.4%	1.23 (0.39, 3.82)	40.9%	29.0%	1.69 (0.63, 4.51)
	Intention	**29.5%**	**2.9%**	**14.26 (1.76, 115.43)**	34.1%	19.4%	2.16 (0.73, 6.39)	25.0%	45.2%	0.41 (0.15, 1.08)
	Attitude	27.3%	16.1%	1.95 (0.61, 6.25)	**40.9%**	**12.9%**	**4.67 (1.39, 15.67)**	43.2%	54.8%	0.63 (0.25, 1.58)
	Perceived Behavioural control	31.8%	14.3%	2.80 (0.90, 8.75)	36.4%	32.3%	1.20 (0.45, 3.17)	47.7%	51.6%	0.86 (0.34, 2.15)

Note: The results presented in bold represent the statistically significant differences between the two intervention groups ($p < 0.05$).

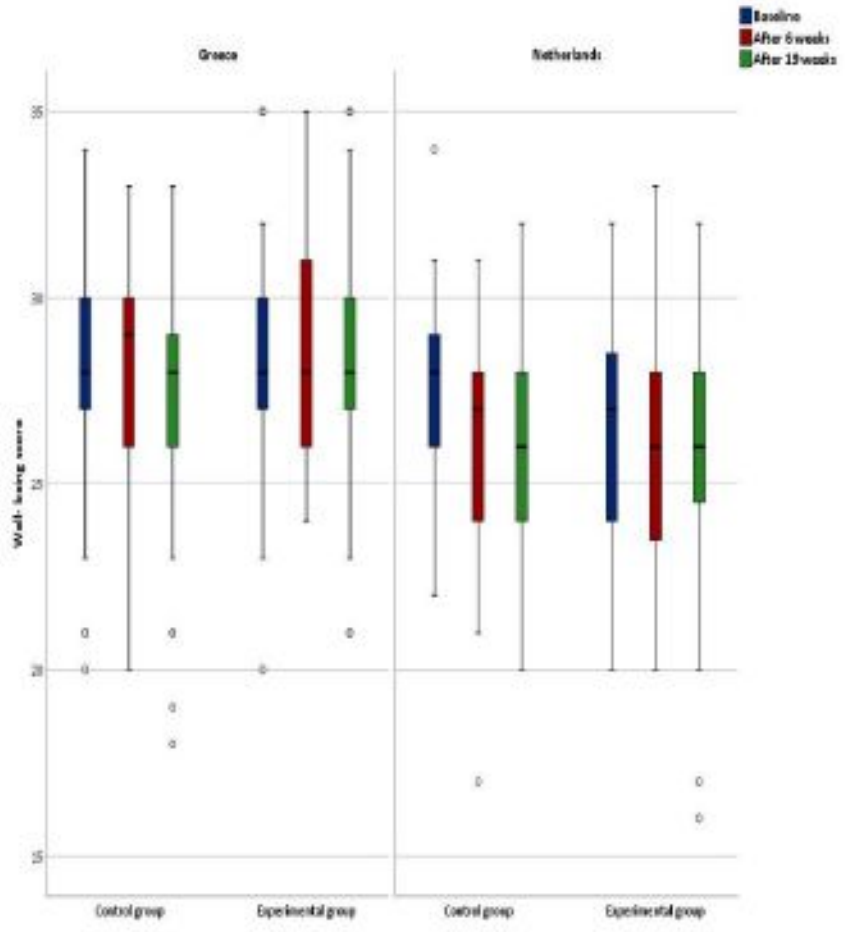
Concerning the difference between the two groups, after adjusting for the country participants in the experimental group had almost 4 times (**OR= 3.56; 95% C.I= 1.71- 7.38**) and 2.5 times (**OR= 2.52; 95% C.I= 1.31- 4.86**) higher odds of improving their physical activity after the 19 weeks' period, compared to baseline and the 6 weeks' period, respectively, with the respective differences being even higher in Greece. In the Netherlands, although a higher percentage of participants in the experimental group improved their physical activity level, the differences between the two groups were not significant. After adjusting for participants' age, gender, country, educational level, SES score, baseline physical activity score, as well as, their intention towards increased physical activity, participants in the experimental group succeeded in a higher improvement of physical activity by 1,049.8 units (**95% C.I= 298.7- 1,800.8; p= 0.006**) after 19 weeks than the control group, while the difference between the two groups was also significant when comparing the physical activity scores at 19 weeks and 6 weeks, with the improvement in the experimental group being significantly higher by 742.8 units (**95% C.I= 203.7- 1,281.9; p= 0.007; Table 4)**.

Table 4: Comparison between the two intervention groups, concerning the difference in their physical activity among the three periods of the study

	Coef. (95% C.I)	**p-value**	**After adjusting for:**
Difference between the baseline and the 6 weeks' period	161.0 (-254.1, 576.1)	0.445	-
	62.0 (-376.2, 500.1)	0.780	IPAQ score at baseline
	195.9 (-337.5, 729.3)	0.469	IPAQ score at baseline, Gender, Age, SES score, Educational level, Country and baseline intention score
Difference between the baseline and the 19 weeks' period	**869.5 (199.0, 1,540.0)**	**0.011**	-
	993.0 (354.5, 1,631.5)	**0.003**	Likelihood of improving their physical activity after the 6 weeks' period, Country
	1,049.8 (298.7, 1,800.8)	**0.006**	Likelihood of improving their physical activity after the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score
Difference between the 6 weeks' and the 19 weeks' period	**616.0 (58.3, 1,173.7)**	**0.031**	-
	623.5 (158.9, 1,088.1)	**0.009**	Likelihood of improving their physical activity after the 6 weeks' period
	742.8 (203.7, 1,281.9)	**0.007**	Likelihood of improving their physical activity after the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score

Note: The results are based on the quantile regression model for difference of the IPAQ score among the three periods, after adjusting for the participants' characteristics shown in the table. Coef= Coefficient comparing the experimental group VS the control group, C.I= Confidence Interval. The results presented in bold represent the statistically significant differences between the two intervention groups ($p< 0.05$).

We also investigated whether the modification in physical activity level and the examined endpoints attributed to the lifestyle e-coaching application within a group of underprivileged participants were significantly associated with the actual SES level. Regarding this issue, no significant correlations with the intra-variation of SES were observed, in both countries (all ps>0.05; results not presented)).



Except for physical activity, we further examined whether this e-coaching application could help participants to improve their well-being, as well as their intention, attitude, and behavioural control. Concerning their well-being, either in Greece or in the Netherlands, participants in the experimental group did not achieve statistically significant improvements (**Figure 2**), yet a small percentage of them did improve their wellbeing indicator after 6 and 19 weeks, respectively (**Table 3**). In addition, participants in the experimental group had almost 2 times higher odds (**OR= 1.91; 95% C.I= 1.03- 3.54**) of improving their well-being between 6 and 19 weeks, succeeding to improve their well-being with 1.0 extra unit (**95% C.I= 0.2- 1.8; p= 0.013**), compared to the control group (**Table 5**).

Table 5: Comparison between the two intervention groups concerning the difference in their well-being, intention to achieve their goals, attitude towards their goals and the perceived behavioural control

	Coef. (95% C.I)	p-value	After adjusting for:
Well- being score			
6 weeks- baseline	-0.4 (-1.3, 0.5)	0.398	Well- being score at baseline, Gender, Age, SES score, Educational level, Country and baseline intention score
19 weeks- baseline	0.9 (-0.1, 1.8)	0.076	Likelihood of improving their well-being after the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score
19 weeks- 6 weeks	**1.0 (0.2, 1.8)**	**0.013**	Likelihood of improving their well-being after the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score
Intention score			
6 weeks- baseline	0.1 (-0.3, 0.5)	0.636	Intention score at baseline, Gender, Age, SES score, Educational level, Country and baseline intention score
19 weeks- baseline	0.03 (-0.4, 0.5)	0.567	Likelihood of improving their intention after the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score
19 weeks- 6 weeks	0.1 (-0.2, 0.5)	0.500	Likelihood of improving their intention after the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score
Attitude score			
6 weeks- baseline	-0.1 (-0.4, 0.2)	0.615	Attitude score at baseline, Gender, Age, SES score, Educational level, Country and baseline intention score
19 weeks- baseline	0.2 (-0.1, 0.5)	0.130	Likelihood of improving their attitude after the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score
19 weeks- 6 weeks	0.002 (-0.3, 0.3)	>0.999	Likelihood of improving their attitude after the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score
Behavioural control score			
6 weeks- baseline	0.1 (-0.3, 0.4)	0.722	Behavioural control score at baseline, Gender, Age, SES score, Educational level, Country and baseline intention score
19 weeks- baseline	**0.5 (0.04, 0.9)**	**0.033**	Likelihood of improving their behavioural control the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score
19 weeks- 6 weeks	**0.5 (0.2, 0.9)**	**0.003**	Likelihood of improving their behavioural control the 6 weeks' period, Gender, Age, SES score, Educational level, Country and baseline intention score

Note: The results are based on the quantile regression model for difference of the well- being, intention, attitude and behavioural control scores among the three time periods, after adjusting for the participants' characteristics shown in the table. Coef= Coefficient comparing the experimental group VS the control group, C.I= Confidence Interval. The results presented in bold represent the statistically significant differences between the two intervention groups ($p< 0.05$)

In **Figures 3- 5,** participants' intention, attitude and perceived behavioural control towards their future goals are presented, separately for each country and intervention group. As seen, none of these scores seems to change significantly after using the e-coaching application, in Greece or the Netherlands. However, there is a proportion of participants who did succeed in a degree of improvement in these scores. More specifically, as seen in **Table 3**, 35.1%, 29.8%, and 34.0% of the experimental group improved their intention, attitude, and behavioural control after using the application for 6 weeks, 36.2%, 33.0%, and 40.4% of the participants improved the same quantities after using the application for 19 weeks, while 31.9%, 39.4%, and 45.7% succeeded to improve their intention, attitude and behavioural control towards increased physical activity, between the 6 week and the 19-week period. In addition, compared to the control group, in the Netherlands, participants in the experimental group had approximately 14 times higher odds of increasing their intention between baseline and the 6 week period (**OR= 14.26; 95% C.I= 1.76- 115.43**) and almost 5 times higher odds of increasing their attitude between baseline and 19 weeks (**OR= 4.67; 95% C.I= 1.39- 15.67**), while in Greece, participants in the experimental group had almost 3 times higher odds (**OR= 2.75; 95% C.I= 1.18- 6.44**) of improving their perceived behavioural control towards increased physical activity between the 6 week and the 19 week period. Finally, after adjusting for various characteristics, participants in the experimental group achieved a significantly higher change in their behavioural control score between 19 weeks and baseline, as well as between 6 and 19 weeks, compared to the control group (19 weeks Vs baseline: **95% C.I= 0.04- 0.9; p= 0.033** and 19 weeks Vs 6 weeks: **95% C.I= 0.2- 0.9; p= 0.003; Table 6**), compared to the control group.

Figure 3: Participants' intention towards increased physical activity in both countries, at baseline, after 6 weeks and after 19 weeks, separately for each intervention group

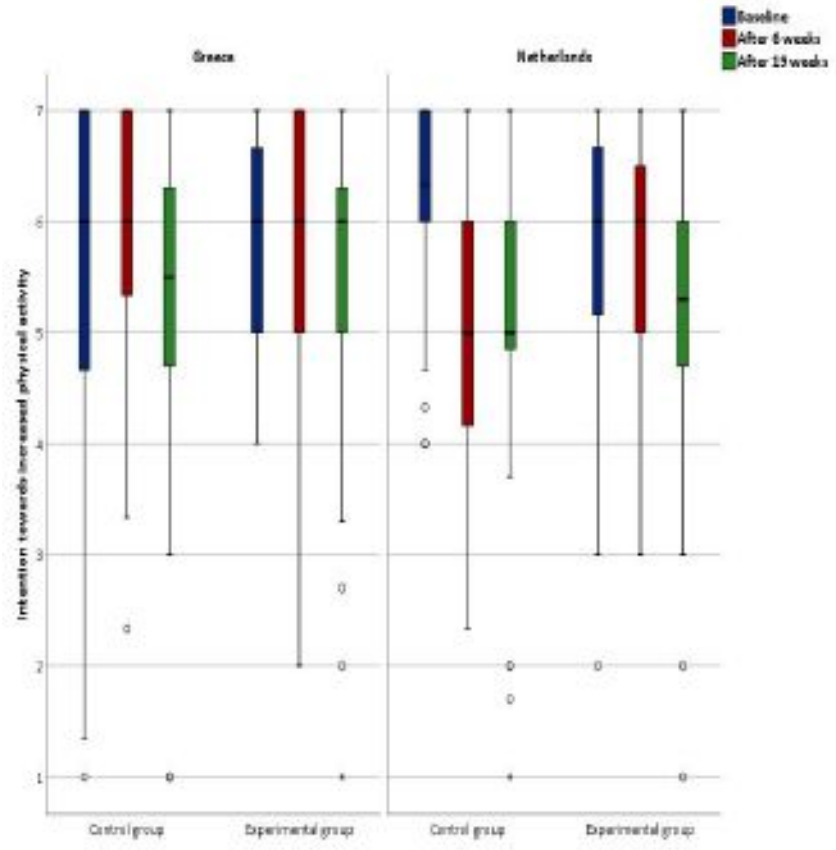


Figure 4: Participants' attitude towards increased physical activity in both countries, at baseline, after 6 weeks and after 19 weeks, separately for each intervention group

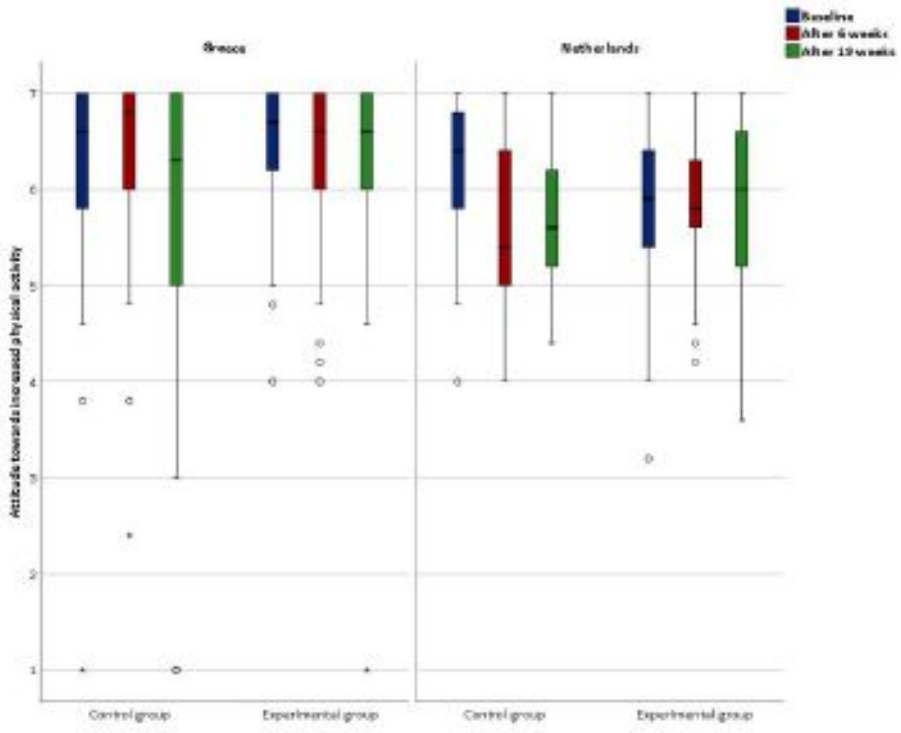
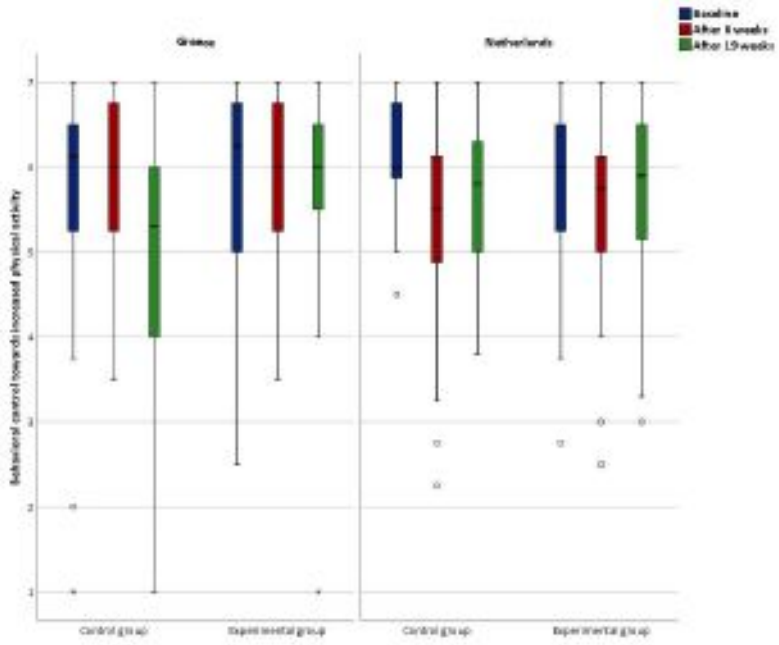


Figure 5: Participants' behavioural control towards increased physical activity in both countries, at baseline, after 6 weeks and after 19 weeks, separately for each intervention group



8.7 Discussion

Many lifestyle e-coaching applications try to influence behaviour as well as the underlying psychological motivations, by indicating opportunities for change, providing information, personalized feedback, social comparison and persuasive messages. Changing behaviours as physical activity can in turn improve well-being. However, social, economic and environmental factors might moderate the effects of lifestyle e-coaching on health and well-being. This randomized controlled study investigated whether a lifestyle e-coaching application can be effective in increasing well-being, physical activity and psychological motivations of physical activity, e.g. intention, attitude and perceived behavioural control, among people living in poor socioeconomic circumstances in Greece and the Netherlands.

Our findings showed moderate positive effects on physical activity levels after using the lifestyle e-coaching application for 6-weeks. These effects became more evident after a 3-month follow-up period. Interestingly, increase in physical activity was more evident among people with a more sedentary lifestyle as measured at baseline, with all low physically active participants at baseline showing an increase in moderate physical activity levels in the post-intervention phase. Although scarce, some studies do confirm our findings. Internet-delivered interventions to promote physical activity revealed moderate effectiveness among the study population (Davies *et al*., 2011). A recent meta-analysis of electronic and mobile health interventions in developing countries showed positive impact on physical activity and healthy nutrition related behaviours (Müller *et al*., 2016).

Besides the effect on physical activity, participants in the experimental group had higher probability of improving their well-being score among 6 and 19 weeks as compared to those of the control group, while a higher difference after 19 weeks was found in the behavioural control score for the experimental group also when compared to the control. These results signal that in the long-term, e-coaching applications can indeed be beneficial for the general well-being of the population. Although non- significant, positive outcomes were observed in the experimental group with regards to the intention and attitude score. This does not indicate necessarily that e-coaching applications do not affect these aspects, since a larger sample size is needed to reveal the significance or not of these outcomes. In addition, we found that for both physical activity and well-being scales (as well as the perceived behavioural control scale in Greece), the experimental group showed higher odds of improving the associated scores only in the third measurement, after 19 weeks. This indicates on the one hand, that the impact of e-coaching applications is not immediate but needs several months to be visible and on the other hand that a larger follow-up time is needed in a future study to assess the sustainability of these effects.

Worldwide, 1 in 4 adults do not meet the physical activity recommendations set by the WHO while the level of inactivity in some countries can be as high as 70% considering the patterns of transportation, increased use of technology and urbanization (WHO, 2018). People from underprivileged areas and living in poor socioeconomic circumstances have usually fewer opportunities for safe, affordable and appropriate programs and services to become more physically active (Guthold *et al*., 2018). Considering the increasing disease burden due to a physically inactive global population, innovative means to achieve behaviour change among large numbers of people at low cost are highly demanded. Lifestyle e-coaching applications have been presented as an innovative cost-effective approach to reaching large numbers of people (Vandelanotte *et al*., 2016). Our results contribute to that direction. E-coaching applications such as mobile health (m-Health) (defined as promotion of health using mobile phones), personal digital assistants and other wireless devices could potentially provide a cost-effective solution in primary and secondary prevention (WHO, 2011).

The present findings suggest that the use of e-coaching may not only increase physical activity levels among people living in poor socioeconomic circumstances but also have a positive effect on perceived well-being. Interestingly, these results were more evident among people with sedentary lifestyles. Considering that other lifestyle modification opportunities of available services may be less accessible for low SES people, e-coaching applications may be an easier and more widely accessible solution to monitor and control detrimental lifestyle behaviours such as physical inactivity. To reduce health inequalities, it might be an option for local/national governments or insurance companies to provide such a lifestyle e-coaching system to those who cannot afford it, and thus help them to obtain a healthier lifestyle nevertheless. If lifestyle e-coaching applications can reduce unhealthy behaviours among people living in poor socioeconomic circumstances, this is potentially advantageous to their health. However, it does not necessarily also lower health inequality, since the link between people facing socioeconomic disadvantages and worse health is both indirect via unhealthy (stress-coping) behaviours and direct via exposure to social, economic and environmental stressors (Dunn, 2010; Stringhini *et al*., 2010).

Research concerning e-coaching interventions to promote physical activity is scarce even more so among people with low SES. People with low SES may not be able to take full advantage of e-Health and m-Health applications for various reasons including lack of access to computers, mobile devices or Internet, social and cultural barriers in relation to digital literacy (e.g. Internet and smart devices self-efficacy) or linguistic barriers. Indeed, overwhelming evidence exists as regards to inequalities in accessing e-Health and m-Health applications (Linke *et al*., 2016). However, considering that the users of smart devices such as smartphones are always increasing even within subgroups of individuals with low socioeconomic status (Ericsson Mobility Report 2015), the exploitation of their potential to promote health behaviours should be separately investigated in this target group. Concerning the secondary objective of this research, we observed that the long-term improvement of physical activity level attributed to the intervention was not associated with inter group SES variation; this could imply that the effectiveness of lifestyle e-coaching applications on physical activity levels is evident even among more underprivileged individuals. However, our study was not powered enough to allow further SES-based stratifications, hence this outcome should be interpreted with caution.

Lifestyle e-coaching application: the Triple Win of the INHERIT Project

Improving health

We tested an e–coaching application measuring impact on physical activity levels, a well-known determinant of health and wellbeing. In 2013, the estimated annual direct health care cost of low physical activity levels and sedentary lifestyles reached $54 billion with an additional $14 billion attributed to lost productivity (WHO 2018). Increasing physical activity at a global level was introduced in the United Nations sustainable goals for 2030; “a 15% relative reduction in the global prevalence of physical inactivity in adults and in adolescents by 2030” (WHO 2018). The results of our pilot study suggest that the use of smart devices and applications can increase physical activity level, as well as positively impact perceived well-being.

Increasing health equity

Studying the effectiveness of lifestyle e-coaching applications has been the subject of research for a number of years, although not among people of low SES. The current study contributes to the limited body of evidence in this area as it showed several positive effects on participants’ physical activity status after a 19- week’s follow-up period, with the effect being more obvious among participants following a sedentary lifestyle as measured at baseline. Considering that other services to achieve lifestyle modifications may be less accessible for individuals with low SES this INHERIT pilot study

indicates that access to such devices and applications may contribute to the improvement of detrimental to health lifestyle factors. Although reducing unhealthy behaviours among people living in poor socioeconomic circumstances, is potentially advantageous to their health it does not necessarily affect overall health inequality, since the link between people living in poor socioeconomic circumstances and worse health is both indirect via unhealthy (stress-coping) behaviours and direct via exposure to social, economic and environmental stressors (Dunn, 2010; Stringhini *et al*., 2010).

Environmental consideration

Interventions to increase physical activity levels are beneficial for the environment considering that in their majority such programs promote walking instead of using mobile transportation means. In the current INHERIT pilot project participants in the intervention group reported walking longer hours, which makes us speculate that they were stimulated to use active transport to increase their personal activity levels indirectly benefiting the environment.

8.8 Limitations

To the best of our knowledge, this is one of the very few studies investigating the effect of lifestyle e-coaching applications on the promotion of physical activity in a sample with people of low socio-economic status. There are some limitations to our study. Firstly, considering the limited sample size of this pilot, findings should be considered as exploratory evidence to build upon and guide a larger study trial. Secondly, data regarding physical activity levels were self-reported hence, under- or over-reporting may exist; although validated scales were used. In addition, interventions targeting lifestyle behaviours may result in overestimated outcomes due to participants' awareness of being observed. Lastly, the short-term follow-up period does not allow to generalize observations to longer time periods and to study long-term sustainability of these outcomes.

The methodology followed was based on the CONSORT statement for non-pharmacologic treatment interventions in terms of age, gender and educational status-matched control group as well as random assignment of participants to study groups (control & experimental). Another strength concerns the concurrent implementation of the study in two different countries Greece and Netherlands, characterized by different socioeconomic and cultural realities. The fact that similar results were observed in both settings leads us to assume that the effect of lifestyle e-coaching applications is strong regardless of SES or cultural backgrounds. Finally, the present work based on a study with a strong methodology, expands the literature on lifestyle e-coaching applications in terms of their effect on other aspects beyond lifestyle parameters such as motivational changes.

8.9 Learning points for future research

Interventions using lifestyle e-coaching applications remain an innovative and promising field in health promotion and self-care. Given the potential of these applications to reach large parts of the population including people of low SES at a low cost, it is important to continue research that will determine widespread effectiveness. It is important to implement large-scale randomised controlled clinical trials to ensure high quality of generated outcomes and minimize the risk of bias, moreover comparing various types of e- or m-applications. Future research would benefit from longitudinal studies with the potential to draw robust conclusions regarding relapse rates, sustainability potential, scope and actual effectiveness over a long-term follow-up period as well as the mechanisms through which the generated outcomes are exerted. Although our pilot study was well accepted by the participants in both countries and rated high in terms of feasibility further research regarding feasibility and acceptability of lifestyle coaching methods in different population groups should take place. Adequately powered studies should consider different target groups stratified according to age, gender, socioeconomic status, region, and digital literacy skills. In addition, more research needs to

be conducted in terms of ethical conduct especially if lifestyle e-coaching applications are part of insurance schemes and access to personal data is jeopardised.

8.10 Learning points for potential scale up and transferability

The core promoting factors for scale up and transferability include commitment of project partners, recognizable benefits for the study population and political will (WHO, 2018). We offer evidence that lifestyle e-coaching applications can have a positive impact on physical activity levels among people of low SES. Scaling up and transferability is also subject to ensuring that people living in poor socioeconomic circumstances have access to e-coaching applications meaning that political and company level solutions for low cost provision have to be discussed.

9. UrbanCyclers

9. 1 Background

UrbanCyclers[27] is a cycling smartphone application (app) developed to promote regular biking in cities. It focuses on supporting and motivating self-regulated behavioural change by providing various planning tools, feedback, rewards and experience sharing. Its key features include a cycling route planner (as of now with full coverage of 5 countries – Czechia, Poland, Germany, Austria and UK – and 9 cities – Bratislava, Milan, Brussels, Copenhagen, Singapore, Sao Paulo, Rio de Janeiro, Bogota and Santiago de Chile), turn-by-turn navigation that allows for combining biking with public transport, and route tracking that is linked to a system of badges, challenges and rewards and community experience sharing. The routing engine is based on state-of-the-art artificial intelligence algorithms that allows for setting preferences for several criteria including safety, comfort and speed. In Czechia, the app is also linked to the country-wide campaign Bike to Work that targets employees and offers several competition categories including the number and total length of bike trips.

In short, UrbanCyclers is an app that focuses on supporting and motivating self-regulated behaviour change. This way, the users' exposure to active mobility/physical activity and nature-contact is increased and more habitual. UrbanCyclers was chosen for inclusion in the INHERIT project for its potential health and environment benefits stemming from clear emphasis on changing behaviour towards a healthier lifestyle. The link to equity is distal, and can be made using the INHERIT Common Analytical framework (van der Vliet *et al.*, 2018) because a modal shift to cycling would improve environmental conditions, with benefits across all social groups in the population, but especially the poorest groups who are more likely to be exposed to noise and atmospheric pollution from motorised transport (Staatsen *et al.*, 2017).

9.2 Overall aims

This INHERIT case-study focuses on improving the effectiveness of the UrbanCyclers app by evaluating distinctive motivational features, financial and social-psychological, as triggers of self-regulated behavioural change based on a rigorous randomized design protocol. In doing so our aim is threefold: (1) to foster the app's effectiveness in supporting behaviour change in pursuit of INHERIT's health, wellbeing and environmental sustainability objectives, (2) to examine the potential effect of different interventions on different segments of users and (3) to add to the existing knowledge of app-based interventions aiming at increasing physical activity.

9.3 Context

The scientific rationale for this randomized experiment stems from a limited (and/or ambiguous) evidence on effectiveness of incentives for commuter cycling (or physical activity in general) communicated through smartphone app in changing routine behaviours.

In their review Stewart *et al*., (2015) finds little robust evidence of effective interventions to increase commuter cycling, the reason being that many studies do not use appropriate control groups or they have high rates of loss to follow-up. External validity of these studies has also been limited due to their focus on specific groups of users. Zuckerman *et al*., (2014) report very similar findings on the effectiveness of gamification to increase physical activity (such as virtual rewards and social comparison) – they found only a few rigorously evaluated studies that yielded contradictory findings.

[27] Starting from April 2019 the app name was shortened to 'Cyclers'. In order to keep consistency with previous reports we keep the original name UrbanCyclers.

Interventions using biking apps are also not numerous – Wunsch *et al*., (2015) explored three persuasive strategies (frequent biking challenge, virtual bike tutorial and bike buddy program), Wunsch *et al*., (2016) tested a gamification incorporated in a biking campaign, and Bopp *et al*., (2018) tested a multi-strategy intervention[28] using an app alongside a social marketing component and social media campaign.

Furthermore, the evidence on effectiveness of app-based interventions is rather ambiguous. A systematic review by Baker e*t al*., (2015) concludes that while numerous studies on physical activity apps have been undertaken, there is a noticeable inconsistency in the findings, in part confounded by serious methodological issues. Direito *et al*., (2016) in a systematic review and meta-analysis of 21 intervention randomized control trials (RCTs) using mobile technologies to aid public health practices (mHealth) finds only a small to moderate but statistically non-significant effect on level of physical activity (PA). A review by Yang *et al*., (2015) observes that contemporary physical activity apps have implemented a limited number of behavioural change techniques (BCTs) – the most frequent were social support, information about others' approval, instruction on how to perform a behaviour, feedback on behaviour, goal setting and prompts/cues. In their review of 25 studies McDermott *et al*., (2016) aimed to identify BCTs associated with changes in intention and behaviour, and reported medium-to-large effects on intentions and small-to-medium effects on behaviour, but failed to produce evidence on how to facilitate behaviour change through a change in intention.

In contrast, personal financial incentives have been shown to be effective in increasing attainment of target levels of health-related behaviour-change (although weakening over time, cf. Mantzari *et al*., 2015). Still, the incentives reviewed by Mantzari and colleagues were widely differing in their nature – direct monetary payments or quasi-monetary lottery tickets such as gift certificates or vouchers, modality of rewards – lump-sum payments, payments or deposits released per unit of achievement, and in certainty of rewards, i.e. lottery vs. certainty. Furthermore, there are not many rigorous evaluations of existing fiscal incentives for commuting cycling, such as the study by de Kruijf *et al*., (2018) on e-cycling. This is somewhat surprising given that various incentives are provided on a broad scale to employees, including cycling allowances in Belgium, tax-free provision of bikes in the Netherlands and the UK, and direct rewards for cycling to work recently announced in Bari, Italy.[29]

A national context may have a substantial influence as well. Cycling is very popular in the Czech Republic, including larger cities where the experiment takes place. With the exception of a few 'flat' cities, where cycling accounts for up to 20% of commuter journeys in the city (so-called 'modal share'), the dominant use of bike is however for sport or recreation (e.g. households in Prague have on average 2.5 bikes but only 1.5 in their Prague's place of residence; the modal share of cycling is mere 1-2% in Prague). At the policy level, there is a clearly stated intention to foster the role of cycling for commuting as well. The National Cycling Strategy (2013) sets the goal of increasing the percentage of travellers using cycling as a mode of transport to 10% by 2020, and the Updated Concept of the Development of Prague Cycling (2014) aims at increasing the number of cycling residents, equalizing cycling as a regular means of transport and extending the cycling network by 200-500 km by 2020. The development of cycling infrastructure, however, lags behind policy commitments, partly due to other priorities, complicated regulatory framework and insufficient funding. Hence, our research may be of

[28] The merits of multi-component interventions is also not entirely warranted. While the review by Baker et al. (op. cit.) finds no support for the hypothesis that the multi-component community wide interventions effectively increased physical activity, Schoeppe et al. (2016) in their review conclude that multi-component interventions appear to be more effective than stand-alone app, but notes that further research is needed.

[29] http://www.eltis.org/discover/news/bari-will-start-paying-people-cycle-work [visited on 13.3.2019]

value here by providing evidence about what motivational measures may be effective in increasing commuter cycling, long before a well-connected cycling infrastructure will be completed.

9.4 Research questions

This randomized controlled trial examines whether smart gamification and/or financial incentives are effective in stimulating regular commuter cycling (as compared to no incentives), which of these two incentives is more effective, and whether there is an extra benefit of combining these incentives. In addition, it aims at distinguishing effects per stages of behavioural change as proposed by contemporary theoretical models (e.g. Thigpen, Driller and Handy, 2015).

9.5 Methodology

The case study follows the evaluation plan developed in the initial phase and updated during case study execution. The evaluation process is split into 5 logic phases (see Figure 1 below) starting from pre-study phase where the case study was prepared, pre-intervention phase with piloting of the experiment, and followed by execution of the randomized experiment. The post-intervention phase includes the final questionnaire for quantitative evaluation, and the qualitative process evaluation (reported in detail in INHERIT Deliverable 5.1) and tentatively will include follow-up survey after 1 year from the main study. The reporting phase amounts to compilation of dataset(s), data cleaning, statistical analysis and writing up of report and peer-reviewed publication.

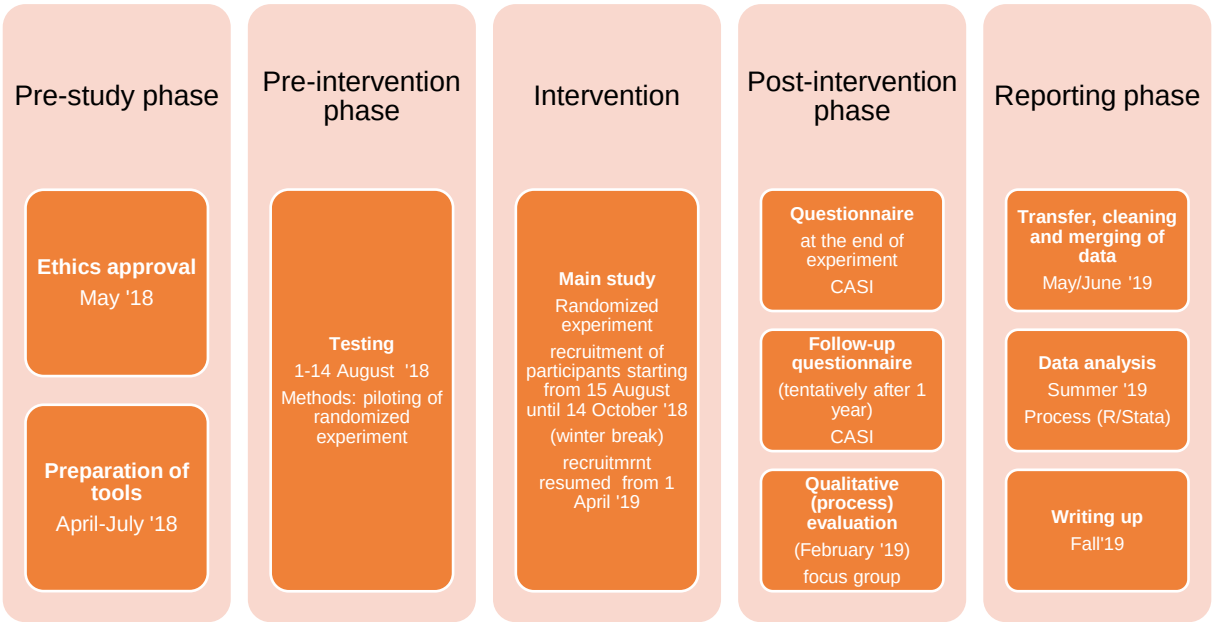


Figure 1: Evaluation plan for UrbanCyclers case study

Randomized controlled trials are considered the most rigorous way of determining whether a cause-effect exists between treatment and outcome (Sibbald and Roland, 1998). By randomising subjects into groups we eliminate potential selection bias and allow for the statistical analyses to be conducted on comparable independent groups (Tai and Iliffe, 2000). Our randomized experiment features two motivation incentives – smart social gamification and financial rewards. The design however is more complex with 5 arms in total (labelled as T0 to T4 in Figure 2) in order to elucidate the extra benefits of a combination of incentives and examine rewards varying in financing profile (cf. flow diagram in Figure 2). Each participant is attributed to one of the five groups at random.

Figure 2: Flow diagram of the stud

Smart social gamification of participants in treatment arms T1 and T2 consists of the app's built-in system of points, badges, leader-boards and challenges combined with personalized push and in-app notifications.

Financial rewards are offered to participants assigned to any of T2-T4 treatment arms. There are two reward payment profiles used: a flat-rate and with decreasing block rates. In the first, participants are rewarded by kilometre cycled to work/school basis and the rate is set to 1 CZK/km for treatments with fixed rate (and capped at 500 CZK, i.e. approx. €20). In the decreasing block rate each subsequent 100 kilometres travelled are rewarded at a lower rate (ranging from 3 CZK/km to 0.2 CZK/km, and the cap is higher at 670 CZK, approx. €26). These rewards will be paid in cash (effectively sent to participants' accounts), based on an offer of a reward publicly stipulated by Charles University, Prague (CUNI) (i.e. an offer addressed to new app users).

We estimated the optimal sample size for an experiment with 5 treatment arms with a conservative assumption of small effect (d<.15). Given the budget constraints on financial rewards we split the tentative sample into groups of 200+200+150+200+150 per treatment arms T0-T4, giving a total sample size 900. This was however conditional on how many participants we effectively manage to recruit in the given time frame of the study. Considering the low conversion rate (i.e. the ratio between those who downloaded the app and who subsequently enrolled in the experiment) we encountered in the summer/autumn 2018 and the remaining time frame for the data collection during the spring 2019, we aimed at obtaining a minimum sample size (still sufficient for disentangling an effect of size d=.16) of about one hundred participants per treatment arm, i.e. 500 participants in total.

It has been repeatedly emphasized in the literature that interventions should be based on more thorough understanding of the psychological processes underlying a behavioural change, i.e. viewing it as a transition through a sequence of different discrete stages (Gatersleben and Appleton, 2007; Bamberg, 2012; Thigpen, Driller and Handy, 2015). This has practical consequences in that, instead of one single intervention designed for all people, specific intervention packages should be matched to the needs and barriers of people in specific stages. Examples of such models are the stage model of self-regulated behavioural change (Bamberg, 2012, 2013) or various modifications of Transtheoretical Model of Behavioural Change (TTM) such as model of action phases (Gollwitzer, 1999).

Practical examples of these developments include Bopp *et al*., (2018) combining TTM and social cognitive theory targeting behavioural constructs self-efficacy, self-regulation, outcome expectations and processes of change. Thigpen *et al*., (2015), using Model of Action Phases, found that travel attitudes matter more to progression toward regular commuter cycling than travel attributes, thus tentatively supporting the efficacy of soft policies focused on changing travel attitudes.

In our study, a set of questions adapted after Thigpen *et al*., (2015) was used to distinguish the individual stage-of-change of each participant (Table 1).

Table 1: Stages-of-change classification

Survey question	**stage allocation**					
Did you go to work / school last week at least once on a bike?	Did not bike in past week	Did not bike in past week	Did not bike in past week	Biked at least once in past week	Biked at least once in past week	Biked at least once in past week
What mode of transport do you usually use to travel to work / school?	Other	Other	Other	Other	Bike	<any>
Have you thought about biking to work / school?	No	Yes	Yes	Not asked	Not asked	Not asked
How likely is you going to work / school at least once a bike in the next 4 weeks?	Not likely	Somewhat likely	Very likely	(very) likely	(very) likely	Not likely
Stage of change	**Pre-contemplation**	**Contemplation**	**Preparation**	**Action**	**Maintenance**	**Disappointment**

Subsequently, the in-app notifications were adapted to broadly reflect the stage of change of participants. The following type of prompts were sent (by treatment arms):

- to those who registered to the experiment but did not record any ride within two (three) days after the registration (T1+T2):
    - infrequent bikers – messages promoting benefits of regular biking;
    - frequent bikers – messages promoting gamification features of UrbanCyclers;
- first (third) ride recorded (T1+T2) – congratulations for recording the first ride,
- first badge (T1+T2) – congratulations for the first badge (after 10 rides),
- weekly summary information (T2-T4):
    - if at least one ride recorded – message detailing amount of financial reward secured so far and number of days to the end of experiment;
    - if no rides recorded – message reminding financial reward per kilometre and number of days to the end of experiment.

No notifications were sent to participants in the control group, and only weekly summary information was sent to participants in T3 and T4 treatments. After 4 weeks all participants (including those in the control group) were invited to complete the final on-line questionnaire by an in-app notification and e-mail.

This particular setup of the experiment was tailored to allow us to discern what incentives are effective in which stage-of-change, i.e. to suggest when, how and to whom such incentives can be effectively targeted and what effects may be expected.

In the final questionnaire we asked questions already included in the short introductory questionnaire on participant's life satisfaction and level of physical activity (using short form of International Physical Activity Questionnaire, IPAQ). We asked questions about regular travel behaviour (transport modes used for specific purposes such as commuting to work or school, for shopping, leisure activities), possession of public transport pass, driver's licence, and car availability. We also asked respondents about their cycling experiences (skills, accidents, vandalism), perceived barriers to cycling and what type of improvement(s) for cyclists they want to be made in their city the most. In addition, we asked about their mode of use of UrbanCyclers app as well as user experience of the app.

Recruitment of participants and data collection

The UrbanCyclers app was adapted to the RCT design just described both in the app's frontend (screen features) and in the backend (database) by the app developers (Umotional Ltd.) collaborating on the experiment. CUNI designed an online questionnaire that participants were asked to fill at the end of the experiment. Once the programming was completed, a throughout pre-testing of the modified app and data transfers from the app to the final questionnaire followed. Each participant upon her/his agreement to participate was given a unique ID that subsequently featured in a link to the final questionnaire which the participant was asked to fill. Once the participant opened the final questionnaire a call was sent to the Application Programming Interface (API) of the UrbanCyclers app using the unique ID. The response to this API call was a set of data from the app database consisting of user's nickname, email, treatment group, number of rides, kilometres travelled and financial reward accumulated (except for T0 and T1 where no financial rewards were offered).

Participants in the experiment were recruited from among those who downloaded the Czech version of UrbanCyclers app from Google Play store (new users), and upon their consent to participate in the experiment they were randomly assigned to one of the treatment arms (i.e. either to one of the treatment groups or the control group). Initially, no specific promotion of the experiment was planned, but due to very low conversion rate observed (i.e. enrolment into the experiment), invitation to download the app and participate in scientific project was posted to several websites and Facebook groups. All the instructions related to the participation in the experiment (along with informed consent) were contained in the app. The ethics of the randomized experiment was approved by Institutional Review Board of Charles University Environment Centre in May 2018. A consent for personal data processing in compliance to General Data Protection Regulation was obtained for both CUNI and Umotional. The financial rewards were paid by CUNI, subject to participant completion of the final questionnaire and providing his/her contact details (including bank account number). All the data collected for the experiment are safely stored on encrypted servers operated on behalf of Umotional and CUNI.

Analytical approach

Our primary goal is to find out whether any of the motivational features induce more commuter cycling. To do so we take the number of *rides* recorded by each participant as the explained variable (i.e. outcome) and the treatment variant as the explanatory variable. As some of the participants may have no commute rides recorded, while others will have more than 20 rides, a model for count data allowing for over-dispersion, such as negative binomial will be used in the analysis.

The basic model equation may be described as:

$$rides = exp(intercept + b_1(treatment = sGam) + b_2(treatment = sGam + fRate) + b_3(treatment = fRate) + b_4(treatment = dRate))$$

where the outcome (i.e. number of rides recorded by participant) is predicted with linear combination of variants of treatment: *sGam* is T1 (smart gamification), *sGam+flRate* is T2 (smart gamification with flat rate financial reward), *fRate* is T3 (flat rate financial reward), and *dRate* is T4 (decreasing block rate financial reward). Taking control (T0) as a reference, we estimate one coefficient for each treatment (*b*'s in the formula). The effects of treatments in the model are additive to the reference, so if any of the coefficients is statistically significant, it captures the effect of this particular motivational feature (or their combination).

9.6 Results

Descriptive statistics

The following table summarizes descriptive characteristics of participants in the experiment. Overall, there is a marked overrepresentation of male participants (63%), with high education (38%) and employed (69%), but this clearly reflects that urban cycling is more frequent among males and we targeted those who commute by bike to work or school. On average, our participant is about 38 years old, lives in household comprising 3 members, one being a child below 18 years.

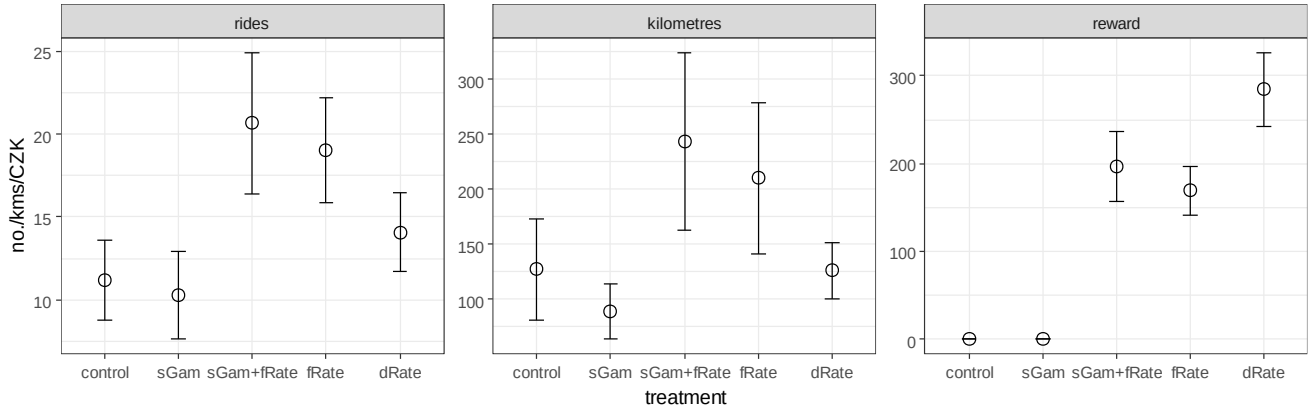
Table 2: Descriptive statistics of study participants (n=482)

Indicator	**mean (SD) or pct.**
Age	37.7 (9.4)
Gender	
- Female	37%
- Male	63%
Education level	
- Low	26.8%
- Middle	35.3%
- High	37.8%
Household size	3.1 (1.2)
Children in household	0.9 (1.0)
Economic activity	
- Employed	69%
- Self-employed	4%
- Student	5.5%
- Other / not disclosed	21.5%
Participation in Bike-to-Work	35.7%

Effectiveness of incentives

The following figure provides summary statistics on the number of rides, total kilometres cycled, and rewards earned per treatment variant. In T1 (smart gamification treatment) mean and median number of rides recorded was 11.2 and 3.5, in T2 (smart gamification with financial reward) 20.7 and 16, in T3 (flat rate financial reward) 19 and 17.5, and in T4 (decreasing block rate reward) 14.1 and 11. In the control group (T0) the mean number of rides was 11.2 (and median 5). The total sum of kilometres cycled to and from work or school during the experiment was the highest in T2 (mean 244 km, median 168 km) and T3 (mean 210 km, median 134 km), and the lowest in the control group (mean 127 km, median 25) and in T1 (mean 88.7 km, median 31 km). The reward earned per participant (relevant in T2, T3 and T4) was the highest in T4 (mean 285 CZK, median 279 CZK), followed by T2 (mean 197 CZK, median 165 CZK) and comparatively lowest in T3 (mean 169 CZK, median 134 CZK).

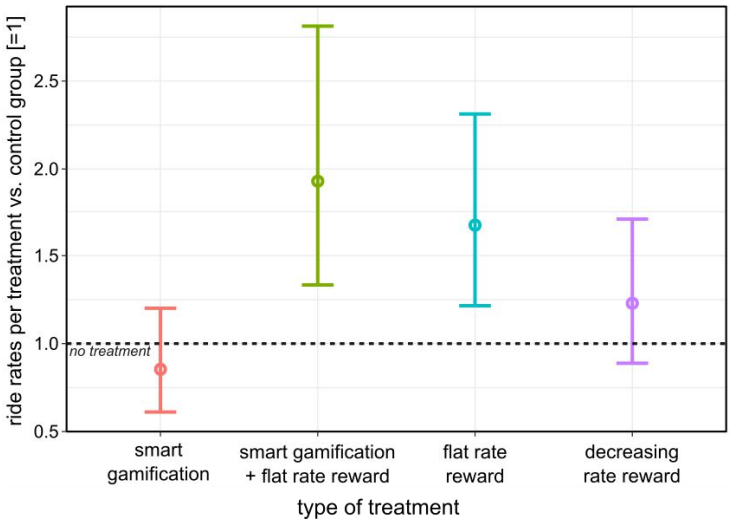
Figure 3: Summary statistics on rides, total length and financial rewards



Note: sGam is T1 (smart gamification), sGam+flRate is T2 (smart gamification with flat rate financial reward), fRate is T3 (flat rate financial reward), and dRate is T4 (decreasing block rate financial reward)

To further analyse the effect of treatments, we estimated a negative binomial regression model described earlier. We explain the number of rides by type of treatment, and we also control for participation in national-wide campaign Bike-to-Work that took place in May 2019 and for about one third of our study participants these engagements partly overlapped. The following figure shows the estimated coefficients along with their 95% confidence intervals to document the effect of treatment vis-à-vis the control group (dashed line at 1). The most effective incentivization is obtained in the treatment with combined smart gamification and flat rate rewards (T2), which has almost doubled the number of commuter cycle rides. Provision of flat rate rewards (T3) is predicted to increase number of rides by two thirds. A provision of decreasing block rate rewards (T4) leads to a small increase the number of rides, but the effect is not statistically significant (on a commonly used 5% level of significance). Finally, smart gamification treatment (T1) is predicted to slightly reduce number of rides compared to no treatment, but again this effect is not statistically significant.

Figure 4: Predicted probabilities of frequency of rides (vs. T0)



9.7 Discussion

This study fits into a growing stream of mHealth research aiming at influencing physical activity and sedentary behaviour. Daily commuting to work (or school) is a prominent candidate for such an intervention that may not only improve one's health but also has a potential to improve liveability of cities by reducing car use and ownership. Using a randomized experimental design, we compare the effects of provision of monetary and non-monetary incentives on frequency of commuter cycling.

We find that small monetary rewards for each kilometre cycled to work (or school) can effectively motivate to significantly increase the frequency of cycling, and combining these rewards with smart gamification may work the same or slightly better. The results presented here are rather illustrative, however, and in subsequent analyses we will expand our model to control for various sociodemographic, socio-economic and other contextual factors that may have influenced the commuting behaviour. Natural candidates include gender, age, family and occupational status, bike availability, biking skills and perceived safety. In order to gain more insight into working of behavioural change, we aim at extending our analysis to account for the behavioural stage-of-change of each participant, and to estimate either separate models for these stages or cluster these stages within one model with latent classes. The advantage of the latter approach is that it may better reflect that stages of behavioural change are not clearly delimited through a joint estimation of treatment effect and class membership probability.

In a broader perspective, our findings corroborate the notion that an effective promotion of active mobility needs a multifaceted endeavour. While we demonstrate how to incentivize more frequent commuter cycling, we also explored what other 'enablers' alleviate this pursuit. Our respondents (as shown in Figure below) indicated that provision of facilities such as showers and dressing rooms at work, better cycling infrastructure and also financial incentives for purchase of new bike increase their likelihood to frequent commuter cycling.

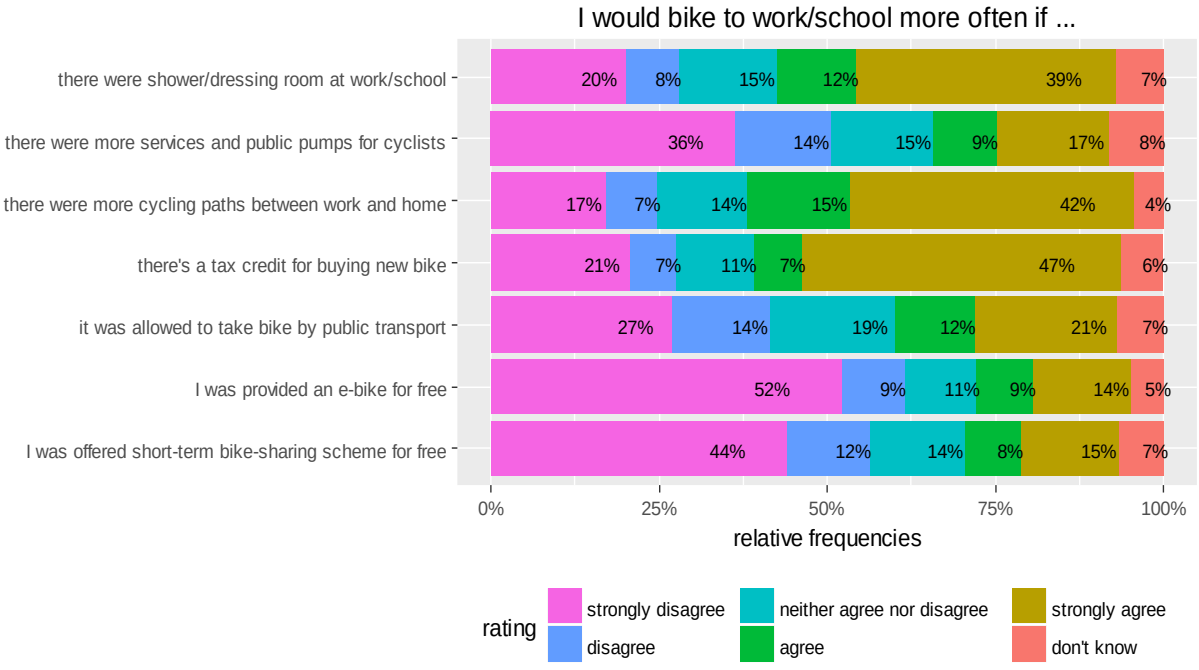


Figure 5: Perceived enablers of more frequent commuter cycling

9.8 Limitations

This case study has naturally its strengths and limitations. Its strength stems from that it follows a rigorous approach of randomized experimental design, and uses convenient and to large extent unobstructive data collection through smart phone app without any need of face-to-face encounter between researchers and study participants.

Yet, the study limitations are also evident – first and foremost, it suffers from limited scope and short duration, so it is not possible to infer any long-term effect (or persistence after incentive cessation). With respect to the sample size, the findings are rather tentative and subject to subsequent more elaborated analyses that will be published in a peer-reviewed paper.

9.9 Learning points for future research

Smartphone-based interventions in public health are still rather novel approach and their potential is not fully developed. While we have demonstrated that it can be used with relatively limited resources for a short period of time, it is crucial to explore long-term consequences of such efforts. Many daily tasks, commuting included, are habitualized and short-term interventions may not break these routines. Also, it would be beneficial to compare alternative modes of intervention delivery (e.g. via social networks or by regular phone calls), especially with respect to effectiveness of targeting low SES groups.

9.10 Learning points for potential scale up and transferability

Thanks to ubiquity and attachment to smartphones, particularly among younger population, it is rather easy to transfer and scale-up such app-based intervention to different cities and/or countries. There is, however, a 'mode-of-delivery' question to consider, i.e. how this can be done most effectively. One way is to use dedicated niche apps (such as UrbanCyclers) and to motivate broader public to install and use them, another is to embed such motivational features to apps already used by large part of population (such as for example Google Maps or Facebook). In terms of transferability to other countries, ability to cycle and bicycle availability might be an obstacle to face, especially among people with lower SES. One option here is to build upon growing availability of shared bikes, and to combine rewards with some form of bike-sharing scheme subscription (or include bike-sharing option into public transport pass). On a more general level, a crucial question for policymakers to resolve is what should be the role of smart 'pull' incentives (such as our incentives for commuter cycling) in the entire policy mix aiming to redesign our urban transport systems into healthy, carbon-free and affordable ones.

10. Eco Inclusion

10.1 Background

Eco Inclusion is an innovative intervention to improve living conditions among refugees in Germany by increasing their knowledge about energy efficiency and waste disposal in the home. This case study differs from most INHERIT case studies in that it reports knowledge among refugees who have attended a training workshop. Knowledge increases capabilities to change behaviours (Michie *et al*., 2011). Knowledge acquired during the workshop potentially enables the participants to create a more energy efficient home environment and save money on heating. At the same time access to energy-saving equipment and/or to individual energy-related counselling in the home environment provides opportunities to put knowledge into practice, thus triggering motivation to change behaviour (Michie *et al*., 2011) for better indoor living conditions. Such improvements may contribute to better health and wellbeing in the longer term (WHO 2009, 2018). Training workshops such as this one might also contribute to self-efficacy and social inclusion. However, these longer-term outcomes cannot be evaluated within the scope of the INHERIT project.

10.2 Overall aims

Eco Inclusion is a peer-based intervention implemented by the city of Pforzheim (Germany) among the population of recognised refugees living in the city. It aims at changing behaviour by: 1) building capacity through raising knowledge on adequate heating, energy saving strategies and recycling-friendly waste disposal; 2) and by enabling refugees to apply strategies thereof and raising opportunities to apply this knowledge through the distribution of energy-saving devices. The objective of the case study is to evaluate the potential of the initiative to raise knowledge about energy consumption and waste disposal, thus contributing to a more sustainable use of energy resources and to close the gap in health between refugees and the local population.

Eco Inclusion established a group of refugees (n=9, from now on referred as “multipliers”) from several ethnic backgrounds who were trained as energy and housing advisors for their peer group of refugees.

The following content was covered in the training: waste management, heating, ventilation, energy saving, being tenants. This theoretical training was complemented by a practical session consisting in two home visits: a first visit was conducted by the trainers’ team in each of the multipliers’ homes. A second visit was carried out by each multiplier in individual homes of refugees. The home visits included a check and documentation of the housing situation in terms of devices used as well as individual advice on energy-efficiency in the home. Additionally, a set of energy-saving devices was provided.

Once the “multipliers” were trained, they trained and provided counselling themselves amongst the target group through group sessions, using standardised written materials and energy-saving equipment (for example different kinds of light bulbs, multiple sockets, timer clock, measuring jug, etc.). In total 11 group sessions were conducted in collective housing facilities for refugees and other settings, for example in a church, an intercultural meeting and coffee house and a municipal family centre. One of these sessions addressed female refugees exclusively. Individual training in the home environment of refugees was also carried out, using the materials and equipment utilised in the group sessions. Finally, two separate group sessions were also conducted in pre-vocational language training classes for young refugees.

Motivation for participation in the intervention was addressed by making both the economic benefits of the knowledge on energy-efficient housing evident to refugees, and by up-skilling peer multipliers. A long-term objective of Eco Inclusion is to support social integration of refugees by reducing the risks

for neighbourhood conflicts and to raise willingness amongst the local population to rent privately owned housing to refugees.

10.3 Context

Between January 2015 and March 2019, the city of Pforzheim was assigned 2,122 asylum seekers and refugees by the Regional Administrative Council in Karlsruhe. However, the number of persons seeking refuge is higher since people who come to Pforzheim through family reunification, for example, are not included in this figure. Further, people who were assigned to other German cities or districts moved to Pforzheim afterwards. At the end of February 2019, the city counted 2,894 persons with recognised status as refugee[30].

The refugees living in Pforzheim originate from countries with a different climate than in Germany (mainly: Iraq, Syria, Afghanistan, Somalia and Eritrea). Different conditions and cultural norms related to the availability, cost, use of energy, and waste management prevail in these countries. As observed in many cases and reported to the Integration Management in Pforzheim, many refugees have trouble coping with facets of living and housing in Germany, in particular with regard to energy consumption and waste disposal. Challenges encountered at the city of Pforzheim are grounded in energy consumption and waste disposal habits that are not adapted to the local housing environment and existing standards. This situation led to sharply increasing expenses for energy use in both collective accommodation facilities and private housing for refugees. Energy costs in collective accommodation are covered by the municipal budget, whereas costs generated in private housing are to be covered by the refugees themselves after the first year. In Germany, estimated costs for heating, water and electricity are usually paid directly on top of the rent in form of an advanced payment to the landlord. Energy related costs often sum up to more than one third of the rent. Differences between estimated and effective energy costs identified at the end of each settlement period can lead to unexpected supplementary payments. Accordingly, high energy consumption costs financially pressurise both the municipal budget and refugees' households, as experienced in the city of Pforzheim. For individuals living in private homes, this increases the risk of homelessness due to potential indebtedness and home evictions, thus worsening the social-economic position of asylum-seekers and refugees.

In addition, inadequate heating and ventilation habits as observed in refugee accommodations increase humidity levels and mould growth associated with health risks, such as risks of respiratory diseases (WHO 2009, 2018). Inappropriate food storage, waste disposal and use of water might lead to the development of an unhealthy environment and an increase in vermin and, as a result, to complaints from and social conflicts with neighbours and landlords as experienced in Pforzheim.

Overall, the housing situation of recognised refugees in Pforzheim is characterised by bad indoor climate, lack of recycling and waste of energy, contributing to local pressures linked to health, equity and sustainability. The Eco Inclusion intervention can thus have indirect co-benefits for health. Improving heating and ventilation habits and installing energy-efficient devices can improve indoor temperatures that support health, while also lowering expenditure on energy and reducing carbon emissions, thus contributing to the INHERIT triple-win (Van der Vliet *et al*., 2018 – see also https://inherit.eu/project/caf/).

[30] Figures provided by the Office for Foreigners of the city of Pforzheim. The indicated number of recognised refugees also include persons who arrived in Pforzheim through family reunification or through moving from other cities.

10.4 Research questions

The aim was to evaluate asylum seekers' knowledge regarding waste disposal and energy (consumption and savings) after participation in a peer-to-peer training opportunity (ex post evaluation).

10.5 Methodology

A survey (hard copy questionnaire) was conducted amongst training participants in a cross-sectional study design. The hard copy questionnaire included 21 items that aimed to measure refugees' knowledge regarding waste management, heating, ventilation, energy savings, and being a tenant. Socio-demographic and socio-economic data were also collected. The questionnaire was piloted within a language course in the city of Düsseldorf; it was translated from German into English, Arabic, Farsi and Tigrinya, which were identified as the most common languages in the specific target group.

As regards the training sessions implemented as from January 2019, the questionnaire was distributed and collected directly on the day of the training by the Integration Manager of the city of Pforzheim responsible for the coordination of Eco Inclusion, who is familiar with the target group. Participants in the training sessions already conducted in November and December 2018 received and completed the questionnaire a few weeks later when the final questionnaire was made available in all required languages. The ethical commission of the medical faculty of the University of Düsseldorf approved this study design (no. 2018-148-ProspDEuA).

For data analysis, all correct answers in the total sample were counted. A rate of 75% correct answers was recognised as acceptable. Results are calculated for the total sample, and stratified by sex, education, duration of stay and type of accommodation. Education was dichotomised into no education versus remaining sample; duration of stay was dichotomised into less than five years versus five years and longer. Type of accommodation was dichotomised into collective housing versus private housing. Group differences were analysed by chi square test ($p < .05$).

10.6 Results

Of 217 participants of the training that took place between November 2018 and end of March 2019, 95 responded to the survey (response rate= 43.7 %). Of those 95 persons, 56 were female, 38 were male (1 missing value). The mean age of respondents was 39 years (10.8 standard deviation). Respondents were mostly from Iraq (n=20), Syria (n=18) and Afghanistan (n=7). Most came in 2015 (n=35) and 2016 (n=15). Living together with the spouse was the most common family status (n=63) and respondents indicated 3 children on average belonging to their household. Respondents were mostly living in privately owned accommodations (n=51) followed by collective asylum seekers accommodations (n=25). Respondents mostly indicated having no (n=26) or elementary school (n=15), having no vocational education (n=61) and having no employment (n=74).

Table 1 shows the percentage of correct answers regarding waste management, heating, ventilation, energy savings and being tenant for the total sample and for sub groups.

In the total sample, more than 75 % of respondents know how to remove newspapers, old carpets, tins, and pizza cartons in tenant facilities. They know how paper, waste glass and electrical waste is removed in municipal facilities. Regarding optimal heating, they have understood that blinds should be closed at night, that heating while windows are open should be avoided and that radiators should not be blocked by furniture. Effective ventilation (cross ventilation)[31] is known by more than 75%. More than three quarters of the sample know about household activities with high water

[31] "Cross ventilation" is a form of wind ventilation which involves wind entering through a vent (or a window or door), and allowing air to flow directly through the house and out through an opening on the other side of the home.

consumption[32]. Finally, they are aware of time periods when tenants should respect quietness in apartment houses (for example quietness periods during the night or on Sundays and public holidays).

Some differences between groups are observed. Comparing men and women, a significantly higher percentage of correct answers is observed among women in two areas: removal of newspapers and position of radiators. Results also differ by education level, with a significantly higher percentage of correct answers regarding heating at night in more educated respondents and a higher percentage of correct answers regarding bulky waste in respondents without education. In refugees with a duration of stay of five years or longer the percentage of correct answers is mostly higher than in the reference group, with significantly higher percentage of correct answers in the area of food leftovers, bulky waste, and ventilation. That heating while windows are open should be avoided is more often known by refugees with duration of stay of less than five years. As far as the type of accommodation is concerned, the results are again not consistent. Participants living in private homes tend to know better how waste is correctly disposed of by the tenant and the municipal services than participants living in collective accommodation. The results for heating and ventilation are mixed. When it comes to energy savings and being a tenant, participants in collective housing facilities are better informed.

[32] For example “bathing and showering” as compared to “washing laundry” and “cooking”.

Table 1: Percentage (%) of correct answers, total sample and by sex, education, duration of stay and type of accommodation

	Total sample	Sex		Education		Duration of stay		Type of accommodation	
		Women	Men	No	Yes	<5 years	≥5 years	Collective housing	Private housing
Waste removal by tenant									
Food leftovers	68.0	73.1	**76.5**	**84.6**	69.7	65.5	***94.7**	70.0	**83.7**
Newspapers	**86.0**	***96.2**	**82.9**	**95.8**	**88.6**	**91.8**	**100.0**	**87.1**	**93.9**
Cigarette ends	59.1	58.8	**75.8**	50.0	70.6	60.3	**77.8**	65.5	66.0
Fruit and vegetable peels	67.7	69.8	**78.8**	72.0	74.3	70.0	**83.3**	74.2	**79.2**
Beverage carton	58.1	68.9	67.6	65.2	70.0	63.6	**88.2**	66.7	72.1
Old carpets	**76.3**	**91.1**	**88.2**	**95.7**	**96.7**	**89.1**	**100.0**	**90.0**	**90.7**
Tins	**77.4**	**88.0**	**90.3**	**96.0**	**87.5**	**85.7**	**94.7**	**96.4**	**87.2**
Ashes	60.2	69.2	71.4	69.6	67.7	64.3	**82.4**	74.1	69.6
Pizza carton	**89.2**	**96.3**	**93.9**	**100.0**	**90.9**	**96.6**	**94.7**	**90.3**	**98.0**
Waste removal by municipal services									
Paper	**83.9**	**90.4**	**91.2**	**96.0**	**94.1**	**90.0**	**100.0**	**90.0**	**91.7**
Waste glass	**89.2**	**92.6**	**97.1**	**96.2**	**88.6**	**91.8**	**100.0**	**93.8**	**93.8**
Bulky waste	69.9	**82.7**	68.8	**95.8***	67.6	70.0	***94.1**	72.4	**85.1**
Electrical waste	**81.7**	**81.5**	**94.1**	**96.0**	**88.6**	**90.2**	73.7	**76.7**	***94.0**
Heating									
Optimal room temperature	65.6	73.6	61.1	65.4	64.7	66.1	**77.8**	50.0	***77.6**
Heating of unused rooms	43.0	50.0	37.1	50.0	48.5	38.7	61.1	51.5	44.9
Blinds/curtains closed at night	**91.4**	**94.4**	**94.4**	**88.5**	***100.0**	**93.7**	**94.4**	**90.9**	**98.0**
Heating while windows open	**79.6**	**81.5**	**83.3**	69.2	***97.1**	**88.9***	55.6	**90.9**	**75.5**
Room position of radiators	**93.5**	***100.0**	**91.7**	**96.2**	**94.1**	**95.2**	**100.0**	**97.0**	**95.9**
Ventilation									
Daily ventilation	67.7	70.4	71.4	69.2	66.7	67.7	**88.9**	**75.8**	72.9
Ventilation and mould	74.2	74.1	**85.3**	**84.6**	**75.0**	70.5	***100.0**	**78.8**	**83.3**
Ventilation in winter	74.2	**78.8**	**80.0**	**76.0**	**84.8**	**78.7**	**88.2**	**78.1**	**80.9**
Ventilation in summer	71.0	**79.2**	70.6	69.2	**81.3**	**75.0**	**77.8**	69.7	**83.0**
Effective ventilation	**83.9**	**89.1**	**80.6**	**92.3**	**85.3**	**82.5**	**100.0**	**84.8**	**88.2**
Energy savings									
Devices with high energy consumption	74.2	**82.4**	**75.0**	**80.0**	**82.4**	**77.4**	**87.5**	**84.8**	**76.6**
Household activities with high water consumption	**75.3**	**82.4**	**84.8**	**87.5**	**81.3**	**82.0**	**81.3**	**87.5**	**80.4**
Being tenant									
Composition of rental fee	71.0	**85.4**	69.4	**83.3**	**78.8**	**79.7**	70.6	**81.3**	**76.6**
Quietness periods	**79.6**	**80.0**	**85.7**	**88.5**	**88.2**	**83.9**	**84.2**	**84.8**	**78.0**

Bold characters: ≥ 75% of correct answers; *) $p < .05$ in group comparison

10.7 Discussion

Our aim was to study what asylum seekers know regarding waste disposal and energy (consumption and savings) after participation in the peer-to-peer training. Based on our sample we see that the issues of waste removal by municipal services seem to have been communicated rather effectively. Regarding waste removal by the tenant, heating, energy savings and being a tenant results are mixed. For some questions fewer than 75 % of respondents knew the correct answers, for example, for questions about removal of food leftovers, cigarette ends, fruit and vegetable skins, beverage carton and ashes as well as optimal room temperature, heating of unused rooms, devices with high energy consumption and composition of rental fee. Finally, information about ventilation has not reached a sufficient percentage of the target group. Since heating and ventilation are important and costly aspects, both for tenants and landlords, and highly relevant for a healthy indoor environment, there is a need for focusing on this aspect, by, for example: 1) developing more effective knowledge communication strategies; and/or 2) reviewing the content of the delivered training.

Group comparisons show that women did not seem to systematically benefit from the intervention to a higher degree as compared to men, the same was observed regarding refugees with education as compared to refugees without education. The consistently higher percentage of correct answers in refugees that have been living in the city for five years or longer could partly be explained by natural learning process over time implying decreasing language barriers and rising knowledge about the living environment. The fact that participants in private homes are less well informed about energy savings and being a tenant than participants in collective housing facilities is counterintuitive and could be problematic, especially in view of the cost aspects.

The study sample includes individuals that mostly live in family groups and in privately owned accommodation. This has the implication that behaviour (change) related to waste management and energy consumption is even more relevant to these individuals as the control or supervision that are inherent to collective housing facilities does not take place in private settings. At the same time the sample consists of people with a low socio-economic status, both in terms of education and occupational status. This has two further implications: firstly, it points to the importance of implementing communication and knowledge transfer strategies and materials for less formally educated participants. Secondly, the precarious financial situation of the target group stresses the necessity of the competence to save energy and, thus, money.

10.8 Limitations

It is important to acknowledge that the study has several limitations. Firstly, the study sample is small. Thus, the descriptive analysis was stratified only along four demographic variables such as sex, education, duration of stay and type of accommodation. It has not been studied how far results differ taking into account external factors such as the multipliers, potential variations in the content of the training provided or participation in group or individual training.

Secondly, since the characteristics of non-respondents are not known, it is not possible to assert if the sample is representative and to which extent estimates are correct. If persons who are particularly deprived or feature an important lack of education or literacy did not respond to our survey, it might be that we overestimated the knowledge regarding waste management and energy use that has reached the target group. This is the case for illiterate individuals who participated in the training (about 10%) but did not fill in the paper-pencil-questionnaire.

Thirdly, due to the cross-sectional study design, we cannot be sure that asylum seekers knowledge is the effect of the training. It could be that the study participants had gained knowledge about energy use and waste disposal in Germany from other sources, e.g. from participation in integration and language courses that partly cover the topics, before taking part in the intervention. However, since there has been no systematic and comprehensive introduction into the issues of waste disposal and energy consumption in asylum seekers accommodations in the city of Pforzheim, we therefore assume that the knowledge has been acquired in the frame of the peer training.

To our knowledge, this is one of the first attempts to analyse what asylum seekers know regarding waste disposal and energy after participation in the peer-to-peer training. Likewise, we assume that Eco Inclusion constitutes one of the first peer-based interventions for transferring knowledge on waste disposal and energy use to the target group of refugees.

10.9 Learning points for future research

Regarding refugee populations, future research needs to develop evaluation methods that are more sensitive towards low formal education and takes into account language barriers as well as illiteracy in the target group. In this respect the development of methods based on verbal evaluation and/or pictograms might need to be explored.

In order to evaluate the effects of the training taking into account external variables, a prospective cohort design involving two measurement points and a control group should be developed. This, however, requires a larger study sample and innovative methods to follow up a population that is more likely to change residence due to the nature of its residence status.

Knowledge is an essential pre-requisite to behaviour change (Michie *et al*., 2011). It could also be useful, however, to assess preconceptions and attitudes towards energy-efficiency and waste disposal among the refugee population to better evaluate the potential of the intervention to trigger behaviour changes. This would require the development of evaluation methods and tools for measurement of attitudes adapted to the specificities of the target group.

Finally, it would be useful to include more objective outcomes such as energy bills and health parameters in the context of heating and ventilation in order to measure the effects of the intervention on behaviour (change).

10.10 Learning points for potential scale up and transferability

The peer-to-peer training seems a promising approach for raising awareness and increasing knowledge among refugees about waste disposal and energy consumption. The interest in Eco Inclusion expressed by two other municipalities of the state of Baden-Wurttemberg that approached the city of Pforzheim to establish cooperation for the implementation of peer-based awareness raising interventions in their local settings testify to the need and relevance of this approach. However, since no published interventions using the peer-approach to train refugee populations on energy-efficiency could be identified, evidence seems to be limited regarding the implementation and success factors of such interventions.

Nevertheless, peer-to-peer trainings or paraprofessional counselling have already been established and partly evaluated in the context of primary (psychosocial) care (Kieft *et al*., 2008) as well as in prevention and health promotion towards migrants and refugees (Walter *et al*., 2007; Ramazan & Weyers 2010; KgC 2018). In view of a potential transfer or scaling up of Eco Inclusion, experiences made in the

implementation of these interventions could be used to further develop or adapt the intervention process, the methodology and the content of the training sessions on energy efficiency and waste disposal. Likewise, lessons learned from the evaluation process of these interventions might be transferred to initiatives like Eco Inclusion focusing on energy-efficiency. Consequently, cooperation between these various interventions and the use of synergies on aspects linked to health-related effects of energy use and waste disposal might prove beneficial for transfer or scaling up.

11. References

Introduction

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