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Living Labs impact at the district level

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Partner organisations

No.	Name	Short name	Country
1	Rheinisch-Westfaelische Technische Hochschule Aachen	RWTH	Germany
2	Stadt Dortmund	DORTMUND	Germany
3	Comune di Torino	COTO	Italy
4	Grad Zagreb	ZAGREB	Croatia
20	Fundacion Privada Instituto de Salud Global Barcelona	ISGLOBAL	Spain
21	Università degli Studi di Torino	UNITO	Italy
22	Consiglio Nazionale delle Ricerche	CNR	Italy
24	Università degli Studi di Bari Aldo Moro	UNIBA	Italy
25	Fachhochschule Suedwestfalen	SWUAS	Germany
33	The Forestry Bureau of Ningbo City (FBNC), City	FBNC	China (People's Republic of)
34	Institute of Urban Environment, Chinese Academy of Sciences	IUE-CAS	China (People's Republic of)

Abbreviations

BMI:	body mass index
CD:	control district
Dx.x:	deliverable
EC:	European Commission
ES:	ecosystem services
FC:	Follower City
FRC:	Front-Runner City
GA:	Grant Agreement
GI:	Green Infrastructure
GIS:	geographic information system
GLMM	generalized linear mixed models
GQ:	general questionnaire
HIA:	Health Impact Assessment
KPI:	key performance indicator
LL:	Living Lab
MET:	metabolic equivalent time
NBS:	nature-based solutions
NDVI:	Normalized Difference Vegetation Index
NGO:	non-governmental organization
proGInreg:	productive Green Infrastructure for post-industrial urban regeneration
SME:	small and medium enterprise
VSL:	Value of Statistical Life
WP:	work package

Executive Summary

The project entitled “productive Green Infrastructure for post-industrial urban regeneration (proGReg)” implemented eight different types of nature-based solutions (NBS) in post-industrial sites of four different cities (called front runner cities - FRC). The implemented NBS are rather local on spatial scale, but, in every FRC, they are networked within a Living Lab (LL) vision that engages a single district. One of the main goals of the project was to assess the benefits produced by the implemented NBS. In the present deliverable, the proGReg impact assessed at the district scale by the LL approach is presented.

To obtain an overview as comprehensive as possible of the benefits produced by the implemented NBS, four domains have been explored, to assess: 1) socio-cultural inclusiveness; 2) increased health and well-being; 3) ecological and environmental restoration; and 4) economy and labour market benefits.

According to the experimental approach described in the Monitoring and Assessment Plan (Deliverable 4.1 – D4.1), district scale key performance indicators (KPIs) are calculated, in compliance with the guidelines described in the Handbook elaborated by the NBS Impact Evaluation Taskforce of the European Commission. For the calculation of the KPI, data have been obtained from geographic information system (GIS)-derived databases, and from a general population survey implemented in proGReg, called the General Questionnaire (GQ).

A negligible impact has been assessed at the district level in term of environmental benefits and improved walkability, likely due to the very spotted size of the NBS interventions and to the substantially unchanged land use in the LL. However, a net positive improvement has been assessed for the perceived social inclusiveness, human health, and economic situation of the residents of the LL districts from 2019 to 2022, as compared to the residents of a comparable control district. We cannot include such results into a direct cause-effectiveness relation with the proGReg implementations, but it more likely demonstrates that a general positive impact on socio-economic aspects is obtained by the LL approach, and by the interest devoted to the selected district by the municipalities, in general.

This document represents a key deliverable for Work Package 4 (WP4 - “NBS benefit assessment and monitoring”).

1. Introduction

1.1. Introduction to the project

Productive Green Infrastructure for post-industrial urban regeneration (proGReg) is developing and testing nature-based solutions (NBS) co-creatively with public authorities, civil society, researchers and businesses. Eight nature-based solutions, which will support the regeneration of urban areas affected by deindustrialisation, were deployed in Dortmund (Germany), Turin (Italy), Zagreb (Croatia) and Ningbo (China). The cities of Cascais (Portugal), Cluj-Napoca (Romania), Piraeus (Greece) and Zenica (Bosnia and Herzegovina) received support in developing their strategies for embedding nature-based solutions at local level through co-design processes.

1.2. Introduction to the deliverable

The NBS implemented during proGReg aimed at achieving several benefits, in different fields of interest. Work Package (WP) 4 of proGReg is devoted to the assessment of the benefits produced by these implemented NBS. WP4 is a collaborative action involving local authorities, the civic sector, small-medium enterprises (SMEs), and research institutes, with the aim of providing a significant and comprehensive evaluation of NBS, which ultimately can be translated into informed policies and targeted interventions aimed at promoting healthy, equitable, sustainable, and economically thriving urban environments.

NBS-produced benefits' evaluation has proceeded as a multi-steps process, described in detail in the D4.6 – Guidelines for Upscaling¹, among which the most important are:

- Identification of the assessment domains;
- Identification of the spatial and temporal scales of interest;
- Identification of significant key performance indicators (KPIs) and related methods;
- Data collection;
- Indicators' assessment and impact evaluation.

The first three steps of this process have been firstly described in the project Monitoring and Assessment Plan (Deliverable 4.1; D4.1)², being developed in line with the guidelines described in 2017 by the EKLIPSE – Expert Working Group on NBS evaluation³. However, in 2021, based on the experience gained by the H2020 NBS projects, including proGReg, the NBS Impact Evaluation Taskforce of the European Commission (EC) released the Handbook

¹ Ristorini, M., Baldacchini, C. (2022): Guidelines for upscaling, Deliverable No.4.6, proGReg. Horizon 2020 Grant Agreement No 776528, European Commission, 68 pp.

² Baldacchini, C. (2019): Monitoring and Assessment Plan, Deliverable No. 4.1, proGReg. Horizon 2020 Grant Agreement No 776528, European Commission, 124.

³ Raymond, B. et al. (2017) An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects. Report prepared by the EKLIPSE Expert Working Group on Nature-based Solutions to Promote Climate Resilience in Urban Areas. Centre for Ecology & Hydrology, Wallingford, United Kingdom.

entitled “Evaluating the impact of Nature-Based Solutions”⁴, which presents the most updated knowledge in the field. Thus, the proGReg benefit monitoring and impact evaluation strategy has been adapted to match with these new guidelines, as described in the D4.5 - Report on benefits produced by implemented NBS⁵.

In particular, 12 key societal challenge areas are identified in the Handbook (Figure 1):

1. Climate Resilience
2. Water Management
3. Natural and Climate Hazards
4. Green Space Management
5. Biodiversity Enhancement
6. Air Quality
7. Place Regeneration
8. Knowledge and Social Capacity Building for Sustainable Urban Transformation
9. Participatory Planning and Governance
10. Social Justice and Social Cohesion
11. Health and Well-being
12. New Economic Opportunities and Green Jobs

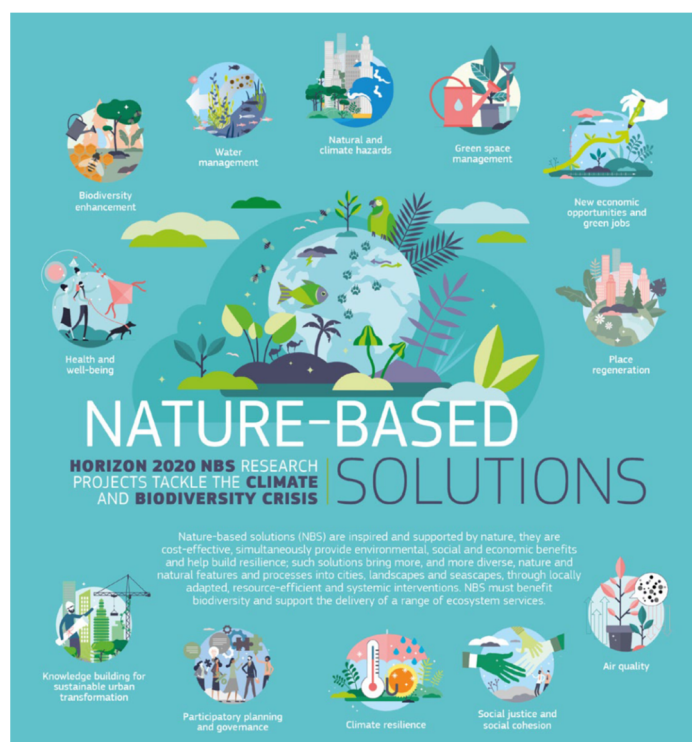


Figure 1. Key societal challenge areas identified in the Handbook realized by the EC NBS Impact Evaluation Taskforce (reprinted from Ref. 4 - image © European Union, 2021).

⁴ Evaluating the impact of nature-based solutions: A handbook for practitioners, A. Dumitru and L. Wendling Eds, European Union (2021).

⁵ Baldacchini, C. (2021): Report on benefits produced by implemented NBS, Deliverable No.4.5, proGReg. Horizon 2020 Grant Agreement No 776528, European Commission, 146.

For each of the identified societal challenge areas, a list of useful KPIs (i.e., measurable parameters that demonstrate how effectively an NBS is producing benefits) is reported in the Handbook, with detailed methodology⁴. To provide a holistic description of produced benefits and ensure comparability, per each area, a few indicators are listed in the Handbook as “Recommended”: these are the indicators that, when possible, each NBS Horizon 2020 project should assess. A further long list of “Additional” indicators is also provided, to match specific project needs.

Within this framework, the four assessment domains identified as priorities for the NBS implemented in proGReg by D4.1² (Figure 2) match the above-mentioned societal challenge areas as follow:

- “Socio-cultural inclusiveness” mainly relates to areas 8,10 and 11;
- “Human health and wellbeing” matches area 4 and 11;
- “Ecological and environmental restoration” includes areas 1, 2, 4, 5, and 6;
- “Economic and labour market benefits” matches area 12.



Figure 2. ProGReg assessment domains (image © ICLEI).

Per each domain, there was a corresponding Task in WP4, handled by a proGReg scientific partner having a clear expertise in the related field. Namely:

- **Task 4.1: Assessing socio-cultural inclusiveness, led by UNIBA** - The available studies indicate a profound and multifaceted connection between nature and social impact⁶. Exposure to natural environments, such as parks and green spaces, has been linked to improved mental health, reduced stress, and a sense of well-being. These benefits, in turn, contribute to stronger

⁶ Arbuthnott, K. D. (2023). Nature exposure and social health: Prosocial behavior, social cohesion, and effect pathways. *J. Environ. Psychol.*, 90, 102109.

community cohesion and increased physical activity, addressing issues like anxiety, depression, and obesity. Moreover, environmental education programs enhance cognitive development, nurturing environmental responsibility. Additionally, nature-based tourism and outdoor recreation boost the economy and provide jobs. These findings highlight the pivotal role of nature in shaping our society and well-being. This task is aimed at assessing indicators of socio-psychological benefits, such as connectedness to nature, mindfulness, social interaction and cohesion, and perceived restorativeness of NBS, in the LL district citizens and among the users of specific NBS. Moreover, the liveability of the LL district has been assessed by the Walkability Index, an objective measure of how much a particular area is more or less likely to be walkable by people. It provides additional information on the urban structure of a city and districts.

- **Task 4.2: Increased human health and wellbeing, led by ISGLOBAL** - Previous evidence has shown an association between exposure to greenspace and improved physical and psychological outcomes, including cardiovascular health stress levels and cognitive functioning⁷. However, the knowledge on the public health benefits that new nature solutions in urban settings (such as providing access to a riverbank, or a new park) may provide still deserve a strong interest. The evaluation of the NBS implemented in proGReg allowed to estimate the potential health and wellbeing benefits. The collected data has provided indicators on general health, mental health, well-being, lifestyle habits, and physical activity of the LL district general population, and time spent in and perceived quality and satisfaction of the NBS, among NBS users. Additionally, the number and demography of visitors and their physical activity levels in the surroundings of the implementation sites is assessed. For those indicators on which there was a significant effect of the implementation of the NBS in the LL, Health Impact Assessment (HIA) was applied to estimate the health benefits at city level. HIA can be used to upscale the findings by estimating the health effects of different scenarios (such as the implementation of the NBS in all districts of the city).
- **Task 4.3: Ecological and environmental restoration, led by CNR** - Green Infrastructures (GI), provide to citizens several environmental services thanks to the interactions that establish with the surrounding environment⁸. At global scale, there are direct and indirect interactions with the carbon biogeochemical cycle. GI can directly remove carbon dioxide (CO₂) from the atmospheric pool and, thanks to temperature regulation, the energy demand can be reduced. At local scale, the major benefits are related to air quality and microclimate regulation and to biodiversity enhancement. Indeed, GI impacts air pollution formation and deposition by removing oxides and other secondary pollutants as ozone through stomata and particulate matter (PM) by wet and dry deposition on leaf surfaces, while providing at the same time suitable habitats for plant and animals. This task aimed at assessing the impact of proGReg approach on the greenness of the LL districts, while several environmental benefits related to the above-mentioned ecosystem services (ES) are assessed at the NBS level. Finally, the environmental impact over their whole life cycle of NBS implementation including innovative technologies for the sustainable use of natural resources, such as soil regeneration and aquaponics, has been evaluated.
- **Task 4.4: Economic and labour market benefits, led by SWUAS** - Extensive research has shown that expanding GI in cities and wider metropolitan areas is accompanied by multiple direct and indirect economic and labour benefits⁹. Effects such as increased real estate values,

⁷Jimenez, M. P. et al., (2021) Associations between Nature Exposure and Health: A Review of the Evidence. *Int. J. Environ. Res. Public Health*, 18, 4790.

⁸ Pereira, P. and Baró, F., (2022) Greening the city: Thriving for biodiversity and sustainability, *Sci. Tot. Environ.* 817, 153032.

⁹ Shakya, R. et al., (2021) A Synthesis of Social and Economic Benefits Linked to Green Infrastructure, *Water* 13, 3651.

new commercial initiatives, new (and frequently green) job opportunities and new business opportunities, among others, are all possibilities when implementing NBS in a city. This task aimed to quantify the economic and labour market (co-)benefits of the project's NBS implementations in the FRC, both in the general district population and among the users of specific NBS implementations.

The Task responsible partners oversaw planning the monitoring activities, training the data collectors, and analysing data. Local partners (coordinated by the FRC) were responsible for data collection. The coordination of the WP4 activities was overseen by CNR. A graphical representation of the partners involved in WP4 is shown in Figure 3.

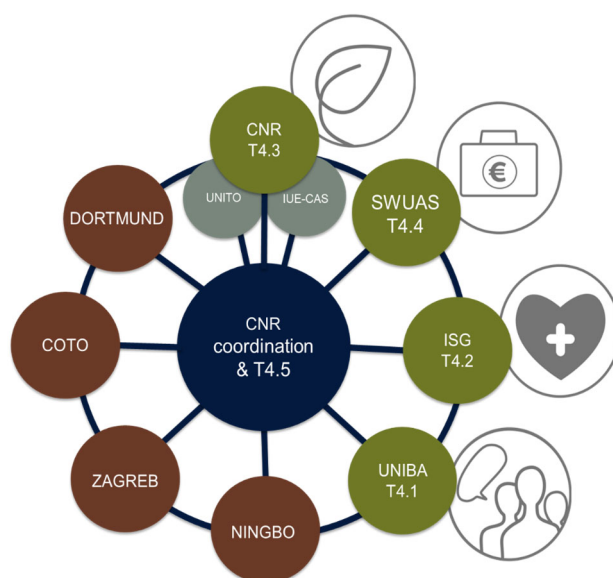


Figure 3. WP4 partners. Task responsibilities are highlighted, together with the corresponding assessment domains, represented by icons (image © ICLEI).

Per each assessment domain, the leading scientific partners have identified the spatial and temporal scales of interest², and the protocols of measurements¹⁰. The impact of the implemented NBS has been mainly assessed at the local (i.e., NBS) scale, as described in D4.9 “Living Lab impact at the NBS scale”¹¹. However, the NBS interventions being networked within a Living Lab (LL) that engages an entire district, the impact at the LL district scale has been also evaluated, and this is discussed in the present deliverable.

KPIs in agreement with the European evaluation framework⁴ have been assessed at the LL district scale for the four FRC in proGReg. Specifically, geographic information system (GIS)-derived data have been used to calculate KPIs, mainly on a yearly base, all along the project, to assess potential benefits on social and environmental aspects by the LL approach (Chapter 3). Additionally, social, health and economic benefits at the LL district scale have been assessed by experimental data collected, in a pre/post-implementation and treatment/non-treatment design, with 36-months delay, through a general population survey,

¹⁰ Baldacchini, C. (2019): Protocols of Measurements, Deliverable No.4.3, proGReg. Horizon 2020 Grant Agreement No 776528, European Commission, 39 pp.

¹¹ Baldacchini, C. (2023): Living Labs impact at the NBS level, Deliverable No.4.9, proGReg. Horizon 2020 Grant Agreement No 776528, European Commission, 86 pp.

called the “*General Questionnaire*” (GQ), whose results are reported in Chapter 4. A wrap-up of the observed impact results is presented in the last Chapter of this deliverable.

2. Collection of demographic data

A descriptive overview of the four post-industrial districts selected by proGReg, and of their changes during the proGReg project duration, has been obtained by collecting a set of 47 spatial data from existing administrative databases, both at the LL district and at the city scale, from 2018 to 2022, on a yearly base. The full list of collected indicators is reported in Annex 1. The raw collected data are available on the proGReg data platform (www.progiredata.eu), to make them available beyond the project to users from outside the project, in an open-data perspective.

Most of the collected data represent intervening variables, or covariates that could provide information about the changes occurred in the LL when compared to the whole city, as well as to develop comparisons among the cities, or that can be useful in an upscaling perspective¹, such as: total population, population density, migration rate, diversity statistics, educational attainment, recreational or cultural facilities, public housing, density of the built environment, green space per capita, gross state product per capita, employment rate, or number of tourist.

It is worth noting that the first version of this dataset, compiled according to research partners’ suggestion, in order to have a dataset as comprehensive as possible over the four assessment domains, was composed by 69 values⁵. However, some of the requested data were not available in administrative databases, or were of difficult evaluation, or differently evaluated in the national datasets. Thus, this reduced list can be intended also as a guideline concerning what reasonably can be obtained from local administrations in terms of cross-national spatial administrative data of interest. However, some parameters have been anyhow difficult to be obtained (or to be obtained for the period relevant to the project implementation and with the required spatial/administrative units/subdivision), despite being needed for HIA, such as population health data and air quality data. This further prevented obtaining the calculation of relevant KPIs at the district scale, previously planned⁵.

3. Spatially explicit KPIs from GIS data for the evaluation of social and environmental impact

Starting from GIS-derived data, the Walkability index and the Normalized Difference Vegetation Index (NDVI) of the LL districts have been obtained. They are both KPIs included as “Additional” in the European framework⁴, related to the societal challenge area 4 – Green Space Management as “8.37 – Walkability” and “8.2 - Annual trend in vegetation cover in

urban green infrastructure". Walkability index and NDVI are delivered as .tif file in the proGReg data platform (www.progiredata.eu).

3.1. Walkability index calculation and analysis

The Walkability index expresses the likelihood that a particular area will be walked by people, and it is thus connected both with well-being increasing (since walking increases health) and with green areas accessibility. It provides useful information on the urban structure of a city and, in turn, of individual districts¹². For example, it can be useful to assess the effects of land use changes (pre/post intervention). The Walkability index is not related to individuals' preferences but mainly to their needs since GIS data used for the calculation of Walkability does not include cycling paths or pedestrian areas (see below). For example, highly populated areas or city hotspots (e.g., city centre) have generally higher Walkability than urban parks. Under an urban planning point of view, it can be used to make a more efficient choice on the location of a new NBS. Additionally, the Walkability index can be an important mediator when analysing the direct and indirect pathways between the presence of nature-based solutions and indicators of socio-cultural inclusiveness.

Data used for the Walkability index calculation includes population density map; road network; public transit (including stops and routes); land use and zoning: residential, commercial and office, industrial, institutional (e.g., schools, libraries, kindergartens), green/park area, and water and wetland; and digital elevation model. In general, for the calculation of the Walkability index, we followed the method developed by Fan et al. (2018)¹² although we used a buffer of 300 m as opposed to the 500 m used in the study. This makes it possible to record limited land use changes such as those generated in the LL districts.

Data needed for the calculation of Walkability at the LL district scale (shape files) have been provided by Zagreb, Dortmund, Turin and Ningbo FRC and the Walkability has been calculated for the LL districts of the previously listed cities before (2018) and after (2022) the NBS interventions, without observing any change, as there were no substantial changes in land use between the considered years as a consequence of the proGReg LL approach, due to reduced size of the NBS interventions. The Walkability maps obtained for 2018 are shown in Figure 4. Values of Walkability can range from 0 to 1, where 1 represents a heterogeneous urban situation where all the land use categories are equally present. In contrast, a value of 0 indicates that only one land use category is present.

¹² Fan, P. et al. (2018), Walkability in urban landscapes: a comparative study of four large cities in China. *Landscape Ecol.* 33, 323–340.

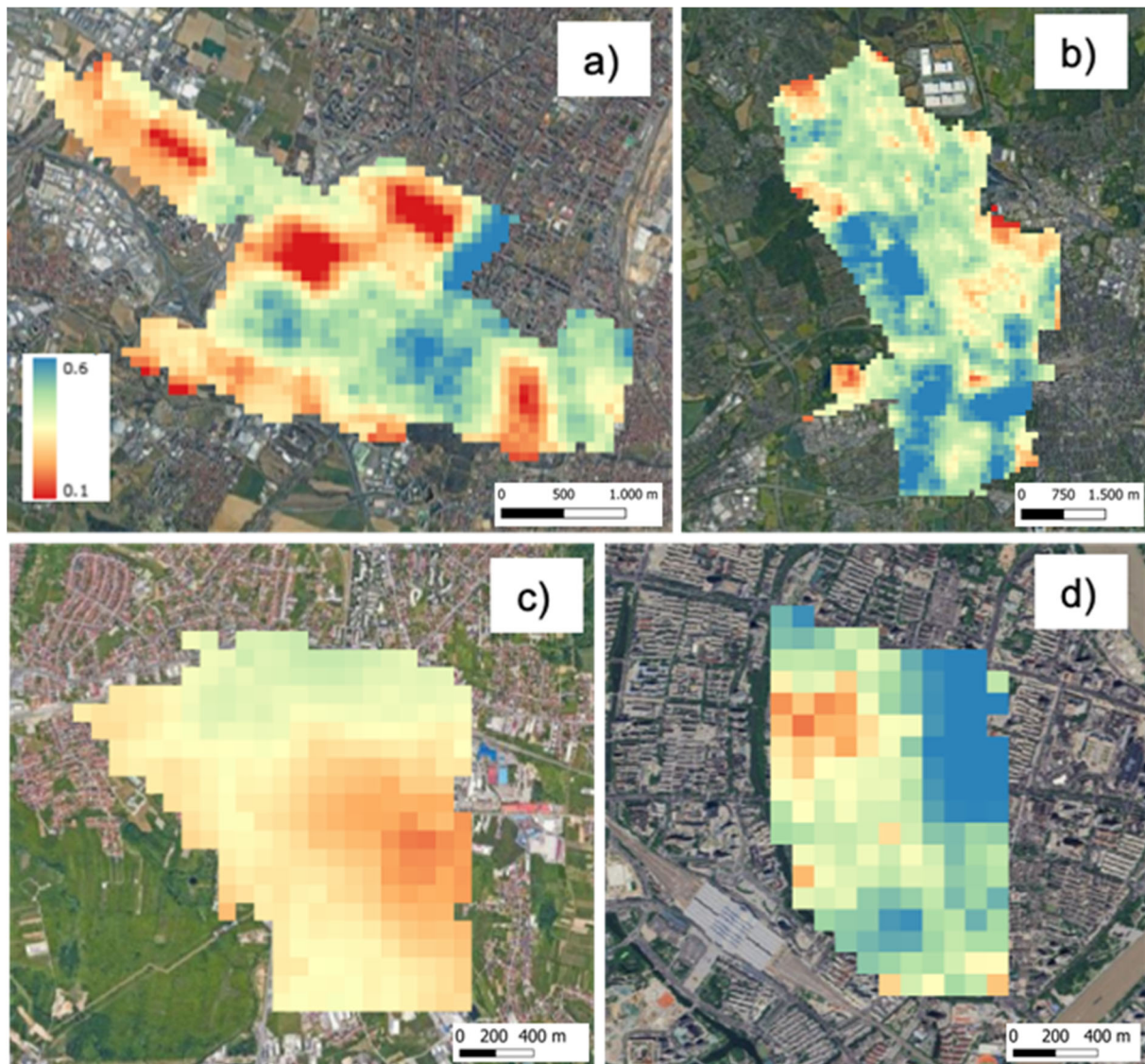


Figure 4. Walkability index calculated at the Living Lab district level for Turin (a), Dortmund (b), Zagreb (c) and Ningbo (d) in 2018.

The Walkability layer was further analysed at the NBS level, by calculating the corresponding value for each NBS intervention from the proGlgreg project located in Turin, Zagreb, Dortmund, and Ningbo LL district (Table 1; the names of the NBS in the Table refer to their typology, as described in D4.9¹¹). In terms of Walkability, we noticed some differences between cities. The NBS located in Dortmund were all positioned in places with good Walkability scores, generally higher than the mean district one. Although the LL area of Turin had a low mean Walkability, also in this case the NBS interventions were generally located in high Walkability areas. This reflects the high suitability of the site selected in Dortmund and Turin for the NBS implementation, in a perspective of use maximization. The opposite is true for Zagreb where the Walkability score for the district were higher compared with the scores in the NBS areas. Ningbo represents a special case, since here the NBS is realized along the shores of an urban lake, which is the reason of its low Walkability value.

Table 1. Mean Walkability scores for the NBS implemented in Front Runner Cities, compared with the mean Walkability score at the LL district level, in 2018. When more than one implementation per NBS type is present in the same city, the average position has been considered for this analysis. The names of the NBS in the table refer to their typology, as described in D4.9¹¹.

NBS location	Dortmund	Ningbo	Turin	Zagreb
NBS1	0.46			
NBS2			0.32	
NBS3	0.54	0.38	0.47	0.27
NBS4	0.44			0.27
NBS5			0.39	0.27
NBS6			0.59	
NBS8	0.58		0.49	
Mean Walkability LL district	0.45	0.46	0.36	0.32

3.2. Normalized Difference Vegetation Index (NDVI) calculation

NDVI is a simple index, derived from multispectral remote sensing data, expressing the vegetation health status¹³. Here we adopted the index to assess the annual trend of vegetation cover in urban GI for each FRC. To this aim, we calculated NDVI at city, LL district and single NBS level, for every year starting from 2018 to 2022.

We used Google Earth Engine to select a series of radiometrically and atmospherically corrected Sentinel 2 images (Sentinel 2 level 2A, ESA Copernicus project) for each year of interest. After masking out clouds and shadows using the “Sentinel-2: Cloud Probability” layer (ESA Copernicus project), we calculated the NDVI for each image and then obtained a mosaic composed by the median yearly NDVI value for each pixel. Zonal statistics were calculated over the city and the LL district to provide useful insight on the spatial distribution of NDVI across the FRC. The NDVI calculated for Turin, Dortmund, Zagreb, and Ningbo at LL district level in 2018 is reported as an example in Figure 5. When the NDVI value is around 0, it suggests the presence of artificial surfaces or very low-density vegetation. As the NDVI value increases from 0 to 1, there is a corresponding proportional increase in

¹³ Pettorelli, N. et al. (2005). Using the satellite-derived NDVI to assess ecological responses to environmental change. *Trends in ecology & evolution*, 20, 503-510.

vegetation density. Higher values within this range imply healthier and denser vegetation cover.

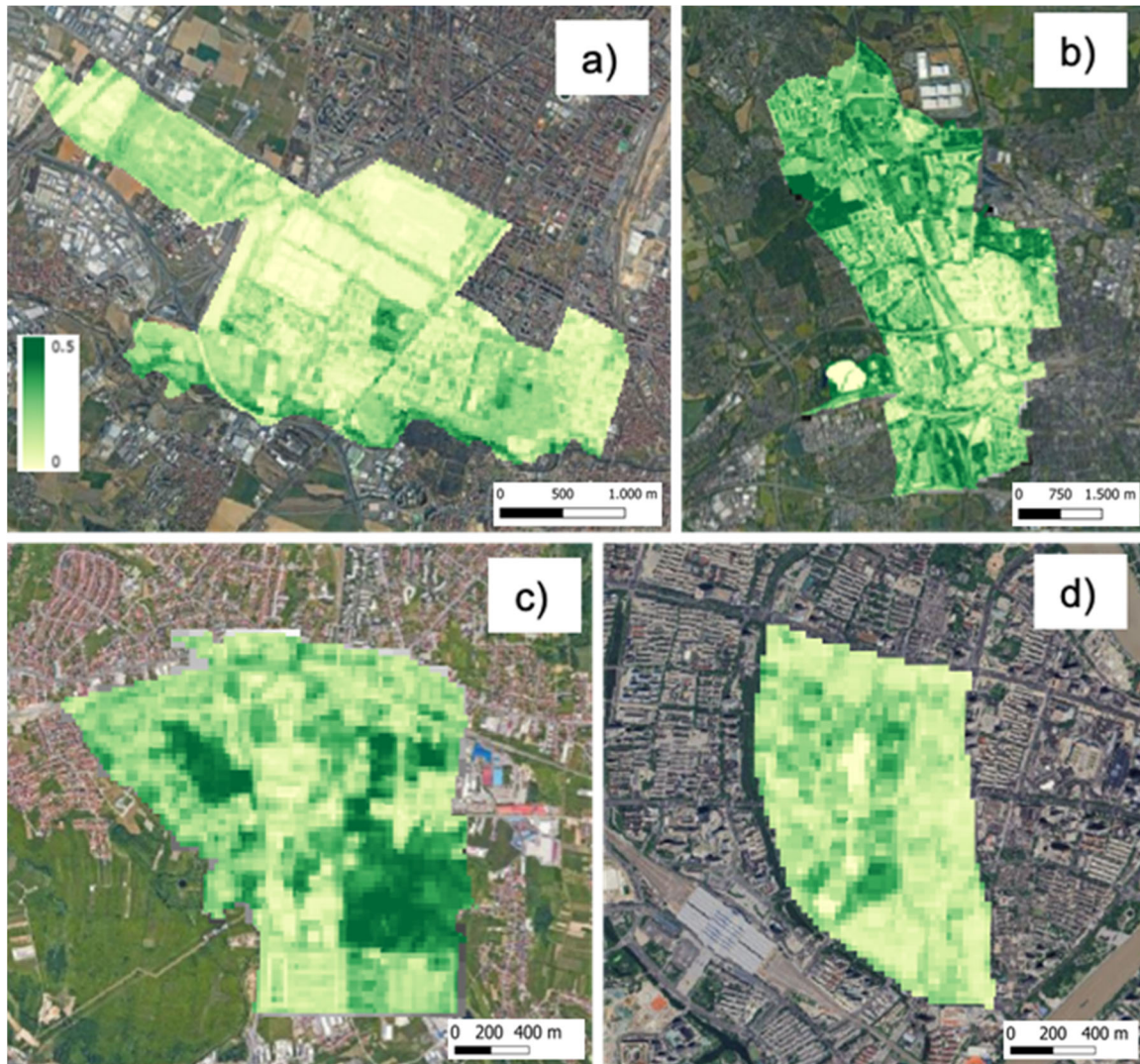


Figure 5. NDVI calculated at the Living Lab district level for Turin (a), Dortmund (b), Zagreb (c) and Ningbo (d) in 2019.

The yearly NDVI data at city level and LL district level was further used to extract the NDVI index through time for all the FRCs, also compared with the NDVI calculated in correspondence of the NBS interventions (Figure 6; the names of the NBS in the figure refer to their typology, as described in D4.9¹¹). The time series show that LLs generally have a lower NDVI than the city (except for Ningbo), thus suggesting that the selected districts deserve an interest in terms of environmental improvement. However, the temporal behaviour of NDVI in the LL district follows the same trend as the whole city, likely indicating that the proGlgreg interventions didn't improve the NDVI index at the district scale, at least during the project life span. However, significant changes in NDVI are observed at the NBS level, with respect to baseline, LL and city levels, either positive (such as for Dortmund NBS3, Dortmund NBS1 up to 2020, and Turin NBS2 up to 2021) or negative (such as for

Zagreb NBS3, Dortmund NBS1 after 2020 and Turin NBS2 after 2021). This is particularly interesting since NBS1, NBS2 and NBS3 are the NBS typologies mostly connected with creation of new green areas, and thus mostly adherent to the recently released unified definition of NBS, where the ecosystem-based approach has been made central¹⁴. The NDVI variability observed in their sites indicated the potentiality of these NBS typologies in providing environmental benefits, even if upscaling¹ is required to obtain a measurable impact at district scale.

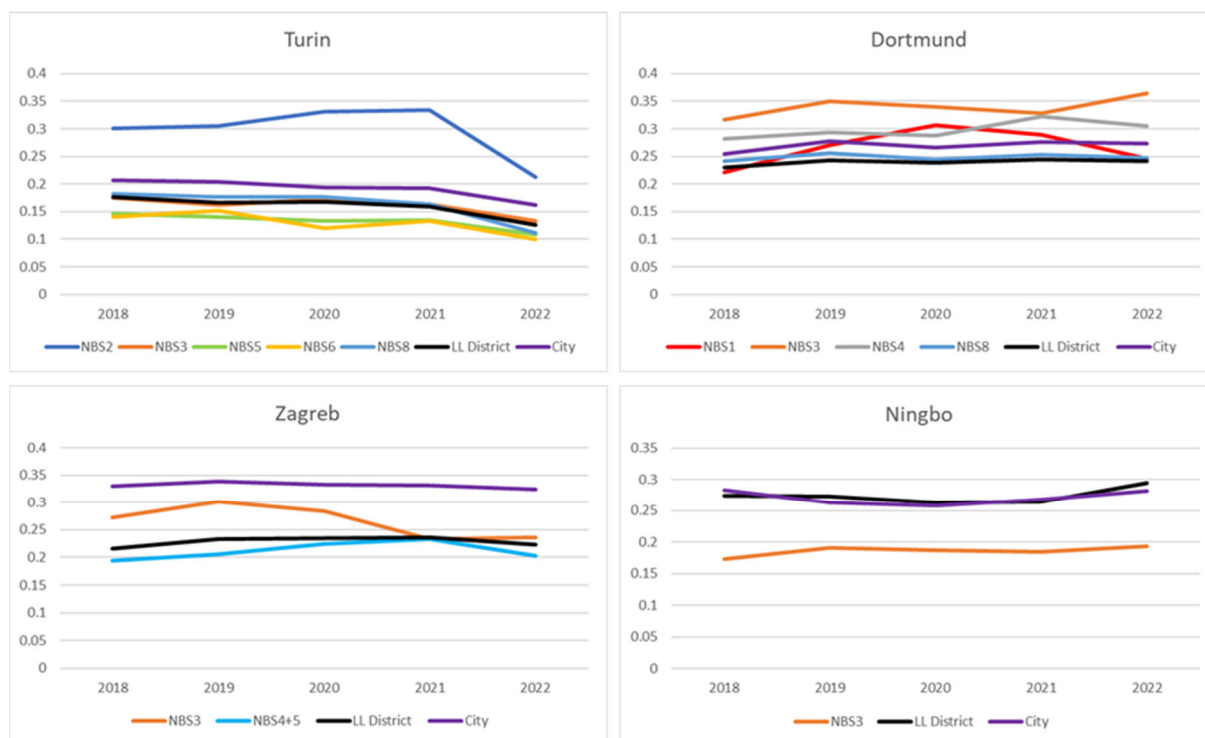


Figure 6. Time series of mean NDVI at city, LL district and NBS levels for Turin, Dortmund, Zagreb and Ningbo. When more than one implementation per NBS type is present in the same city, the average position has been considered for this analysis.

4. Evaluation of the impact at the district level on social, well-being and economic aspects

A novel interdisciplinary measurement tool, called the *proGlgreg Assessment Tool (GIANT)*, has been created during the project, starting from previously validated methods to monitor and assess health, wellbeing, social and economic benefits derived from NBS implementation, as well as their observed use, across different spatial scales (Figure 7). The GIANT tool is composed of: (1) the *General Questionnaire (GQ)*, a comprehensive tailored survey on social, health, and economic benefits of new NBS(s) at city or district level; (2) the

¹⁴ United Nations Environment Assembly of the United Nations Environment Programme, UNEP/EA.5/Res.5 (2023).

NBS-visitor questionnaire, a survey on perceived social and health benefits derived from a specific NBS, (3) the System for Observing Play and Recreation in Communities (SOPARC)¹⁵, an observation tool for recording the characteristics of the users and the types of use for a specific NBS, and (4) the Economic and Labour Market Questionnaire (ELMQ) for NBS, a survey including economic impact indicators at a NBS level. The first one (GQ) is presented here, while the other three tools are discussed in D4.9¹¹.

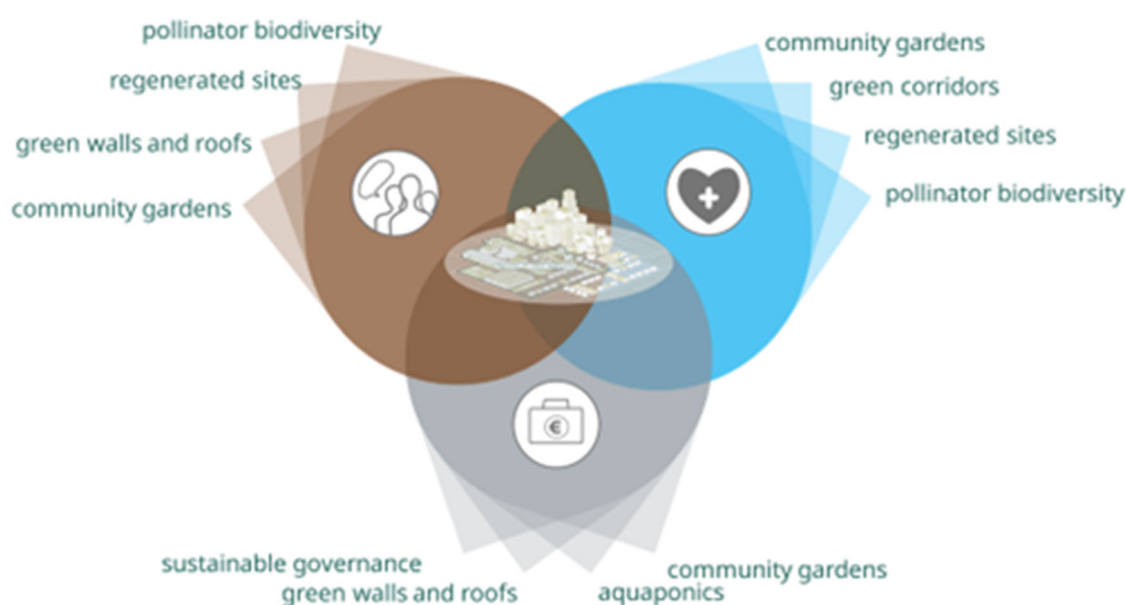


Figure 7. Schematic representation of the GIANT applied in proGReg to assess social, health and well-being, and economic impact of an NBS implementation project at multiple spatial scales (image @ proGReg).

The GQ has been conducted in the LL districts of Dortmund, Turin and Zagreb, both at the beginning of the project (i.e., pre-implementation, in 2019) and after three years (i.e., post-implementation, in 2022), when most of the NBS implementations were realized since more than one year. The limited project lifetime has posed some constraints along with adaptations in the original monitoring plan due to delays and cancellations of NBS implementations across the project development. Moreover, Ningbo FRC was not included into this activity due to the shorter timeframe of proGReg participation (three years overall).

To ensure scientific validity, the GQ is compiled of validated questionnaires/scales previously applied (more details can be found in D4.1². A validated questionnaire refers to a questionnaire or scale that has been developed and administered to a representative study population. The validation process confirms that: a) the measuring instrument covers the full range of the issues being measured; b) the measuring instrument appears understandable and doable on its surface; c) the measuring instrument predicts behaviour or ability in a given

¹⁵ McKenzie et al., (2006). System for Observing Play and Recreation in Communities (SOPARC): Reliability and Feasibility Measures. *J. Phys. Act. Health* 3 Suppl. 1, S208-S222.

area; and, most importantly, d) it measures the theoretical construct that it is designed to measure. Also, a validated measure assures a good reliability (i.e., it is consistent), reproducibility, and comparability between studies. Validated instruments may properly validate translations that can be applied in different countries. Additional items not included in validated scales but that have been used in previous were also included. The GQ has been reviewed and made suitable to FRC requirements (e.g., ethical/legal and non-intrusiveness).

The GQ was administered by the FRCs, who could involve NGOs and other stakeholders. The questionnaire was designed to be administered through face-to-face interviews of about 30-35 minutes. Two different questionnaires were developed for the pre-implementation and the post-implementation analysis. WP4 partners trained the interviewers for this task and provided detailed guidebooks for the interviewers, as well as informed consent forms and questionnaire sheets. The data was collected using the “EU-Survey” tool on a tablet or notebook. “EUSurvey” is a free, online platform for survey provided by the EC, which allows data collection, processing, and upload.

To disentangle the change attributable to the newly implemented NBS from the general temporal trend in the city, an identical survey was conducted in a Control District (CD). The CD, selected by the FRC, is very similar to the LL district in terms of socio-economic and demographic characteristics but was not interested by any (or minimal) NBS implementation during the proGReg project lifetime². The validity of the chosen CD was proven after the pre-implementation survey, based on the similarity in the obtained scores of the evaluated baseline indicators⁵.

The GQ ideal target is composed by 600 participants in each city (300 from the LL and 300 from the CD)¹⁶. The same participants should be contacted for the pre- and the post-implementation survey. Further details on identification and recruitment of participants and on data anonymization and storage are reported in D4.1⁴, as well as the GQ template and guidelines. However, despite the efforts, the target has not been reached, except in the pre-implementation survey conducted in Zagreb. A detailed analysis of the data collection process and of the participant statistical description in terms of gender and age is reported in Annex 2, but also shortly presented in the next section.

By using the GQ, the impact of the proGReg LL approach at the district level has been evaluated by assessing 26 KPIs, over the three above-mentioned dimensions, related to societal challenge areas 4, 8, 10, 11 and 12, as described in detail in the next sections. With respect to what was planned⁵, some new KPIs, not included in the Handbook⁴ are introduced to better evaluate the economic impact. An overall description by KPIs is reported in this deliverable, with values reported in resuming tables, by assessment domain. Aggregated results for descriptive data are available in plot graphs and tables in the Annexes. Such aggregated results, as well as KPIs' values, are also available on the platform (www.progiredata.eu).

¹⁶ Hu, Y. and Hoover, D. R. (2018), Simple Power and Sample Size Estimation for Non-Randomized Longitudinal Difference in Differences Studies, *J. Biom. Biostat.* 9, 415.

4.1. The data collection: related issues and lessons learned

The pre-implementation survey of the GQ took place in 2019, as much as possible before the starting of the proGReg NBS implementations. Specifically, it was conducted between October and December in Dortmund, between June and August in Turin, and between July and September in Zagreb.

In the cities of Dortmund and Turin, 4000 invitation letters were sent to both LL and CD residents (*i.e.*, in Huckarde (LL) and Mengede (CD) in Dortmund, and in Mirafiori Sud (LL) and Barriera di Milano (CD) in Turin). In both cities, a number of students were selected and trained to perform participants recruitment and GQ data collection. In the city of Zagreb, a total of 7652 leaflets were distributed to the Sesvete (LL) and Špansko-Jug (CD) residents, and interviewers from an external company were in charge of the participants recruitment and data collection.

Accounting for the potential cultural differences among the FRC that might have influenced the recruitment and data collection process, the challenges conducting the GQ were similar in the three cities. The main challenges encountered in administering the pre-implementation interviews were: (a) low response rate, (b) complaining on questions and/or procedure and/or length of the interview, and (c) lack of trust in the interviewers and interviewing procedure itself. To overcome low response rate, additional sampling methods were used in the pre-implementation assessment, such as contacting twice by letter, approaching individuals in public spaces such as markets, community centres or sports clubs. Advertising door-to-door and snowball sampling was also used. For those uncomfortable questions on personal information and to overcome lack of trust, the purpose of the project was clarified. In the case of continuing to refuse answering, the question was skipped. In general, cooperation with local NGOs and associations greatly increased the likelihood of positive feedback by the respondents.

The final number of respondents at pre-implementation was 141 in Dortmund, 373 in Turin and 614 in Zagreb. Thus, despite strong efforts have been made by both FRC and research partners, Turin and Dortmund could not achieve the target of 600 questionnaires for the pre-implementation GQ survey, while Zagreb strategy was very successful: the incidence of consent ranged from about 15% to 25%, and the required target of 600 participants was achieved. Moreover, in the city of Zagreb, participants reported to be the most satisfied with the course of the interview (65% rated it as “easy” and 30% as “neither easy nor difficult”; Figure 8).

The post-implementation questionnaire was administered between September and December 2022 in Dortmund, June-July and late August-September 2022 in Turin, and between September and October 2022 in Zagreb. In Dortmund and Turin new students were selected and trained to perform participants recruitment and GQ data collection, whereas in Zagreb this was performed by interviewers from the same external company. The same participants were contacted for the post-implementation survey, but the number of respondents was much lower than in the pre-implementation assessment: 48 in Dortmund, 119 in Turin and 211 in Zagreb. Thus, only about one third of the participants who completed the pre-implementation

questionnaire also took part in post-implementation questionnaire, resulting in a drop-out of around 68%, similar across the FRC. Especially for Dortmund, the total number of participants at post-implementation was very low.

Some participants drop-outs from baseline to follow-up assessment is common in this type of studies, but the number of drop-out rate to be this high was not expected. A possible reason for the high drop-out is the length of the survey, as the interview took between 35 and 60 minutes. Furthermore, the fact that the survey was administered by a third person (i.e., the interviewer) might have complicated the timing to plan the interview, and/or might have made participants reluctant to participate due to privacy concerns. The mitigation measures (e.g., outsourcing to specialized personnel in Zagreb, emphasizing the social and other benefits the project might have, conducting the survey at numerous occasions, and the explanation and reassurance about the processing of personal data) showed to be insufficient.

Participants feedback highlighted potential reasons that might have affected participation: i) sense of disappointment because of the lack of communication across the project. Participants would have liked to be updated on the progress of the project. Some of them could not remember their participation in the pre-implementation (Dortmund), ii) some participants did not know that the places they visit are part of the proGReg (Dortmund), iii) disappointment to not have been included further in the project development (Turin) iv) discomfort/embarrassed with some questions, especially those related to mental and health status, economic condition or personal information (Dortmund, Turin, Zagreb), v) the feeling of repetitiveness in some questions, vi) missing the meeting after having agreed on the appointment (Turin). Despite this, the interview was perceived as easy by a higher percentage of participants with respect to the pre-implementation assessment (Figure 8). It is likely that some of the individuals who rated the interview as difficult at pre-implementation, did not participate again at post-implementation.

A detailed description of participants' distribution in terms of gender, age and other parameters is reported in Annex 2. Briefly, a comparable distribution of gender and age between the sample from the LL and CD districts is observed for the three FRC in the pre-implementation survey, while, likely due to the loss of follow up, the distribution of gender changed at the post-assessment, with substantially more women participating in the post-questionnaire in all FRC, and a higher proportion of adults over 45 years in Dortmund.

However, despite the different approaches to recruitment, timings, locations, and sample sizes that have characterized the data collection among the three FRC, this has not affected the reliability of the results as the same tool (i.e., the *General Questionnaire*) was implemented by all the FRC. Concerning the small sample size, its yield has been maximized using appropriate statistical methods.

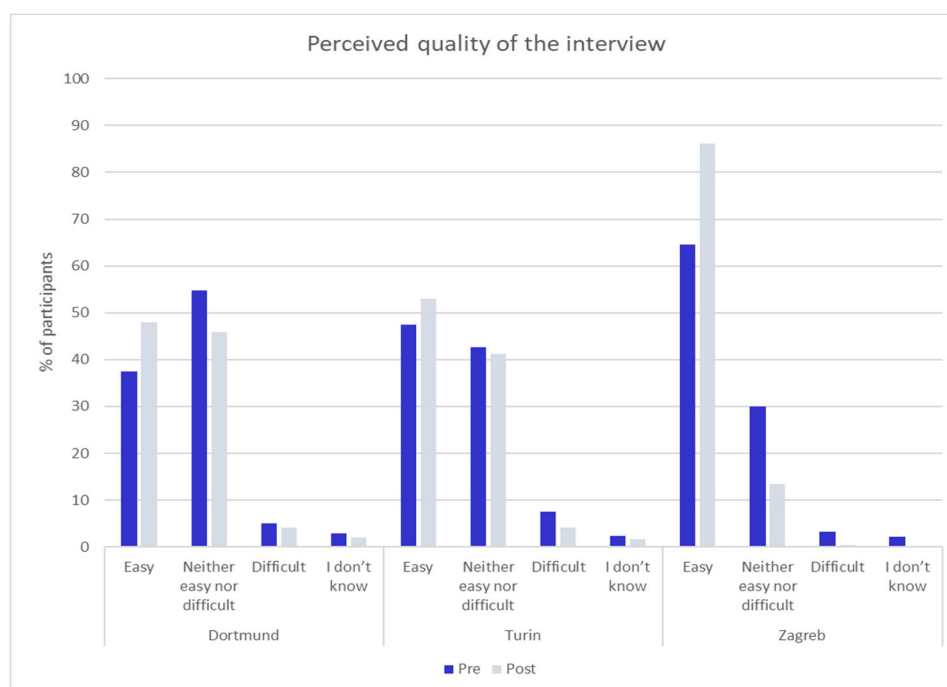


Figure 8. Distribution on response regarding the perceived quality of the interview according to the participants.

4.2. Social impact at district level of the Living Lab

The KPIs from the European assessment framework⁴ related to social aspects that have been assessed at pre- and post-implementation are: 16.3 - Mindfulness, 20.2 - Perceived social interaction, 20.4.2 - Perceived social support, 20.5 - Perceived social cohesion, and 22.15 - Connectedness to nature. For these KPIs, a changing in the interviewed population has been evaluated as a function of both time and zone (LL vs CD). The KPI 22.13 - Perceived restorativeness has been also assessed, but only at the post-implementation and only the zone (LL vs CD) effect has been evaluated. These six KPIs were classified as “Additional” in the Handbook⁴. Boxplots of the descriptive statistics analysis performed for connectedness to nature, social support, social cohesion, perceived social interaction, mindfulness, and perceived restorativeness are reported in Annex 3. Table 2 reports results on the comparisons among FRCs regarding social dimensions.

After the implementation of the NBS in Dortmund’s LL district, there was a significant increase in Connectedness to Nature compared to the pre-implementation. This effect was not observed in the CD.

Likewise, in Turin’s LL district, after the implementation of the NBS in the LL, perceived social support was significantly higher than before. The same was not found in the CD. The same was not found for connectedness to nature: after the implementation of the NBS in the

LL connectedness to nature was not significantly higher than before. Consistently, the perceived restorativeness was found to be significantly higher in the LL than the CD after the implementation, confirming the effectiveness of the intervention.

Overall, these findings indicate the success of the interventions, in both Dortmund and Turin, with Dortmund LL actions being more focused on the relationship among citizens and nature, while Turin LL being more devoted to improving social support.

Table 2. Coefficient F and p value of the effect of Time (T0 vs T1) x Zone (CD vs LL) Mindfulness, Perceived social interaction, Perceived social support, Perceived social cohesion, and Connectedness to nature, and Coefficient and p value for the effect of Zone (CD vs LL) for Perceived restorativeness. Statistically significant results are highlighted in bold and marked by asterisks.

	Dortmund		Turin		Zagreb	
	Coefficient F	p	Coefficient F	p	Coefficient F	p
16.3/22.11 - Mindfulness	0.057	0.813	0.041	0.839	0.041	0.297
20.2 - Perceived social interaction	0.607	0.440	0.201	0.654	0.655	0.419
20.4.2/22.14 - Perceived social support	0.258	0.614	5.264	0.024*	1.497	0.223
20.5 - Perceived social cohesion	1.963	0.168	3.562	0.062	0.590	0.443
22.15 - Connectedness to nature	10.393	0.002**	1.160	0.284	0.110	0.741
22.13 - Perceived restorativeness	0.279	0.600	4.867	0.032*	2.494	0.212

4.3. Impact at district level of the Living Lab approach on human self-perceived health and well-being

Fourteen KPIs, belonging to health and well-being domain have been measured with the GQ survey. Most of these KPIs are “Additional” in the Handbook, except for 21.2 - Level of chronic stress and 21.3 - General well-being and happiness, which were rated as “Recommended”⁴, as well as 21.4 - Self-reported mental health and well-being, to which two assessed KPIs are related. Some indicators not reported in the Handbook have been also evaluated, to provide a better description of the LL impact on resident health and well-being.

Perceived improvement of the neighbourhood

To obtain a general overview of the LL impact at district scale, at post-implementation assessment, the Perceived improvement of the neighbourhood (KPI not in the Handbook⁴) was evaluated. Participants were asked whether they had visited the LL where the new NBS were implemented. In Dortmund, about 90% of the respondents, both in the LL district (N=18) and the CD (N=22), had visited the new NBS at least once. In Turin, 61% of the respondents in the LL district (N=43) and 15% in the CD (N=6) had visited the new NBS. In Zagreb, only 3% of the respondents in the LL district (N=3) and 1% of the respondents in the CD (N=2) had visited the new NBS. The low number of visitors in Zagreb may be due to the fact that the green corridor was not yet implemented, and that a large part of the LL was fenced and not freely accessible.

The participants who indicated that they had visited any of the new NBS in the LL, were asked whether they thought the neighbourhood surrounding the NBS had improved due to the presence of the NBS (Figure 9). In Turin, most visitors (94% of LL and CD together) experienced an improvement of the neighbourhood due to the NBS implementation. In Dortmund, fewer inhabitants from the LL district (46%) than from the CD (69%) perceived an improvement of the LL neighbourhood. In Zagreb, of the very few people who visited the NBS, less than 1/3rd experienced an improvement of the neighbourhood.

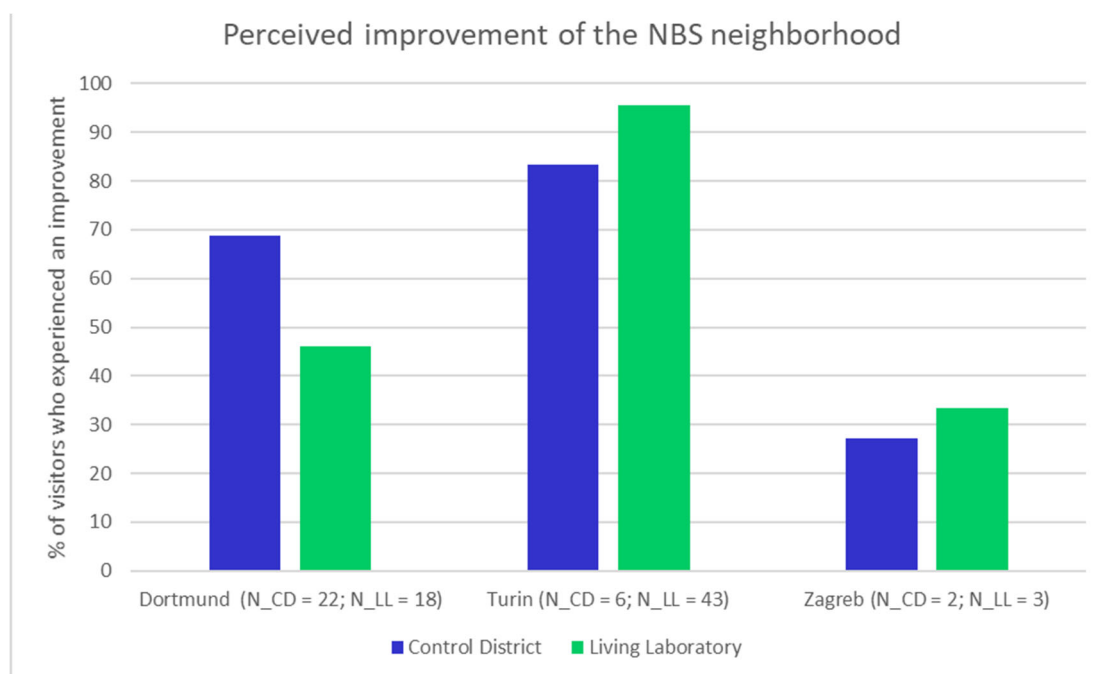


Figure 9. Improvement of the NBS neighbourhood as perceived by the respondents living in the Living Lab (LL) and Control District (CD) who visited the NBS area at least once.

The changes in the health and well-being status of the LL district residents were then assessed in a pre-post configuration by using twelve KPIs. For these KPIs, a statistical approach based on multilevel generalized linear mixed models (GLMM) was applied, and an overall description of the evaluated impact is provided below.

The mixed models that were used account for the intra-individual change over time because the GLMM followed a nested multilevel analysis with the individual included as random intercept. The KPIs analysed by GLMM belong to the following areas: *Visits and satisfaction with green and blue spaces*, *Mental Health and Well-being*, and *Physical Activity*. Overall discussion per KPI is presented in the following, together with the general results from statistical analysis (Table 3) and the percentages of statistically significant observed changes (Table 4). The descriptive statistics (barplots) of these KPIs (comparing baseline and post-implementation for the LL and CD by considering as statistical sample the subset of participants to both the pre- and the post-implementation surveys) and full statistics from GLMM (for the subjects participating in the pre- and/or post-implementation surveys) are reported in Annex 4. The results for Dortmund should be interpreted with more caution due to the small sample size.

- *Visits and satisfaction with green and blue spaces*

- **8.31.4 - Frequency of use of green and blue spaces**

In the GQ, participants were asked about their visits to green and blue spaces in their leisure time. Green and blue spaces are areas of grass/trees/vegetation or water in urban or more rural areas. In this deliverable, the total time spent in different types of green and blue spaces is represented instead of the mean of the time spent in each green or blue space that was reported in D4.5.

Overall, there seems to be a decrease in time spent in green and blue spaces, both in the LL and the CD. In Zagreb, there is a tendency towards a beneficial effect of the NBS-implementation in summer. No other effect of the NBS implementation is observed on the participants' self-reported time spent in green and blue spaces.

- **8.33 - Satisfaction with green and blue spaces**

In addition to the time spent, also people's satisfaction with the quality, amount, maintenance and safety of green and blue spaces was collected.

Satisfaction with the maintenance and safety of green and blue spaces in the neighbourhood had a tendency to be increased after NBS implementation, although results are not significant. In Turin, results seem to indicate that the satisfaction with the quality of natural spaces decreased after NBS-implementation: when adjusting the model for the change in the CD and for age, sex and education, the perception of the quality of green and blue spaces decreased in the LL with 20 points out of 100. However, there was only a very small decrease observed in the LL district, and the statistical significance of these results come from the increase in quality satisfaction in the CD. It is likely that some quality improvements were performed in natural spaces in

the CD. In Zagreb there was observed a tendency towards an increase in the perceived quality of natural spaces.

- **22.12 Visual access to green space**

Greenness (trees, grasses, flowers, etc.) amount in the view from windows at home (bedroom, kitchen and living room). Participants were asked to report how much greenness they could see through the windows in their bedroom, kitchen and living room.

In the Dortmund LL district, between half and $\frac{3}{4}$ of the view from participants' window was green, while in Turin and Zagreb this ranged between $\frac{1}{3}$ and a bit more than half of the window view. In Dortmund and Zagreb, there was no changes in green window views, whereas in Turin a decrease in greenness seen through the windows at home was reported, which resulted significantly for the bedroom window: the participants in the LL reported to see 13% less green space from the bedroom window, when adjusting the model for the change in the CD and for age, sex and education.

– *General Health*

- **21.3 General well-being and happiness**

Self-reported energy (i.e., feeling full of energy as compared to experiencing fatigue) and emotional well-being (i.e., feeling happy, calm and peaceful as compared to nervous and downhearted) was assessed.

Energy: The implementation of the NBS did not show an effect on self-reported energy and fatigue in any of the FRC.

Emotional well-being: Self-reported emotional well-being did not change much from 2019 to 2022 or between the LL and CD. Only in Zagreb, there was a positive effect given that emotional well-being reduced less in the LL than in the CD. When adjusting the model for the change in the CD and for age, sex and education, emotional well-being in the LL from pre- to post implementation increased with 6 points out of 100. It might be that the NBS, such as the therapeutic garden, provided some protection in the neighbourhood against the emotional impact of the earthquake that took place in March 2022, six months before the assessment of the post-implementation questionnaire.

- **Self-rated general health**

Although it is not specifically included as a KPI in the Handbook, self-rated health is a widely used and reliable measure to assess perceived general health status and was reported in the GQ.

Results did not show any effect of the NBS implementation on general health at the district level. In all cities, participants' ratings of general health slightly increased in the LL district, but this was not significant when compared to the change in the CD.

- **22.4 - Incidence of obesity**

The prevalence of self-reported obesity class I and above (i.e., Body Mass Index - BMI ≥ 30) is reported, whereas in D4.5⁵, the plot presents the prevalence of self-reported obesity class II and above (i.e., BMI ≥ 35).

Due to the small number of obese cases (given to the small sample sizes), the regression analyses cannot be interpreted. To give an idea of the prevalence of obesity before and after implementation of the NBS, we present the proportion of obese participants in Annex 4. In Dortmund, the prevalence of obesity in the LL remains the same, while in Turin we observe a decrease similar to the decrease in the CD, and in Zagreb prevalence of obesity increased in the LL compared to a decrease in the CD.

- **22.10 - Somatization**

With respect to the Handbook⁴, the scoring (1 to 5) is obtained as recommended by the Four Dimension Symptom Questionnaire¹⁷, taking into account the number and the severity of symptoms. In D4.5⁵, the descriptives of this indicator presented the number of reported symptoms without counting the severity.

The number and severity of physical symptoms was assessed as a measure of somatization. In Zagreb, a beneficial effect was observed: somatization significantly decreased with 7 points out of 100 after implementation of the NBS in the LL, compared to the CD (adjusting for the change in the CD and for age, sex and education). Although in Turin a beneficial trend was observed, this decrease in somatization was not significant when compared to the change in the CD.

- **22.19 - Prevalence, incidence, morbidity and mortality of respiratory diseases**

It has been assessed by means of prevalence of respiratory symptoms (in D4.5, missing data were treated as not having respiratory symptoms while in this deliverable missing data are not included in the results).

In none of the cities there was a significant change in the prevalence of respiratory symptoms.

- Mental Health and Well-being

- **21.2 - Level of chronic stress**

It was assessed through the average of self-perceived stress levels.

Participants in Turin perceived more stress compared to the participants in Dortmund and Zagreb. In Zagreb, a slight decrease in stress was observed after implementation of the NBS compared to an increase in stress in the CD: self-reported stress in the LL from pre- to post implementation decreased with 7 point out of 100 (adjusting for the

¹⁷ Terluin, B. et al. (2006) The Four-Dimensional Symptom Questionnaire (4DSQ): a validation study of a multidimensional self-report questionnaire to assess distress, depression, anxiety and somatization, BMC psychiatry 6, 34.

change in the CD and for age, sex and education). In the other cities, we found no significant effects of the implementation of the NBS on self-perceived stress.

- **Self-reported depressive symptoms**

Depressive symptoms were reported, which together with KPI 22.18 - Self-reported anxiety are used to assess well-being and mental health (related to the Handbook indicator 21.4 – Self reported well-being and mental health).

Implementation of the NBS in Turin and Zagreb did not significantly affect depressive symptoms at the district level. In Zagreb, there is an increase in depressive symptoms from pre- to post-implementation which is slightly lower than the increase in the control district. The overall increase in depressed feelings in Zagreb might be due to the earthquake that hit Zagreb in March 2020. In Turin, depressive symptoms were relatively high in the control district at baseline, with very little difference between the districts in average depression scores post-NBS-implementation. In Dortmund, there seems to be an increase of depressive symptoms after implementation of the NBS, but due to the small sample size, it is likely that these findings are due to chance.

- **22.18 - Self-reported anxiety**

Reported by means of anxiety symptoms. Together with Depressive symptoms, this KPI is used to assess well-being and mental health (related to the Handbook indicator 21.4 – Self reported well-being and mental health).

Average anxiety symptoms were higher in Turin than in Dortmund and Zagreb. In Dortmund and Turin, implementation of the NBS in the LL did not affect anxiety symptoms, whereas in Zagreb, anxiety symptoms significantly decreased in the LL after implementation of the NBS. In Zagreb, self-reported anxiety in the LL from pre- to post implementation decreased with 5 point out of 100 (adjusting for the change in the CD and for age, sex and education).

- *Physical Activity*

- **22.1 Self-reported physical activity**

Physical activity was measured with the International Physical Activity Questionnaire short-form (IPAQ-SF)¹⁸. Participants indicated the minutes per week walking and performing moderate- and vigorous-intensity physical activity, and these were transformed to Metabolic Equivalent of Task (METs). One MET is the amount of energy used while sitting quietly. METs represent the energy required and are comparable to kilo-calories.

Although some changes are visible, the analyses showed no effect of the NBS-implementation on the total volume of activity in any of the cities.

¹⁸ Craig, C. L. Et al., (2003) International Physical Activity Questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise*, 35, 1381-1395.

Table 3. Coefficient F and p value of the effect of Time (T0 vs T1) x Zone (CD vs LL) for visits and satisfaction with green and blue spaces, health and well-being indicators, adjusted for age, sex and education. Statistically significant results are highlighted in bold. P-values < 0.05 are considered statistically significant.

KPI	Dortmund		Turin		Zagreb	
	Coefficient F	p	Coefficient F	p	Coefficient F	p
8.31.4 - Frequency of use of green and blue spaces (time spent-min/week)						
Summer	-2,3578	0,5178	2,5829	0,5586	4,4716	0,0805
Winter	-0,6880	0,7919	-1,4914	0,4134	-0,4274	0,7156
8.33 - Satisfaction with green and blue spaces						
Quality	-0,4828	0,1131	-0,8010	0,0001	0,2955	0,0705
Amount	0,0810	0,7796	-0,1134	0,5562	0,2479	0,1221
Maintenance	0,0635	0,8405	0,0460	0,8216	0,0405	0,8084
Safety	-0,3509	0,2526	0,3437	0,0955	0,1629	0,2971
22.12 Visual access to green space						
Bedroom	7,8173	0,3810	-12,7353	0,0268	4,1779	0,3925
Kitchen	7,2311	0,3824	-7,3937	0,2631	-0,2657	0,9571
Living room	-0,7766	0,9305	-10,0546	0,0957	3,6438	0,4487
21.3 General well-being and happiness						
Energy	1,1542	0,8094	1,8174	0,5399	-0,5256	0,8320
Emotional well-being	-1,9230	0,6209	-2,7226	0,3884	5,6922	0,0119
Self-rated general health	-0,0235	0,9263	0,0016	0,9921	-0,1714	0,1259
22.4 - Incidence of obesity (by means of obesity prevalence)						
	Not interpretable results due to small sample size					
22.10 - Somatisation	0,8138	0,3604	-0,3919	0,6606	-2,1946	0,0019

22.19 - Prevalence, incidence, morbidity and mortality of respiratory diseases	-1,7443	0,1418	-0,8362	0,2492	-0,8435	0,4432
21.2 - Level of chronic stress	0,6837	0,3237	0,8722	0,1142	-1,0614	0,0119
Self-reported depressive symptoms	0,0294	0,8764	0,3268	0,0887	-0,2804	0,0685
22.18 - Self-reported anxiety	0,2261	0,8152	-0,4985	0,5541	-1,0061	0,032
22.1 Self-reported physical activity	533,861	0,2515	-527,317	0,3637	150,162	0,553

Table 4. Size of the significant changes observed for the LL residents compared to effect of Time (T0 vs T1) x Zone (CD vs LL).

KPI	Turin	Zagreb
	Change	Change
8.33 - Satisfaction with green and blue spaces: Quality	+20%	
22.12 Visual access to green space: from the bedroom window	-12,7%	
21.3 General well-being and happiness: Emotional well-being		+5,7%
22.10 - Somatisation		-6.8%
21.2 - Level of chronic stress		-6.9%
22.18 - Self-reported anxiety		-4.8%

Overall, these results suggest beneficial effects of the LL approach for emotional well-being, somatization, self-reported stress, and anxiety symptoms in all three FRC. Most significant effects were observed in Zagreb which could be explained by the variation in the implemented NBSs and a potential contextual heterogeneity in the health and wellbeing effects of NBS across 3 different cities, and/or the larger sample size reached (i.e., more statistical power to avoid false negative results) in Zagreb. Accordingly, it might be also speculated that the observed beneficial associations could be, in part, a result of the overlap

among proGlgreg and other actions realized by the local administration to improve the LL. The high drop-out in the post-implementation GQ assessment resulted in a small sample size (i.e. low statistical power) to identify potential health effects at the district level after NBS implementations (especially in Dortmund, but also in Turin and even in Zagreb). The COVID-19 pandemic and Zagreb's earthquake, which have had a huge impact on the implementation and monitoring plans, also could have affected the impact evaluation. However, these impacts could have been mostly avoided by our study design that was based on comparing the change in health outcomes in the LL district with a control district, both of which enduring these issues. It worthy to note that In the case of Zagreb, although we detected some beneficial effects (i.e. improved emotional well-being, reduced somatization, levels of chronic stress and anxiety symptoms) after NBS implementations, at the same time, not all NBS in Zagreb were implemented on time before the post-implementation monitoring phase with the GQ (i.e., the green corridor), and other NBS were implemented with delay with respect to the original monitoring plan. These issues were reflected in the very small number of participants that reported to have actually visited the NBS.

Premature deaths prevented by increased physical activity

Finally, a quantitative health impact assessment (HIA) approach has been used to estimate mortality and related health costs in the FRCs as a consequence of increased physical activity after implementation of the NBS. related to increased physical activity from the NBS in the FRCs LL. Physical activity at the LL level assessed by the GQ via the widely used self-report questionnaire IPAQ¹⁶ has been combined with the data obtained by the single NBS implementation via observations using the SOPARC¹⁴ (see D4.9¹¹), and converted into metabolic equivalent time (MET). IPAQ data from the GQ in the LL district at pre-implementation, converted into metabolic equivalent time (MET), were used to estimate basal PA for each FRC. SOPARC data for which there was pre- and post-implementation assessment, were used to estimate the additional number of adult users that went from being inactive to perform physical activity (i.e., walking or more vigorous activity) within the LL. Given that for Zagreb no complete SOPARC data at pre- and post-implementation was available, the HIA was performed for Dortmund and Turin. Population data were obtained from public data bases. The Value of Statistical Life (VSL) was used to monetize mortality impacts from physical activity¹⁹. The non-linear response function between METs hour/week and relative risk (RR) for all-cause mortality (obtained from meta-analysis²⁰) was applied to estimate the relative risk and population-attributable fraction by using the Blue Active Tool²¹. Additional information on the calculation is attached in Annex 4.

¹⁹ Retrieved from the Health tool (<https://www.heatwalkingcycling.org/tool/>), calculated for the year 2017.

²⁰ Woodcock, J. Et al. (2018) Non-vigorous physical activity and all-cause mortality: systematic review and meta-analysis of cohort studies, *Int. J. Epidemiol.* 40, 121–38.

²¹ Vert, C. et al. (2019), Health Benefits of Physical Activity Related to an Urban Riverside Regeneration, *Int. J. Env. Res. Public. Health* 16.

We estimated that, as a result of increased physical activity, the implementation of the NBS could prevent 0.206 (95%CI 0.155 – 0.280) annual premature deaths in Dortmund, and 0.592 (0.441 – 0.807) annual premature deaths in Turin (Table 5). This would translate into an annual health cost saving of €789 133 (95%CI 590 760 – 1 069 075) in Dortmund and € 1 701 989 (1 268 684 – 2 318 985) in Turin.

Table 5. Premature deaths prevented by increased physical activity in the LLs, based on HIA results obtained by combining the General Questionnaire district level data on physical activity with those observed at NBS level by SOPARC¹¹ and the related health costs saved.

KPI	Dortmund	Turin	Zagreb
Premature deaths prevented by increased physical activity	0.206 [0.155 – 0.280]	0.592 [0.441 – 0.807]	N/A
Health costs savings by increased physical activity	€789 133 [590 760 – 1 069 075]	€ 1 701 989 [1 268 684 – 2 318 985]	N/A

4.4. Economic impact at district level of the Living Lab approach

The economic and labour sections of the GQ aim to quantify the benefits that can be attributed to the project in the intervention areas, such as the specific phenomena of green job creation and gentrification, but also financial self-assessment and housing costs (rent). KPIs related to the economic and labour market that have been measured are about employment, financial situation, and property value mainly. Some of the assessed KPIs are in line with (or related to) those reported in the Handbook⁴, especially concerning the change in mean house prices/rental markets (23.2.1) and the number of new jobs in the green sector (24.18), as previously announced in D4.5⁵. The population mobility (24.28), which was also mentioned as possible output of the GQ in D4.5⁵, is not further discussed here due to insufficient data availability. However, also additional KPIs, not included in the Handbook are proposed, and reported. More specifically, the economic impact provides insights on the following areas: *Employment, Financial situation, Property value*. The overall behaviour of such KPIs across the project and in the LL and CD are discussed in the following and resumed in Table 6. Further information such as bar plots are reported in Annex 5.

– Employment

- **Sector of employment, focus green jobs (related to 24.18 - new jobs in green sector)**

The GQ approached to a large number of people living in the LL as well as in a similar CD elsewhere in the FRC and allowed to define the number of *green jobs*. Due to the setting of the GQ, this is only true for the pre-implementation phase (see Annex 4). For the post-implementation phase, the questionnaire focuses on job changes only. The

share of green jobs in the three European FRC prior the project's NBS implementations ranges from no (Dortmund LL) to nearly 13% (Turin LL). While no interviewee indicated a green job within Dortmund's Living Lab, around 13% of the interviewees from Dortmund's CD name a green job. The shares are 13% (LL) and 8% (CD) for Turin, and 9% (LL) and 2% (CD) in Zagreb. Between pre- and post-implementation, several job changes occurred. Here, the decreased number of interviewees for the post-implementation has to be considered as well as the setting of the GQ impeding the full picture for post-implementation data on green jobs. However, the following can be stated for the three cities:

Dortmund

- 2 interviewees name job changes
- Both from LL
- Non into green jobs

Turin

- 24 interviewees name job changes
- in total 24 job changes; 4 changed into a green job --> 2 from LL and 2 from CD
- only one (from LL) was already in a green job before

Zagreb

- 11 interviewees name job changes
- 10 in the LL, 1 in the CD
- None into green jobs

– *Financial situation*

- **Financial self-assessment**

The financial self-assessment is asked for by using a five-point Likert scale plus the option not to answer²² (see Figure 10).

The most positive statement “living comfortably” reaches nomination shares of above 50% for pre- and post-implementation for both districts in Dortmund; LL and CD. The LL interviewees name only the two most positive statements “living comfortably” and “doing alright” post-implementation, while the CD interviewees also name less positive statements of in total below 10% (“just about getting by” and “finding it quite difficult”).

In Turin, the statements are not as positive as in Dortmund, but still a huge share is “living comfortably” or “doing alright”. When comparing pre- and post-implementation, the share of these two assessments increased in the LL, while this share decreased in Turin's CD. In the CD, nearly 20% state “just about getting by” and “finding it quite difficult”.

Similar findings can be seen in Zagreb, where the post-implementation financial self-assessment is quite the same prior to implementation. Contrarily, a light worsening

²² Hanusik, K., & Łangowska-Szczeńiak, U. (2017). Differentiation of self-assessment and objective inequalities in the level of consumption of rural households, *Journal of Agribusiness and Rural Development*, 44, 337–349.

trend can be detected in the CD. Here, a lot more interviewees state that their financial situation is quite difficult.

Actually, it is important to highlight, that the financial situation depends on many internal and external influencing factors not connected with the NBS implementations, e.g. Covid19, Russian invasion into Ukraine with associated rising energy prices, and many other more regional or even local factors. However, these more global aspects affect citizens in both districts of investigation.



Figure 10. Financial self-assessment pre- and post-implementation in the Living Lab (LL) and Control District (CD) of the three Front Runner Cities Dortmund (top), Turin (middle), and Zagreb (bottom).

- **Affordability of basic needs (food, clothing, heating, rent)**

The affordability of basic needs (here food, clothing, heating, and rent/mortgage) can describe the economic situation of residents²³. It is presented in the following figures city by city (see Figures 10).

In Dortmund (Figure 11-top), the changes between pre- and post-implementation are not significant, but for heating changes due to the global energy crisis. While in the pre-implementation survey, more than 90% (LL) respectively ca. 85% (CD) indicated that the affordability of heating is not difficult. For both regions, this share decreased below 70%. However, the majority of interviewees highlighted no difficulties to afford basic needs.

The increasing difficulty to afford heating as highlighted in Dortmund is less obvious in Turin (see Figure 11-middle). However, the share of the statement “no difficulties” reduced to below 50% (CD) respectively ca. 60% (LL) for the post-implementation phase, compared to around 65% pre-implementation. For all four basic needs, the scores worsened more in the CD than in the LL when comparing the individual pre- and post-implementation nominations. However, most scores reach more than 50% no difficulties in affording the basic needs; except for two basic needs (heating and rent/mortgage) in CD’s post-implementation.

A similar tendency can be extracted from the Zagreb findings (see Figure 11-bottom). The CD statements tend to worsen more between pre- and post-implementation compared to the LL.

²³ Storms, B. et al. (2023), How can reference budgets contribute to the construction of social indicators to assess the adequacy of minimum income and the affordability of necessary goods and services? EuSocialCit Working Paper, January 2023. Doi: 10.5281/zenodo.7629202.

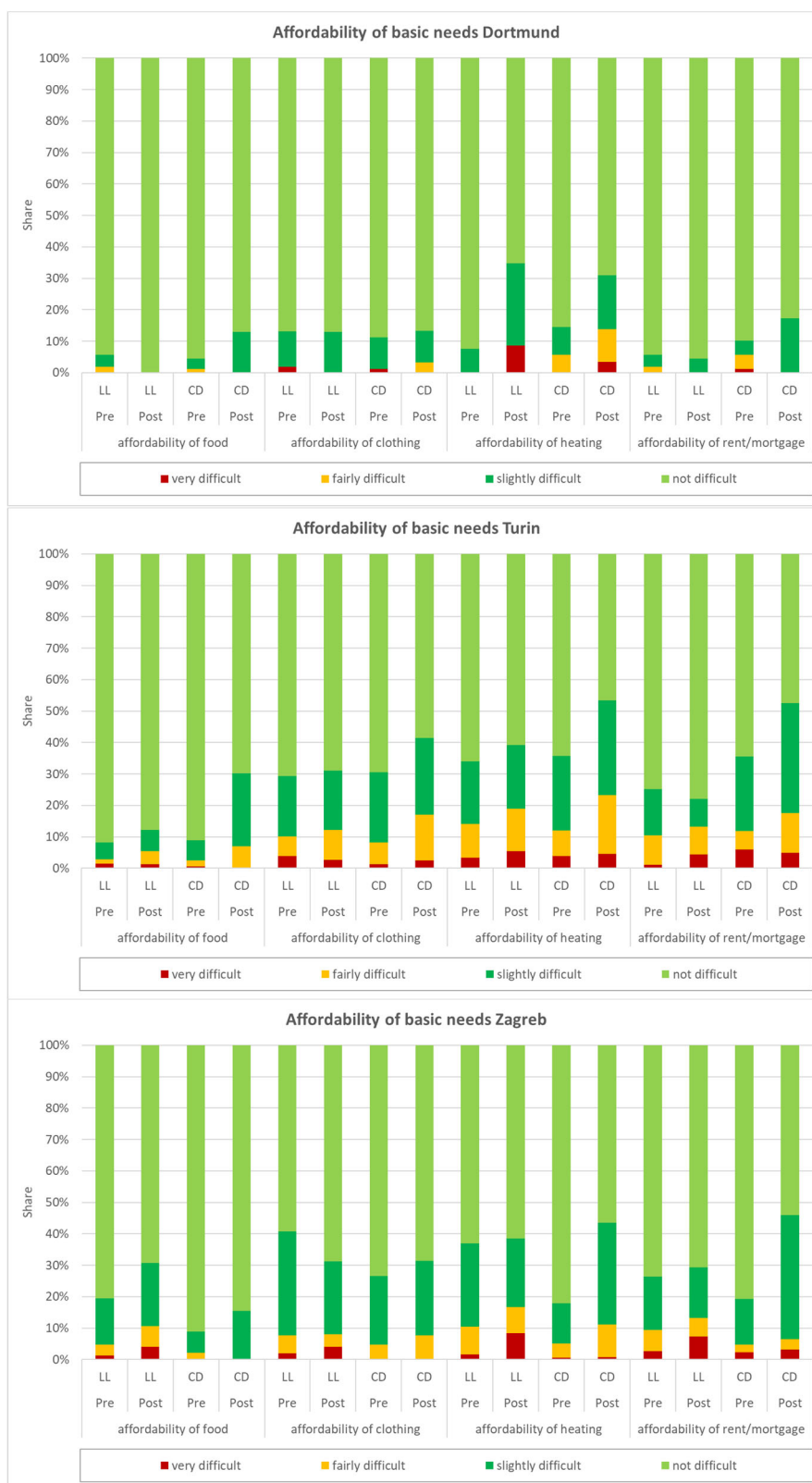


Figure 11. Affordability of basic needs in Dortmund (top), Turin (middle) and Zagreb (bottom), for residents from the Living Lab (LL) and the control district (CD) in 2019 (Pre) and 2022 (Post).

– Property value

- **Living situation (owned, rented)**

The ownership of the house is a crucial choice in people's life, which could impact long-term condition²⁴. In all three FRC, the majority of interviewees owns the property. The share mainly increased between pre- and post-implementation reaching 71% (Dortmund), 80% (Zagreb), and 85% in Turin. This high share of owned property is between 5-10% higher compared to the pre-implementation situation.

- **23.2.1 Change in mean house prices/ rental markets**

The following numbers on rent prices have to be seen in light of low response numbers for interviewees living in a rented property. For example, only eight (LL) respectively seven (CD) interviewees in Dortmund rented a property. In Turin this numbers are also below ten: eight (LL) and nine (CD). The numbers are higher in Zagreb (32 interviewees in LL and ten in the CD). However, not sufficient for statistically significant statements.

The monthly rent increased for all regions, except for one (Turin's LL) (see Figure 12). Here, the LL rent decreased to 84% of the pre-implementation rent (from 433€ to 365€). At the same time, the rent increased in the CD from slightly above 200€ per month to ca. 300€ per month (+36%). In Turin, the public statistics demonstrate that in the City of Turin the rent is on average more than 50% higher than in Mirafiori Sud district (<https://www.progiredata.eu/sp-spatial-data/>). As mentioned before, these numbers have to be seen in light of very low response rates. Thus, they do not allow strong arguments at all. The same is true for Dortmund. Here, the CD rents increased more sharply than the LL rents. Overall, this increasing trend is also reflected by a 33% plus in Dortmund rent prices between 2015 and 2021 reported in the project's spatial dataset (<https://www.progiredata.eu/sp-spatial-data/>). In Zagreb, the rents in the LL increased by 65% (176€ to 290€), while only by a few Euros in the CD.

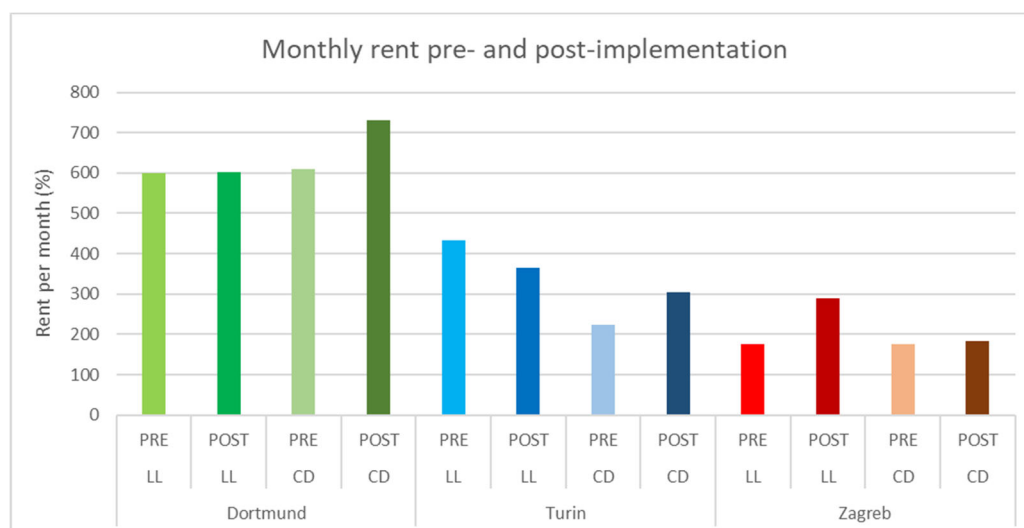


Figure 12. Monthly rent pre- and post-implementation in Dortmund (left), Turin (centre), and Zagreb (right).

²⁴ Cox, A., and Followill, R. (2018), To Rent or Buy? A 30-Year Perspective, Journal of Financial Planning 31, 48–55.

- **Household income (related to 23.2.1 Change in mean house prices/ rental markets)**

This very personal data is asked for in six classes (<851€, 851-1150€, 1151-1750€, 1751-3050€, 3051-3500€, >3500€) to avoid the nomination of precise numbers.

Additionally, it is offered to answer “do not know I prefer not to answer”, which was used by more than one quarter of the survey interviewees (27%). The development of the net household income in the three cities’ LL and CD is presented in form of bar charts in Annex 5. The results presented below, have to be seen in light of this, but also the considerably lower number of interviewees for the post-implementation survey. Generally, the net household income is highest in Dortmund and lowest in Zagreb. Furthermore, the pre-implementation numbers are very similar between the three LL and CD.

In Dortmund, the highest class (>3500€) was already most often named prior to the NBS implementations for both study areas, LL and CD. Only around 12% indicate one of the three lowest categories below 1750€. After the NBS implementations, only 7.5% name net household incomes below 1750€ with very few nominations in the CD. Simultaneously, the share of the highest class (>3500€) increased to more than 50% on average for both areas; 60% in the CD, and 43% in the LL. This shows a sharp increase not taking into account the limitations of the survey (low response rate; high share of missing data or unwillingness to answer).

In Turin, the classes between 1151-1750€ (CD) and 1751-3050€ (LL) are named most often pre-implementation. Overall, the net household income increased for both areas in Turin until post-implementation. Post-implementation, the LL reaches a share of ca. 40% of the interviewees indicating a net household income of 1750€ and above. The CD’s share is somewhat lower with 35%.

In Zagreb, the classes up to 1750€ net household income cover nearly half (48%) of the LL’s and CD’s interviewees before implementation. Only very few named values above 3050€. This share increased to 9% (LL) and nearly 4% (CD), post-implementation indicating a trend towards higher income patterns.

Table 6. Economic KPIs as obtained by the General Questionnaire. Pre-post percentage variations are reported.

KPI	Dortmund		Turin		Zagreb	
	LL	CD	LL	CD	LL	CD
Sector of employment, focus green jobs (share of green jobs) (related to 24.18 - new jobs in green sector)	pre: 0% post: no new green jobs	pre: 13 % post no new green jobs	pre: 13% post: 1 more green job	pre: 8% post: 2 more green job	pre: 9% post: no new green jobs	pre: 2% post: no new green jobs
Financial self-assessment (Share of living comfortable / doing all-right in %)	pre: 92% post:100% (+8%)	pre: 90% post 93% (+3%)	pre: 64% post: 59% (-5%)	pre: 53% post: 42% (-11%)	pre:39% post:43% (+4%)	pre: 54% post:41% (-13%)
Affordability of basic needs (share of not difficult statements in %)						
food	pre: 94% post:100% (+6%)	pre: 95% post:87% (-8%)	pre: 92% post: 88% (-4%)	pre: 91% post: 70% (-19%)	pre: 80% post:70% (-10%)	pre: 91% post:88% (-3%)
clothing	pre: 87% post: 87% (=)	pre: 89% post:87% (-2%)	pre: 71% post: 69% (-2%)	pre: 69% post: 59% (-10%)	pre: 59% post:69% (+10%)	pre: 73% post:69% (-4%)
heating	pre: 92% post: 65% (-27%)	pre: 85% post:69% (-16%)	pre: 66% post: 61% (-5%)	pre: 64% post: 47% (-17%)	pre: 63% post:61% (-2%)	pre: 82% post:56% (-26%)
rent	pre: 94% post: 95% (+1%)	pre: 90% post:83% (-7%)	pre: 75% post: 78% (+3%)	pre: 64% post: 48% (-16%)	pre: 74% post:71% (-3%)	pre: 81% post:54% (-27%)
Living situation (% of house owner and change post-pre)	64% (-6%)	77% (+22%)	89% (+3%)	78% (+8%)	67% (+19%)	91% (+1%)
23.2.1 Change in mean house prices/rental markets* *very low responses	+1%	+20%	-16%	+36%	+65%	+4%
Household income (Share of households with an income >1751€ in %; related to 23.2.1 Change in mean house prices/rental markets)	pre: 70% post: 61% (-9%)	pre: 58% post:90% (+22%)	pre: 42% post: 42% (=)	pre: 29% post: 35% (+6%)	pre: 13% post:37% (+24%)	pre: 24% post:29% (+5%)

5. Conclusions

ProGReg was a 5-years and a half project dedicated to the implementation of NBS in post-industrial districts, within a Living Lab (LL) vision. This means that all the NBS interventions were realized, in each one of the four FRCs involved in the project, within the same district, ideally connected in a network.

The impact of such an approach at the LL district scale, despite the relatively small size of the single NBS implementations, has been monitored and assessed in terms of Key Performance Indicators (KPIs), in connection with the four assessment domains identified in proGReg, and in compliance with the guidelines of the European impact assessment framework for NBS⁴. This assessment has been conducted by using GIs-derived data and a general population survey (the General Questionnaire; GQ), which is part of the GIANT, an innovative tool developed within proGReg to assess impact on social, health and well-being, and economy of an NBS intervention, at different spatial scales.

The overall impact at the district scale was mainly negligible, and the temporal trend of specific KPIs reproduces the same trends observed at the city scale (such as for the NDVI, which represent the “amount of green surfaces”) or in a control district (such as for many social, health and well-being and economic KPIs assessed). However, NDVI and self-reported KPIs about social, health and well-being, and financial and economic situation showed sometimes a different trend, with respect to the LL scale, when evaluated at the NBS level¹¹. On one side, this demonstrates that setting the appropriate scale is crucial for capturing the NBS impact, and on the other that the proGReg NBS interventions are mostly not large or networked enough to produce an impact at the district scale, but they potentially could be, upon intervention upscaling¹.

Nevertheless, some significant differences emerged between the citizens of the LL district and those of the selected control districts, in the three European FRCs. In particular, in Dortmund’s LL district there was a significantly increase in connectedness to nature, while in Turin’s LL district, a significant increase in the perceived social support and in the perceived restorativeness was found. The analyses of the health and well-being indicators at district level, suggest beneficial effects of the implemented NBS for emotional well-being, somatization, self-reported stress, and anxiety symptoms. With regard to the economic dimension, the overall trend is more positive in the LL than in the CD regions. This concerns employment (green jobs and household income), the overall financial situation (based on a self-assessment and affordability of basic needs), and property value.

Since these differences have been observed among citizens of two different districts, within the same city, at the same time, this allowed us to reasonably decouple these results from events occurred in the project period at the national or international level.

However, the GQ encountered many problems during its implementation in the three European FRC, both during the recruitment of participants for the pre-implementation survey and when the same participants were contacted after three years for the post-implementation evaluation. Contacted people identified as a barrier to their participation: the length of the

interview, the presence of the interviewer, the request of information felt as too personal, not being sufficiently involved in the project between the two interviews. This resulted in a small number of responses, which weaken the results of the survey. The detailed analysis performed of the issues related to the GQ deserves an interest for the development of future, more efficient, multi-domain assessment tools at the district level.

Annex 1 - Parameters obtained from administrative databases at city and Living Lab district scales

REF. DOMAIN	SUBDOMAIN	DATA	DESCRIPTION
1. Socio-cultural inclusiveness	1.1 Demographics	1.1.1 Total population	Total number of persons living in the specific area. Indicator should be collected for both the city/MA scale and the LL/regeneration area district scale
		1.1.2 Population density	Number of persons per square km of land area. Indicator should be collected for both the city/MA scale and the LL/regeneration area district scale
		1.1.3 Population growth rate	Average annual rate of change of population size (%). Data should be collected for both the city/MA scale and the LL/regeneration area district scale
		1.1.4 Migration rate	Net number of migrants (immigrants – emigrants) per 1,000 population. Data should be collected for both the city/MA scale and the LL/regeneration area district scale
	1.2 Social and cultural inclusiveness	1.2.1 Welfare recipients	Percentage of residents having access to welfare
		1.2.2 Work intensity	% employed out of total economically active population (15-64 years of age)
		1.2.3 Diversity statistics	% foreign born residents (if available, for both scales)
	1.3 Education and access to social and cultural services and amenities	1.3.1 Educational attainment	Average level of education completed by the 20-64-year-old population
		1.3.2 Recreational or cultural facilities	Relevant for LL/regeneration level: no. and identification of recreational and / or cultural facilities
	1.4 Housing	1.4.1 Housing quality	Average useful floor area per person, calculated in sqm
		1.4.2 Public housing	Percentage of residents in public housing
		1.4.4 Density of the built environment	Building Coverage Ratio, or if unavailable, Floor Area Ratio (Total residential floor area divided by total residential area surface)

REF. DOMAIN	SUBDOMAIN	DATA	DESCRIPTION
2. Human health and well-being	2.1 Health	2.1.1 Incidence of cardio and respiratory diseases	Rate of new (or newly diagnosed) cases of the disease per 1,000 persons
		2.1.2 Incidence of allergic disease	Rate of new (or newly diagnosed) cases of the disease per 1,000 persons
		2.1.3 Incidence of chronic stress, stress-related diseases, mental health diseases and NCDs	Rate of new (or newly diagnosed) cases of the disease per 1,000 persons
		2.1.4 Obesity rate	Possibly available by region / in specific studies (or possibly at school level)
		2.1.5 Life expectancy at birth	Average life expectancy (possibly available at higher levels / regional level)
	2.2 Wellbeing	2.2.1 Green space per capita	Sqm of green space / person
		2.2.2 Urban safety – crime	Yearly number of reported crimes per 1,000 persons
		2.2.3 Urban safety – accidents	Yearly number of reported road accidents involving pedestrians and / or bicyclists

REF. DOMAIN	SUBDOMAIN	DATA	DESCRIPTION
3. Ecological and environmental restoration	3.1 Land use and Vegetation	3.1.1 % of green spaces	% of total surface which is destined for green spaces
		3.1.2 structure of green spaces	% of tree covered areas
			% of shrub covered areas
			% of meadow covered areas
	3.1.3 % Surface of brownfields	Total surface which is destined for brownfield areas	
	3.2 Climate / Meteorological data	3.2.1 Precipitation	Average annual precipitation (mm)
		3.2.2 Relative humidity	Relative humidity (%)
		3.2.3 Air temperature	Annual mean temperature (°C)
			Winter mean temperature (°C)
			Spring mean temperature (°C)
			Summer mean temperature (°C)
		Fall mean temperature (°)	
	3.2.4 Wind strength	Wind intensity (km/h)	
	3.2.5 Wind direction	Main wind direction	
	3.3 Air Quality	3.3.1 Ozone concentration	µg/m3 / ppb
3.3.2 NOx concentration		µg/m3 / ppb	
3.3.3 PM 2.5 concentration		µg/m3 / ppb	
3.3.4 PM10 concentration		µg/m3 / ppb	
3.3.5 VOC Concentration		µg/m3 / ppb	

REF. DOMAIN	SUBDOMAIN	DATA	DESCRIPTION
4. Economic and labour market	4.1 Labour market and economy indicators	4.1.1 GDP per capita	GDP (PPP), Euro
		4.2 Gentrification indicators	4.2.1 Employment rate
	4.2.2 Unemployment rate		The proportion of unemployed adults in the working age (20-64 years)
	4.2.3 Revenues by household		Average household disposable income
	4.2.4a Current property sale value for residential use		Property value, average, EUR/sqm, for single- and collective housing, sale price
	4.2.4b Current property rental value for residential use		Property value, average, EUR/sqm, for single- and collective housing, renting (monthly)
	4.2.5a Current property value for commercial/ industrial/ office use		Property value, average, EUR/sqm, sale price
	4.2.5b Current property rental value for commercial/ industrial/ office use		Property value, average, EUR/sqm, renting (monthly)
	4.3 Tourism and attractiveness indicators		4.3.1 Current number of tourists
		4.3.2 Number of temporary events	Trade Fairs, Congresses, Symposiums, Concerts, Parades before NBS application (in number)
		4.3.3 No. of foreign students	% of foreign students out of total enrolled higher education students
		4.3.4 Local expenses	Expenses in local retail businesses
	4.4 Taxes, Investment & Financing	4.4.1 Local taxes	Average local taxes per capita
		4.4.2 Green investment programs/funds	Public investment programs, and investment funds

Annex 2 - General Questionnaire (GQ) data collection: A comparison among different approaches

Introduction

The objective of this report is to detail the process of data collection through the General Questionnaire (GQ) pre-implementation across the three European Front Runner Cities (FRCs) i.e., the city of Dortmund (Germany), the city of Turin (Italy) and the city of Zagreb (Croatia).

For each involved FRC, the whole procedure including number of collected data, timing, locations, participants' recruitment approached, challenges, and adopted strategies have been detailed. In addition, a section of feedback from participants have been included.

The entire process of data collection was coordinated by the FRCs and supervised by the research units responsible for monitoring and assessment task involved with the GQ, i.e., Task 4.1 – Socio-cultural inclusiveness; Task 4.2 – Increased human health and wellbeing; and Task 4.4 – Economic and labour market benefits.

1. GQ Pre-implementation data collection, 2019

City of Dortmund, Department of Urban Renewal

Background

This report documents the preparation and process of conducting the General Questionnaire (GQ) carried out by the City of Dortmund, Department of Urban Renewal.

The GQ is part of the experimental data of WP4 that aims to collect data on social, health, and economic indicators in the Living Lab (LL) at the NBS and district level before and after implementing the Nature Bases Solutions (NBS) to evaluate the change in the quality of life resulting from implementing the different NBS.

Dortmund LL encompasses 215 ha within the Huckarde district, the post-industrial part of Dortmund, where five NBS have been implemented, while no NBS are planned in the control district (CD, Mengede).

General Overview of Preparation and Processing the GQ

- Translating the survey documents (GQ information sheet, informed consent sheet, contact information sheet, and questionnaire)
- Signing of the translated DPO letter

- Selecting and recruiting of interviewers (BSc and MSc students)
- Selecting the address (2000 addresses LL, 2000 CD)
- Posting the GQ survey announcement online (City of Dortmund homepage, Huckarde district newsletter)
- Sending the GQ invitation letter and the data protection notice (2000 LL, 2000 Control district)
- Training the interviewers
- Printing the interview documents (300 LL, 300 control district)
- Performing the field survey

Timeframe

October 7 until December 31, 2019.

Location, Sample Size, and Responses

There were 4,000 invitation letters sent to the residents of Huckarde and 4,000 to the residents of Mengede on September 25, 2019. The city of Dortmund received responses from 258 residents within the first few weeks after sending the letters. However, out of the 258 responses, 140 appointments were organized for the interviews. The persons who responded but did not participate in the survey either cancelled their interview appointments or cut the interview in the middle and did not want their personal information to be recorded or processed. Furthermore, a few residents sent written complaints to the Mayor's office that they were not interested in participating in the survey and informed the City of Dortmund not to use their contact information for the survey of the post-implementation GQ or for any survey purposes.

Info letter: 4,000. Huckarde: 2,000. Mengede: 2,000.

Responses: 258. Huckarde: 97. Mengede: 161.

Interviews: 140. Huckarde: 48. Mengede: 92.

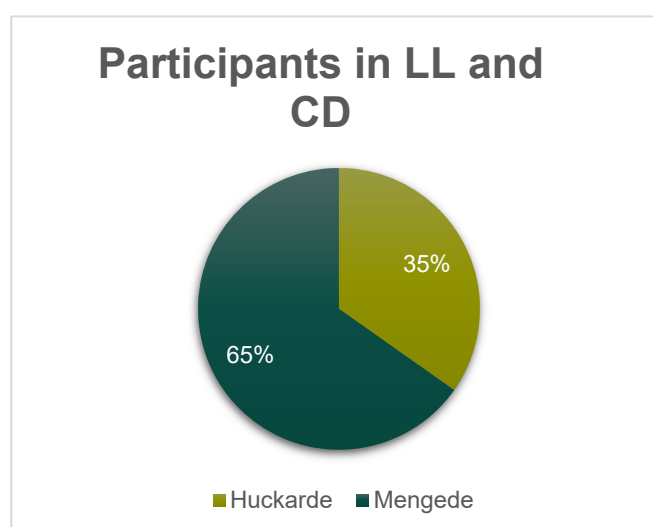


Figure 1. Conducted interviews in LL and CD.

Sampling Methods

- There were 65 residents (40%) who replied to the invitation letter of the GQ, either by email or by phone, and appointments were arranged accordingly.
- There were 36 residents (26%) approached through the door-to-door technique and the ones who were willing to participate were either directly interviewed or proposed an appointment according to their convenience. Many residents were not interested in participating and asked not to be approached again.
- There were 56 residents (34%) approached at public events and buildings, such as:
 1. Weekend markets- most positive responses were received at the market place
 2. Secondary schools
 3. Sport clubs
 4. Social clubs

A flyer of proGlgreg was given to those who were interested, and the students informed them to contact the coordinator of the project either by email or phone if interested.

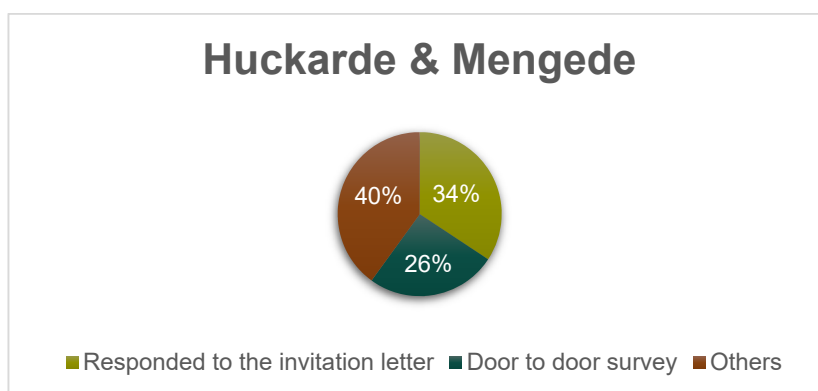


Figure 2. Conducted interviews in the LL and CD.

Course of the Interview

Six students were recruited for the data collection, five for conducting the interviews, and one for transferring the data to the EU-Survey platform. A list of the interviewees and their contact information (paper copy) were given to the students. Identification cards were also issued to the students to be presented to the residents before starting the interview.

Interview documents included:

- GQ information sheet;
- Informed consent sheet;
- Contact information sheet;
- Two copies of the GQ, one to be handed to the participant and a copy to remain with the interviewer for reading the questions.

On the contact information sheet, respondent ID-numbers (10000-10300) were given to the residents of the LL and the respondent ID-numbers (10300-10600) to the residents of the control district.

The interview length was between 35 minutes and one hour.

Planned interviews took place on weekdays; mid-mornings and afternoons were preferred.

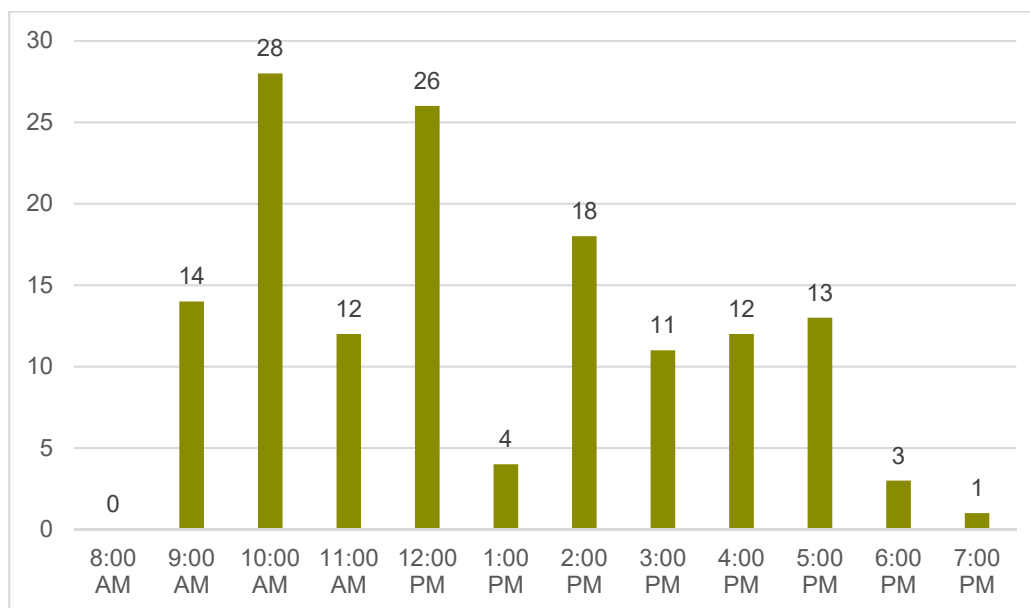


Figure 3. Time of the interviews.

Challenges and solutions in conducting the GQ

Unfortunately, it was not possible to reach the required 600 interviews (300 LL + 300 control district) due to many reasons. Following are the main challenges confronted when conducting the GQ and the adopted strategies to increase the response rate.

Table 1. Challenges and solutions in the pre-implementation (2019) survey of the General Questionnaire in Dortmund.

Challenges	Solutions
Low response rate	Other sampling methods were used such as: <ul style="list-style-type: none"> - approaching people at public events such as weekend markets and festivals - door-to-door technique - in a few cases, interviewing more than one family member of the same household - contacting sport clubs and community centers - advertising the survey on the local newsletter of the target district - weekend days were suggested as an option for the interview appointments - Snowball sampling: some respondents recommended contacting other citizens who would be interested in the project, however didn't receive the invitation letter.
Respondents tended to skip certain questions on personal information	The purpose of these questions were explained to them as well as that their information will be treated with high confidentiality and the information they provided in the questionnaire will be separated from their personal data.
Answering method: writing or speaking	For those who preferred the survey not to be administrated orally, the purpose of the survey was explained to them by the interviewers and a copy of the survey documents were given to them to be either picked up to their well or to be sent to the City of Dortmund

Participant Feedback

Many participants showed enthusiasm toward taking part in the GQ. On the other hand, the proGfreg coordination office and the students received other critical feedback about the content of the GQ and the data collection methods. Following is a summary of the comments received:

- Participants showed enthusiasm towards proGfreg and the concept of the Nature Based Solutions and expressed their willingness to participate in the project's planned activities. They also would like to be updated on the progress of the project. This unfortunately was not part of the survey and that led to a sense of disappointment. Given this feedback, WP2 (Co-design) could have potentially benefited from the reflection of the participants of the GQ as a tool for community engagement.
- Most participants complained about the length of the GQ (45 – 60 minutes).
- Many participants indicated that the content of the invitation letter that described the project was not related to the content of the GQ which collected the personal information of the participants.
- Some participants of the control district argued that their district shouldn't be part of the survey as no NBS were implemented in their area, but rather in Huckarde.
- Some participants were irritated by certain questions, especially the ones related to their mental and physical health status. A few ended the interview because they felt that the questions were very personal.
- Many participants didn't feel comfortable and/or didn't answer the questions about their financial situation (salary, rent of the house, etc.)
- Having the possibility of answering the GQ online would have increased the number of participants as many participants asked if it was possible to digitally take part in the survey according to their time of convenience, in many cases at night or at the weekend.
- In line with that, participants asked if it was possible for the students to leave them a copy of the questionnaire, and they would fill it out and send it back to the City of Dortmund at a later time.
- Some participants preferred to read and fill out the questionnaire by themselves, and it was not necessary for the students to read the questions to them. They said that they would let them know if they had any questions.
- Some participants asked if there was any kind of reward or incentives for their participation in the survey.

City of Turin, EU funds and Innovation Department

Background

The GQ is part of the experimental data of WP4 that aims to collect data on social, health, and economic indicators in the Living Lab (LL) at the NBS and district level before and after implementing the Nature Based Solutions (NBS) to evaluate the change in the quality of life resulting from implementing the different NBS.

The GQ (pre – implementation) has been submitted in the LL of Turin, Mirafiori Sud District, a post-industrial and peripheral area in Torino located in southside of the City, where all NBS will be implemented. The control district (Barriera di Milano) has been chosen because of, supposed, similar characteristics: a peripheral area with an important post-industrial legacy. Anyway, the perception of the interviewers gave us some relevant differences between the two areas in terms of security, green areas, marginalization, poverty, and exclusion. More specifically, in Mirafiori Sud District people seemed higher collaborative and socially cohesive, while in Barriera di Milano emerged a larger distrust towards neighbours.

General Overview of Preparation and Processing the GQ

In Turin, this activity was held in two sessions, both managed in the same way. The first one was performed in summertime and the second one in autumn 2019.

- Selecting and recruiting of interviewers (BSc and MSc students)
- Selecting the address (2000 addresses LL, 2000 control district)
- Posting the GQ survey announcement online (Social media)
- Sending the GQ invitation letter (2000 LL, 2000 Control district)
- Training the interviewers
- Printing the interview documents
- Performing the field survey

Timeframe

First session: 18/06/2019 – 10/08/2019

Second session: 25/10/2019 – 23/12/2019

Location, Sample Size, and Responses

By summing the two periods of investigation, there were 4,000 invitation letters sent to the residents of Mirafiori Sud and 4,000 to the residents of Barriera di Milano. The city of Turin received responses from around 200 residents that agreed to be interviewed. The other interviews were collected through a “searching activity” held in the field by the interviewers (see below).

Info letter: 4,000. Mirafiori Sud: 2,000. Barriera di Milano: 2,000.

Interviews: 398. Mirafiori Sud: 221. Barriera di Milano: 177.

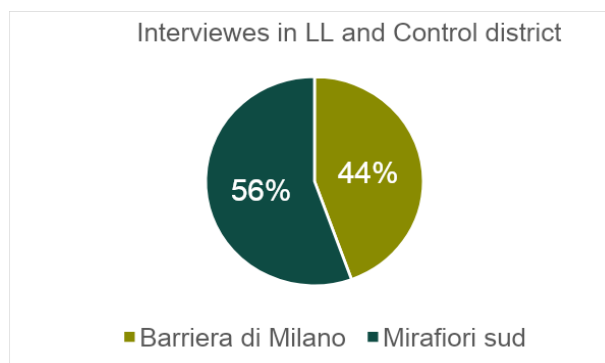


Figure 4. Conducted interviews in LL and CD.

Sampling Methods

In Turin we used three main methods to collect interviews:

1. By appointment with those who contacted us because of the letter or because of the advertising in social media websites (mainly Facebook)
2. Searching Activity. This activity was mainly conducted in two different ways:
 - Approaching citizens in some public locations previously identified (Public library, civic center, local markets, etc.).
 - Contacting citizens during some events occurring in the two districts
3. Involving higher schools located in both the two boroughs. Thanks to the collaboration of teachers and school headmasters, interviewing sessions were organized in two schools (one located in Mirafiori Sud and the other in Barriera di Milano): this made it possible to reach students over 18 that reside in the interested areas. Anyway, as the participation wasn't compulsory, we had a scarce response from the students.

When those citizens approached during the searching activity accepted to be interviewed, interviews took place either in that moment or after arranging an appointment.

A banner about the GQ activity was posted up in some buildings identified as a base location for the interviewers and where to conduct the interviews (called "Case del Quartiere" - Borough houses – public spaces managed by NGOs with the goal to promote social activities for the neighborhood).

The local NGOs contacted for the activity advised us against use door to door technique. This is due to the distrust of the residents that are scared of being defrauded and do not easily allow strangers to come into their houses, even though providing proofs of visitors' identity. It is also necessary to point out that, in some very rare cases, a couple of citizens specifically asked to be interviewed in their home or at their workplaces. This was mainly due to familiar restrictions (e.g. a close relative with disabilities or a young child). Citizens that asked for this specific arrangement have been reached both by letters and during the searching activity.

An additional point of criticism was the low heterogeneity of NGOs and places involved in the searching activity. Even though the participation of local libraries and Borough Houses – and few additional associations – that gave us permission to carry on interviews in their buildings and look for new respondents among their clients and visitors, the possibility of reaching new residents decreased in a short period of time. In fact, these places attract very specific – and in some cases homogenous – people that are not always eligible for the survey (e.g. they work

in the district and use some commodities and services provided by local associations but they are not residents). Moreover, addressing citizens in public spaces without a contact person is unsuccessful (the identification card wasn't always an effective mean). Hence, in many cases the intermediation of local NGOs made it easier to overcome initial suspiciousness towards the survey from those citizens that otherwise would have never accepted to be interviewed.

Course of the Interview

16 students were recruited for the data collection, 15 for conducting the interviews, and one for coordinating the students (back-office job). A list of the interviewees and their contact information (paper copy) were given to the students. Identification cards were also issued to the students to be presented to the residents before starting the interview.

Interview documents included:

- GQ information sheet
- Informed consent sheet
- Contact information sheet
- Two copies of the GQ, one to be handed to the participant and a copy to remain with the interviewer for reading the questions

On the contact information sheet, respondent ID-numbers were given to the residents of the LL and the respondent ID-numbers to the residents of the control district.

The interview length was between 35 minutes and one hour.

Challenges and solutions in conducting the GQ

Unfortunately, it was not possible to reach the required 600 interviews (300 LL + 300 control district) due to many reasons. The main challenges faced while conducting the GQ and the relative solutions applied to increase the response rate are reported in Table 2.

Table 2. Challenges and solutions in the pre-implementation (2019) survey of the General Questionnaire in Turin.

Challenges	Solutions
low response rate	<ul style="list-style-type: none"> • interviewing more than one family member in the same household • snowball sampling: some respondents recommended contacting other citizens who would be interested in the project, however, they didn't receive the invitation letter (less effective than other methods) • approaching people at public events organized by local NGOs and groups that have cooperated with us as well as events organized outside these structures • sending invitations letters twice (the first time in summer, the second in autumn). This solution actually gave a positive feedback in terms of citizens' engagement and response rate
respondents tended to skip certain question on personal information	The purpose of these questions was explained to them as well as that their information will be treated with high confidentiality and the information they provided in the questionnaire will be separated from their personal data. However, especially when it came to information about the economic situation, some interviewees skipped the question anyway
lack of trust in the interviewing system itself and in the interviewers	We relied upon local NGOs and groups that operate at the local level in the neighbourhoods and have already gained citizens' trust. In this way, they have advocated and promoted our initiative.

Participant Feedback

Many participants showed enthusiasm toward taking part in the GQ. On the other hand, the proGReg coordination office and the students received other critical feedback about the content of the GQ and the data collection methods. Following are main comments received:

- Participants showed enthusiasm towards proGReg and the concept of the Nature Based Solutions and expressed their willingness to participate in the project's planned activities. They also would like to be updated on the progress of the project. This unfortunately was not part of the survey and that led to a sense of disappointment. Given this feedback, WP2 (Co-design) could have potentially benefited from the reflection of the participants of the GQ as a tool for community engagement.
- A small number of participants interrupted the interview because they refused to give personal information (e.g. personal address, telephone number...) to be contacted in the future for the second part of the survey. This is related to a general scepticism and to a lack of trust in institutions.
- Most participants complained about the length and complexity of the GQ (45 – 60 minutes). Difficulties also regarded those questions that asked for a calculation of time spent doing some specific activities (e.g. time spent outdoor in summer/winter; hours per day spent being seated...). In many cases, this calculation was subjected to huge approximations. Also, questions concerning for example the emotional aspect or the connection with nature section were considered either too private or – in some cases - pointless, increasing a certain scepticism towards the survey. When it comes specifically to the section about each one's personal connection with nature, some interviewees were disoriented and unable to provide a significant answer.
- Many participants indicated that the content of the invitation letter that described the project was not related to the content of the GQ which collected the personal information of the participants. More specifically, many believed that the municipality wanted to ask them about their neighbourhood living conditions in an extensive way (e.g. bad maintenance of green areas or lack of public services). Also, some citizens expected interviewers to collect their complaints and suggestions about - what they perceived as - real problems and possible solutions. In some cases, this detachment between expected and real questions lead to a further disappointment.
- Some participants of the control district argued that their district should not be part of the survey as no NBS were implemented in their area (Barriera di Milano), but rather in Mirafiori. In many cases, this led to further disappointment, especially because the invitation letter misloaded them.
- Some participants were irritated by certain questions, especially the ones related to their mental and physical health status. A few ended the interview because they felt that the questions were very personal.
- Many participants did not feel comfortable and/or did not answer the questions about their financial situation (salary, rent of the house, etc.).
- Having the possibility of answering the GQ online would have increased the number of participants as many participants asked if it was possible to digitally take part in the survey according to their time of convenience, in many cases at night or at the weekend.
- Some participants preferred to read and fill out the questionnaire by themselves, and it was not necessary for the students to read the questions to them. They said that they would let them know if they had any questions.

City of Zagreb, City Office of Strategic Planning and IMPROVE

Background

The City Office for Strategic Planning and Development of the City of Zagreb is the local coordinator of the EU Project ProGREG which began in June 2018 and is funded under the Horizon 2020 program.

The City of Zagreb implements the project activities at the site of the former Sljeme industrial plant in Sesvete.

This report documents the preparation and process of conducting the General Questionnaire (GQ) carried out by the City of Zagreb, City Office of Strategic Planning and IMPROVE.

The GQ is part of the experimental data of WP4 that aims to collect data on social, health, and economic indicators in the Living Lab (LL) at the NBS and district level before and after implementing the Nature Based Solutions (NBS) to evaluate the change in the quality of life resulting from implementing the different NBS.

Within the project, the first phase of surveys was conducted in the area adjacent to the former factory, and simultaneously in the control area (Špansko-Jug). The purpose of the research is to determine the increase in quality of life by introducing project activities.

General Overview of Preparation and Processing the GQ

- Translating the survey documents (GQ information sheet, informed consent sheet, contact information sheet, and questionnaire)
- Signing of the translated DPO letter
- Selecting the address
- Sending the GQ invitation letter and the data protection notice
- Performing the field survey

Timeframe

From July 17, 2019. until September 15, 2019.

Location, Sample Size, and Responses

Contact area of the former factory Sljeme Sesvete: n = 302, Control area - Špansko-Jug: n = 313.

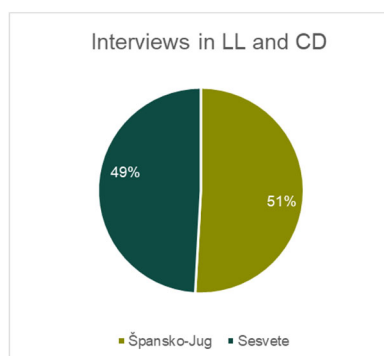


Figure 5. Conducted interviews in LL and CD.

Prior to the start of the survey in Sesvete, the company distributed a total of 7652 leaflets containing a letter describing the proGireg project and an invitation to participate signed by the Head of Office

It was possible to conduct the survey solely by means of interviewers visiting households and trying to persuade the citizens to cooperate. The incidence of consent was highly dependent on the interviewer and his / her approach and experience and ranged from about 15% to 25%.

Course of the Interview

When presenting, the interviewers had all the necessary materials, including the letter and a leaflet about the project.

After the respondents were introduced to the project and the survey method, and if they expressed interest in participating in the survey, the first thing the interviewers obtained was a signature on the consent form confirming the willingness to participate and a completed and signed sheet with the contact details of the respondents. Subsequently, the interviewers surveyed the respondents and guided them through the survey, explaining whatever was necessary.

Whenever possible, interviewers entered the answers directly via tablets into the EUSurvey application, and a portion of the surveys were completed on paper and subsequently entered the EUSurvey application.

After the field survey was completed, a final control of the surveys was made. The surveys entered in EUSurvey were linked with the documents (signed consents and completed contact lists).

Upon completion and after data harmonization, complete documentation (signed consent forms and completed contact information sheets) was submitted to the City of Zagreb.

Challenges and solutions in conducting the GQ

Table 3. Challenges and solutions in the pre-implementation (2019) survey of the General Questionnaire in Zagreb.

Challenges	Solutions
Lack of capacity of the partner employees to conduct such a demanding survey	In order to fulfill the demands of the project, the City Office of Strategic Planning and Development of the City of Zagreb has reallocated part of the personnel cost funds to outsourcing, i.e. we hired an outside firm that specializes in surveys to conduct the survey using the translated questionnaire, so the task was finished in planned time.
Low response rate	The surveyors have sent out a very large number of letters explaining the basic info on the project, with the emphasis on the social and other benefits that the project implementation is expected to have on the area, to convince them to participate.
Scheduling of the survey during the summer, when a large number of local residents were on holidays away from home	The survey was conducted on numerous occasions, making sure that the required number of participants are involved
Some respondents were reluctant to answer some of the questions they felt were too personal	The interviewers needed to be able to respond in an adequate manner and to explain to the respondents that they need not be afraid of anything, that the answers would not be analyzed individually, etc. In most cases the interviewers were eventually able to get all the answers.

Participant Feedback

It is important to stress that in the recent time, the trend that people are unwilling to participate in the face-to-face surveys and prefer to be questioned online, especially if the surveys take 30 minutes or longer to complete.

Some respondents were reluctant to answer some of the questions and commented that it seems like psychoanalysis session.

2. GQ Post-implementation data collection, 2022

City of Dortmund, Department of Urban Renewal

Background

This report documents the preparation and process of conducting the post implementation General Questionnaire (GQ) carried out by the City of Dortmund, Department of Urban Renewal.

The GQ is part of the experimental data of work package 4 (WP4) that aims to collect data on social, health, and economic indicators in the LL at the NBS and district level, before and after implementing the NBS, to evaluate the change in the quality of life resulting from implementing the different NBS. As the pre-implementation GQ was conducted in October-December 2019, this documentation reports summarizes the post implementation GQ in September- December 2022. To obtain comparable results, the same respondents who participated in the pre-implementation survey in 2019 were contacted and re-interviewed in the post-implementation questionnaire in 2022.

Dortmund LL is located in the Huckarde district, the heart of the post-industrial part of Dortmund, where five NBS are implemented. The post-implementation GQ should be conducted at least 24 months after the completion of all NBS, in the same season as the pre-implementation survey. However, the post-implementation GQ was conducted before all NBS in Dortmund have already been implemented for two years (the movement park (NBS1) was completed in October 2022, path connecting Deusenberg to the Huckarde district (NBS6) in November 2022, and the Aquaponic (NBS4) is still at the implementation phase). This has been communicated with the WP4 partners and it was agreed to perform the GQ monitoring despite the delay of implementation in some NBS.

General Overview of Preparation and Processing the GQ

- Selecting and recruiting of interviewers (two MSc students from the TU Dortmund University, Faculty of Spatial Planning)
- Training the interviewers on how to conduct the GQ (online)
- Contacting the interviewees for fixing appointments for the post implementation GQ
- Providing the list of persons to be interviewed and their contact data to the students
- Creating online zoom rooms for each student to conduct the interviews
- Carrying out the interviews either online or by phone
- Recontacting the persons who couldn't be reached or didn't participate in the planned appointments
- Transferring the data into the EU-Survey platform (the original questionnaires – printouts - will be kept at the City of Dortmund until the end of the project in November 2023; after that, they can be destroyed, except for the consent forms, which will be kept or destroyed according to national legislation)

Timeframe

September until December 2022.

Location, Sample Size, and Responses

57 residents of Huckarde and 90 residents of Mengede were invited to participate in the post-implementation GQ either by phone or e-mail in the period of September 19-30, 2022. Out of the 140 invitations, 59 appointments were organized for interviews. 32 residents were not interested in participating in the post-implementation survey, and 49 residents were unreachable, not responding to the invitation e-mails or phone calls despite being contacted multiple times. In addition, 7 participants were scheduled for an interview, but did not participate in the survey because they either canceled their interview appointments or did not join the online meeting (Figure 6).

Contacted: 140. Huckarde: 48. Mengede: 92.

Appointments: 59. Huckarde: 26. Mengede: 33.

Interviews: 52. Huckarde: 24. Mengede: 28.



Figure 6. Conducted interviews in LL and CD (left) and interviews via phone vs by zoom (right).

Sampling Methods

- 133 residents were contacted by telephone and 14 residents by e-mail
- 59 residents expressed their willingness to participate in the Post-implementation GQ, and appointments were made accordingly
- Given Covid prevention and social distancing measures, all participants were offered the option to participate in an online survey via Zoom in addition to the in-person option. All were in favor of using digital format, with many suggesting being interviewed by phone
- Out of 52 conducted interviews, 28 surveys were conducted by telephone (54%) and 24 by zoom call (46%)
- None of the 14 residents contacted by e-mail responded to the invitation

Course of the Interview

Two MSc students were recruited for the data collection, both for conducting the interviews, and for transferring the data to the EU-Survey platform. A list of the interviewees and their contact information (paper copy and online list) were given to the students.

The interview materials included a copy of the GQ sheet for the online interview for the interviewer to read the questions. On the GQ sheet, respondent ID numbers of LL residents and respondent ID numbers of control district residents were noted (no names or personal information). No informed consent sheet was included as all participants have already signed this for the pre-implementation GQ. The interview length was between 35 and 60 minutes.

Challenges and solutions in conducting the GQ

Unfortunately, it was not possible to reach the same number of interviews compared to the pre-implementation in 2019. Following are the main challenges confronted when conducting the GQ and the adopted strategies to increase the response rate:

Table 4. Challenges and solutions in the post-implementation (2022) survey of the General Questionnaire in Dortmund.

Challenges	Solutions
COVID-19 Due to Covid-19 many people did not want to meet in person because of safety issues.	Interview options were offered online and by phone.
Low response rate (52 out of 140 participants in the pre-implementation GQ) - 32 residents were not interested in participating - 49 residents were unreachable - 7 residents didn't join the online interview	Every resident was called several times on different weekdays and was contacted per e-mail. Residents who showed no motivation to participate were offered to have an online interview.
Respondents tended to skip certain questions on personal information	The purpose of these questions was explained to them as well as that their information will be treated with high confidentiality and the information, they provided in the questionnaire will be separated from their personal data.
Cancellation of appointments	With every cancellation there was a phone call or e-mail for a new appointment.

Participant Feedback

Not many participants showed openness toward taking part in the GQ, especially that for many the implemented NBS were not visible and therefore cannot provide information on the change occurred after implementation. Furthermore, the proGlgreg coordination and the students received other critical feedback about the content of the GQ especially about questions related to health and well-being situation. Following is a summary of the comments received:

- The majority of participants would have liked to be updated on the progress of the project.
Some of them could not remember their participation in the pre-implementation.
Communication about the progress of the project was not part of the survey and that led to a sense of disappointment.
- Some participants complained about the length of the GQ (45 – 60 minutes).

- Compared to 2019, more participants were open and comfortable to answer the questions about their financial situation.
- Some participants were irritated by certain questions, especially the ones related to their mental and physical health status. A few skipped certain questions because they felt that the questions were very personal or incomprehensible.
- Many participants mentioned that the questions in section 3 “Connection with nature” were too esoteric.
- Some participants did not know that the places they visit are part of the proGReg, e.g. St Urbanus urban gardening project. Most participants did not know anything about NBS 8 “Increase of biodiversity”.
- Implementing the GQ via zoom was twice as fast as by phone.
- Some participants preferred to read the questionnaire via zoom by themselves, and it was not necessary for the students to read the questions to them. They said that they would let them know if they had any questions.

City of Turin, EU funds and Innovation Department

Background

The GQ (post – implementation) has been submitted in the LL of Turin, Mirafiori Sud District, and in the control district (Barriera di Milano) like it has been done during the pre-implementation phase. Both districts have similar characteristics of post-industrial and peripheral areas: abandoned industrial spaces, high percentage of elderly and foreign people, diffused social and economic low profiles.

General Overview of Preparation and Processing the GQ

In Turin, this activity was held in two sessions, both managed in the same way. The first one was performed before summertime break (June and July) and the second one by the end of August and September 2022.

The activities related to the GQ were managed together with the “visitor questionnaire” that was filled by the interviewers in two NBS areas: New Soil (NBS 2) and Orti Generali (NBS 3.2).

The steps of monitoring and survey activities are summarized below.

- Selecting and recruiting of interviewers (BSc and MSc students)

The City of Torino has launched a call, in May 2022, to engage with internship programme students from the University of Turin. More than 10 people have applied to it and 9 were selected to perform the two surveys (General Questionnaire post and visitor questionnaire).

- Training the interviewers

The training activities were conducted in two ways:

- a. Online classes: three hours were dedicated, by University of Puglia and City of Torino to explain to the interviewers the proGReg project and the specific tasks they were engaged for.
 - b. Site visits: a walking tour through the NBS realized in the Life Lab of Mirafiori Sud was organized in order to help students in orientating themselves within the District and know the typologies of intervention and results implemented and obtained thanks to proGReg project.
- Performing the field survey

Following the training course, the students were able to start managing the survey autonomously. Nevertheless, a constant support was provided to them also by involving the managers of Orti Generali who help the students in identifying potential interviewees. The GQ activity was supervised by a student who contacted the residents already interviewed in 2019. Once the agreement on a second interview has been found, the coordinator student has set up the meeting for the interview by matching the timeframe agreed with student availability.

Timeframe

First session: 07/06/2022 – 29/07/2022

Second session: 25/08/2022 – 22/09/2022

Location, Sample Size, and Responses

Interviews: 119. Mirafiori Sud: 75. Barriera di Milano: 44

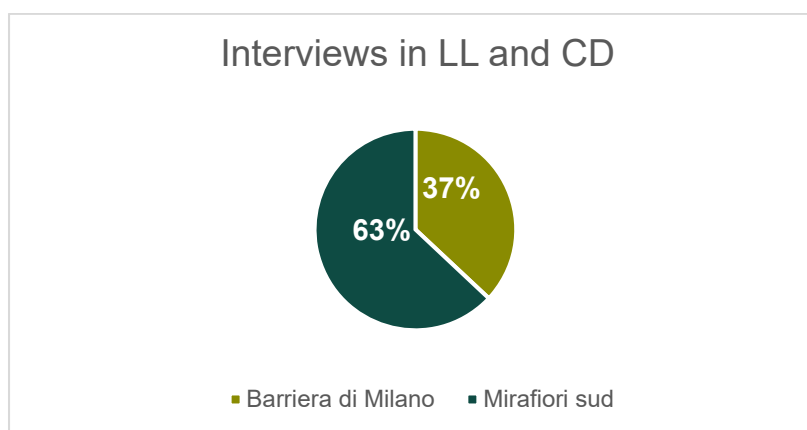


Figure 7. Conducted interviews in the LL and CD

Sampling Methods

The list of pre-implementation questionnaires was the source of data to involve the interviewees. The dataset of 398 of residents in the two districts was checked and used for the post-implementation survey. Unfortunately, a large number of interviewee contacts were no more available or resulted to be useless because of no reply. Some contacts were wrongly reported, or they were incorrect.

The supervisor contacted the potential interviewees via email and telephone. The contacts via email received very few replies, 5 upon more than 50 messages sent. The telephone resulted more useful, unless many people refused to give again their availability to be interviewed.

Course of the Interview

9 students were recruited for the data collection, and 1 for coordinating the students (back office job). Identification cards were also issued to the students to be presented to the residents before starting the interview. Having the interviewees already filled their informed consent there was no need to give them any document to be filled in. A google sheet form was established by the City, for planning and checking the activity.

The interview length was between 35 minutes and one hour and a half.

Challenges and solutions in conducting the GQ

Unfortunately, it was not possible to reach the required 398 interviews due to many reasons. The main challenges faced while conducting the GQ and the relative solutions applied to increase the response rate are reported in Table 5.

Table 5. Challenges and solutions in the post-implementation (2022) survey of the General Questionnaire in Turin.

Challenges	Solutions
respondents tended to skip certain question on personal information	The purpose of these questions was explained to them as well as that their information will be treated with high confidentiality and the information they provided in the questionnaire will be separated from their personal data. However, especially when it came to information about the economic situation, some interviewees skipped the question anyway.
lack of trust in the interviewing system itself and in the interviewers	We relied upon local staff of Orti Generali and groups that operate at the local level in the neighbourhoods and have already gained citizens' trust. In this way, they have advocated and promoted our initiative.
Uncomfortable reply from interviewed (mainly from control group)	The disappointment to not have been included in the Living Lab produced, fortunately few times, disturbing reactions that consequently ended the interview.
Difficulty in understanding some questions	Face to face interviews allowed to explain the sense and meaning of each questions, but it was a time consuming activity that prolonged the interview for more than an hour

Participant Feedback

The residents who participated and are currently actively frequenting the implemented NBS showed enthusiasm toward taking part in the GQ. On the other hand, the proGReg coordination office and the students received other critical feedback about the content of the GQ. The criticism encountered during the pre-implementation survey were almost the same already illustrated in the previous report. Following is a summary of the comments received:

Some participants showed enthusiasm towards proGReg and the concept of the Nature Based Solutions and expressed their willingness to participate in the project's activities. Notably, while some respondents were happy to live in a district with many green areas, other consider them too few or distant from their place.

Few participants refused to be interviewed by missing the meeting after having agreed on the appointment, showing an irresponsible behaviour.

A small number of participants interrupted the interview because they refused to give personal information (e.g. personal address, telephone number...). A second element causing interruption or no response was the feeling of repetitiveness in some questions.

Other issues encountered by the interviewer in both phases:

- excessive length and complexity of the GQ
- huge approximation by respondents due to very detailed and precise measurement
- disorientation feeling because of some questions (economic, health and social condition issues)

Some participants of the control district argued that their district should not be part of the survey as no NBS were implemented in their area (Barriera di Milano), but rather in Mirafiori. In many cases, this led to further disappointment.

City of Zagreb, City Office of Economy, Environmental Sustainability and Strategic Planning and IMPROVE company

Background

As part of the proGlgreg project, a second round of population surveys was carried out in the area of Sesvete, as well as in the control area (Špansko). The purpose of the research was to monitor the success of the implementation of the project activities.

This report documents the preparation and process of the second round of surveys carried out by the City of Zagreb, City Office of Economy, Environmental Sustainability and Strategic Planning (successor to the City Office of Strategic Planning and Development) and IMPROVE Research and Analytics.

The GQ is part of the experimental data of WP4 that aims to collect data on social, health, and economic indicators in the Living Lab (LL) at the NBS and district level before and after implementing the Nature Based Solutions (NBS) to evaluate the change in the quality of life resulting from implementing the different NBS.

Within the project, the first phase of surveys was conducted in the area adjacent to the former factory, and simultaneously in the control area (Špansko-Jug). The purpose of the research is to determine the increase in quality of life by introducing project activities.

General Overview of Preparation and Processing the GQ

- Translating the changed documents (2nd round questionnaire was a bit different)
- Contacting the people that have participated in the first round
- Performing the field survey

Timeframe

From September 9th, 2022 until October 20th, 2022.

Location, Sample Size, and Responses

Contact area of the former factory Sljeme Sesvete: n = 93

Control area - Špansko-Jug: n = 118.

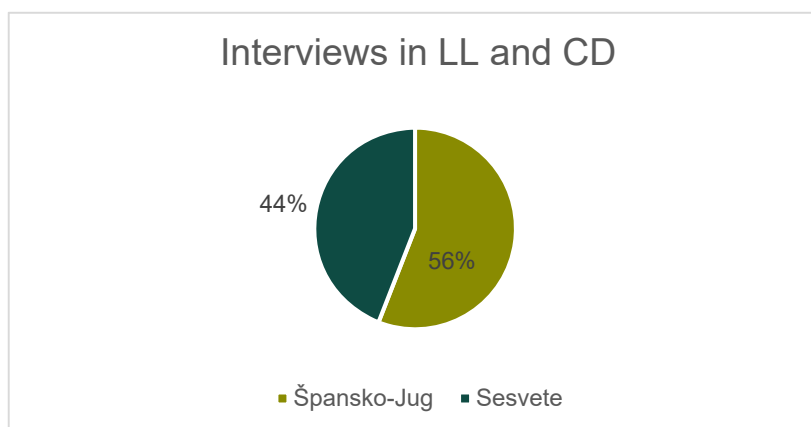


Figure 8. Conducted interviews in the LL and CD.

Before the start of the survey, the surveying company has distributed letters to respondents who participated in the first phase of the survey (302 in the area of Sesvete and 313 in the area of Špansko), reminding them of the first phase of the survey and inviting them to participate in the second phase. The letter briefly describes the project and its benefits for the local population.

Respondents had the option to respond via their preferred communication channel (mail, e-mail, phone call, text message).

Course of the Interview

Since the response to the letters was extremely low, the interviewers called all those respondents who did not respond and "persuaded" them to cooperate.

An interview date was arranged by phone with respondents who agreed to participate.

The interviewers gave the questionnaires to the respondents and guided them through the survey and assisted, i.e. additionally explained whatever was necessary.

Surveys were completed "on paper" and subsequently entered into the EUSurvey application.

After the completion of the field survey, a final revision of the questionnaires was made. The necessary corrections to the entries in EUSurvey were recorded in an xlsx table and sent to the client.

Upon completion and after harmonizing the data, complete documentation was delivered to the city of Zagreb (signed consents and filled-in lists with contact information collected in the first phase of the survey).

Challenges and solutions in conducting the GQ

- In the second round of surveying, there were even more challenges than was the case with the 1st round.
- It was more difficult to persuade the respondents to participate for the second time, because recalling the first contact, they assessed the survey as very detailed and that certain questions (most often personal questions) were difficult or uncomfortable for them to answer.
- The COVID-19 pandemic certainly had an impact on response, as many respondents, especially the elderly, expressed fear of the interviewer coming to their homes, even after the interviewer assured them that they would respect all epidemiological measures.
- Sometimes it even happened that even after a successfully arranged survey appointment, the respondents were not at home or were not able to complete the survey, so the interviewers had to come again to the same address at another appointment.
- With all these challenges, the interviewers tried to do everything to conduct as many surveys as possible, and with the respondents who did participate, answers were successfully collected on the vast majority of topics/questions, so that almost all surveys were completed.
- Although there was an already existing database of respondents who participated in the 1st contact, this turned out to be complicated for several reasons.
- At the 1st contact, the interviewers went to the given area and it was easier for them to arrange the survey because they did the survey on the spot with those respondents who were available and willing to participate at that moment.
- This time the surveying company had to survey those same people after 3 years, which turned out to be very demanding.
- To begin with, a very small number of people responded after receiving the letter inviting them to participate, when it was only necessary to agree on a survey date and conduct the survey.
- All other respondents had to be contacted by phone and persuaded to cooperate.
- Part of the respondents could not even be reached by phone because they did not answer, or the number is no longer used.
- In such situations, the interviewers tried to reach these respondents by going to those addresses, sometimes on multiple occasions because the respondents were not at home, and there were also cases where these people no longer even live at those addresses.

Participants Feedback

The length of the survey (about 30 minutes on average) is certainly a disrupting factor for this type of research.

Some of the respondents could not be contacted because they did not answer the phone or that number is no longer used since 3 years have passed since the first contact.

It was difficult to persuade the respondents to participate, also for the reason that they evaluated the survey from their recollection of the first contact as very detailed and with some questions that were difficult or embarrassing for them to answer.

With respondents who nevertheless agreed to participate, answers were successfully collected on the vast majority of topics/questions so almost all surveys are completely filled out.

3. Statistical analysis of participants by gender and age

Sample characteristics are presented in Table 6. At pre-implementation assessment, distribution of gender and age was comparable between the sample from the LL and from CD, for all FRC. Due to the low response rate at follow-up, the distribution of participant characteristics in the LL and CD groups was no longer equal at post-implementation assessment. In Dortmund in the control district, substantially more women (73%) than men (27%) participated in the post-questionnaire. Also in Turin in the LL and in Zagreb in the CD, somewhat more women than men were responsive to the post-implementation questionnaire (64% women in Turin LL, 61% women in Zagreb CD). In Dortmund, also the age group was less normally distributed in post- compared to pre-implementation assessment. Note that especially for Dortmund the total number of participants at post-implementation was very low (N = 21 in LL, N = 27 in CD). The small sample size reduces the power to detect effects of the NBS implementation, for which the results for Dortmund should be interpreted with caution.

Table 7 compares the sample characteristics of all participants with the participants who took part at pre- and post-assessment. Gender distribution did not significantly differ between all participants and those who responded to pre- and post-implementation assessment. The distribution in age group differed significantly for Turin and Zagreb. Fewer participants under 25 years of age responded to follow-up assessment in Turin LL. Also in Zagreb, younger participants were less likely to also participate at post-implementation assessment whereas older participants showed to be more responsive.

Table 6. Participants' description in the pre- and post-implementation data collection of the GQ, in both LL and CD of the three European FRC, according to gender and age.

	DORTMUND								TURIN								ZAGREB								
	Pre				Post				Pre				Post				Pre				Post				
	LL		CD		LL		CD		LL		CD		LL		CD		LL		CD		LL		CD		
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
GENDER																									
Female	26	49%	50	57%	9	45%	19	73%	112	54%	81	50%	47	64%	18	44%	177	59%	185	59%	53	57%	70	61%	
Male	27	51%	38	43%	11	55%	7	27%	97	46%	82	50%	27	36%	23	56%	124	41%	127	41%	40	43%	45	39%	
Third gender	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	
AGE																									
<25	3	6%	3	3%	1	5%	0	0%	61	29%	38	23%	7	9%	2	5%	27	9%	18	6%	2	2%	5	4%	
25-35	6	12%	5	6%	1	5%	1	4%	17	8%	28	17%	11	15%	10	23%	60	20%	46	15%	13	14%	7	6%	
36-45	6	12%	15	17%	6	29%	4	15%	17	8%	19	12%	8	11%	6	14%	63	21%	51	16%	15	16%	24	21%	
46-55	8	15%	23	26%	1	5%	5	19%	32	15%	20	12%	10	13%	9	21%	69	23%	85	27%	27	29%	22	19%	
56-65	17	33%	23	26%	9	43%	6	22%	28	13%	27	16%	16	21%	7	17%	50	17%	61	20%	20	22%	30	26%	
>65	12	23%	19	22%	3	14%	11	41%	54	26%	32	20%	23	31%	9	21%	32	11%	51	16%	16	17%	26	23%	
TOTAL	53		88		21		27		209		164		75		43		301		312		93		115		

Table 7. Sample characteristics of all participants and of the group who participated at pre- and post-implementation, with test for difference.

	DORTMUND								TURIN								ZAGREB							
	LL				CD				LL				CD				LL				CD			
	All		Pre & Post		All		Pre & Post		All		Pre & Post		All		Pre & Post		All		Pre & Post		All		Pre & Post	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
GENDER	p = 0.9627				p = 0.207				p = 0.1794				p = 0.6253				p = 0.8493				p = 0.8547			
Female	26	49%	9	45%	50	57%	19	73%	112	54%	47	64%	81	50%	18	44%	177	59%	53	57%	185	59%	70	61%
Male	27	51%	11	55%	38	43%	7	27%	97	46%	27	36%	82	50%	23	56%	124	41%	40	43%	127	41%	45	39%
Third gender	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
AGE	p = 0.3552				p = 0.5849				p = 0.01221				p = 0.1362				p = 0.05743				p = 0.03307			
<25	3	6%	1	5%	3	3%	0	0%	61	29%	7	9%	38	23%	2	5%	27	9%	2	2%	18	6%	5	4%
25-35	6	12%	1	5%	5	6%	1	4%	17	8%	11	15%	28	17%	9	23%	60	20%	13	14%	46	15%	7	6%
36-45	6	12%	6	30%	15	17%	4	15%	17	8%	8	11%	19	12%	5	13%	63	21%	15	16%	51	16%	24	21%
46-55	8	15%	1	5%	23	26%	5	19%	32	15%	10	14%	20	12%	9	23%	69	23%	25	27%	85	27%	22	19%
56-65	17	33%	8	40%	23	26%	6	23%	28	13%	16	22%	27	16%	7	18%	50	17%	20	22%	61	20%	30	26%
>65	12	23%	3	15%	19	22%	10	38%	54	26%	22	30%	32	20%	8	20%	32	11%	16	18%	51	16%	26	23%
TOTAL	53		20		88		26		209		74		164		41		301		93		312		115	

4. General considerations

The three European FRCs followed a standardized procedure for recruitment and data collection, in accordance with WP4. Before getting started, WP4 trained the interviewers. WP4 also supported the whole process through informal exchange of information and formal telematic meetings in order to implement strategies to reach the target number of completed questionnaires.

All cities sent a first information letter to the population in order to invite to participate in our research. In Turin, the invitation letters were sent a second time. As expected, the response rate was very variable between cities and was between 15% and 40%.

The timing for data collection varied. In Dortmund, data collection pre-implementation took place in the months of October, November and December 2019; in Turin from June to December 2019 with a suspension of a couple of weeks during October; in Zagreb, the entire summer season was covered, i.e., from July to September 2019. The post-implementation phase ran between September and December 2022 in Dortmund, June-July and late August-September 2022 in Turin, and September and October 2022 in Zagreb.

Although the three cities reported the same difficulties, the final outcome differed. In the pre-implementation assessment in 2019 the city of Dortmund collected 140 interviews (48 in Huckarde and 92 in Mengede), the city of Turin has collected a total of 398 interviews (221 in Mirafiori Sud and 177 in Barriera di Milano). Only the city of Zagreb managed to reach and even exceeded the determined target number of interviews, previously set at 600 (302 from Sljeme Sesvete and 313 from Špansko-Jug).

The number of respondents at post-implementation dropped between 66%-69% and was 48 in Dortmund, 119 in Turin and 211 in Zagreb (Table 8).

Table 8. Number of participants who completed the General Questionnaire at pre- and post-implementation.

Time of GQ assessment	Dortmund	Turin	Zagreb
pre-implementation	N = 141	N = 373	N = 614
post-implementation	N = 48	N = 119	N = 211
pre- and post-implementation	N = 46	N = 115	N = 209
% of drop-out	67.4%	69.2%	66.0%

Possible reasons for the high drop-out are: the length of the survey (between 35 and 60 minutes), the survey was administered by a third person (i.e., the interviewer) that might have complicated the timing to plan the interview, and/or might have made participants reluctant to participate due to privacy concerns. The mitigation measures, being outsourcing to specialized personnel in Zagreb, emphasizing the social and other benefits the project might have, conducting the survey at numerous occasions, and the explanation and reassurance about the processing of personal data, showed to be insufficient. Finally, at the end of the pre-implementation questionnaire, some participants indicated that they experienced some questions as too personal, which might have prevented them from participating in the post-implementation interview.

Overall, at the pre-implementation assessment, the quality of the interview was rated as positive or neutral. In the city of Zagreb participants reported to be the most satisfied with the course of the interview (65% rated it as “easy” and 30% as “neither easy nor difficult”). Among the interviewers, in Dortmund and Zagreb, 3-5% of them rated the interview as “moderate”, while the same rating was provided by 15% of Turin’s interviewers. Lastly, a negligible percentage (1%) rated the interview as “poor” in Dortmund and Zagreb, compared to 4% of Turin’s interviewers (Figure 9).

QUALITY OF THE INTERVIEW ACCORDING TO THE PARTICIPANTS

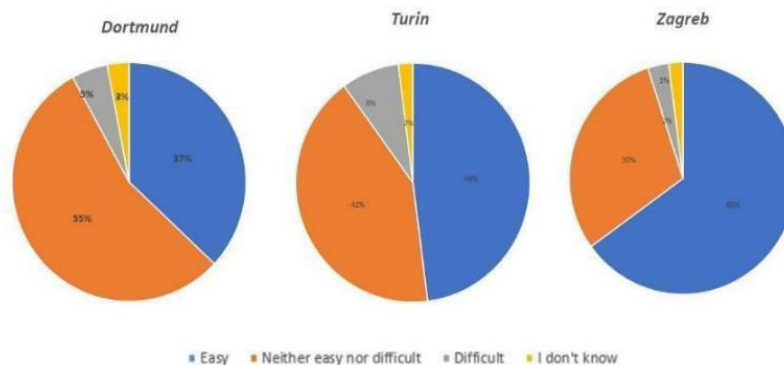


Figure 9. Distribution on response regarding the perceived quality of the interview at pre-implementation assessment in 2019 according to the participants.

At post-implementation assessment, participants again evaluated the quality of the interview. The rating of the quality of the interview at pre and post-implementation assessment is presented in Figure 10. In all cities, the interview was perceived as easy by a higher percentage of participants at post- compared to pre-implementation assessment. It is likely that some of the individuals who rated the interview as difficult at pre-implementation, did not participate again at post-implementation. At both time points, more than 90% of participants perceived the interview as easy or neither easy nor difficult.

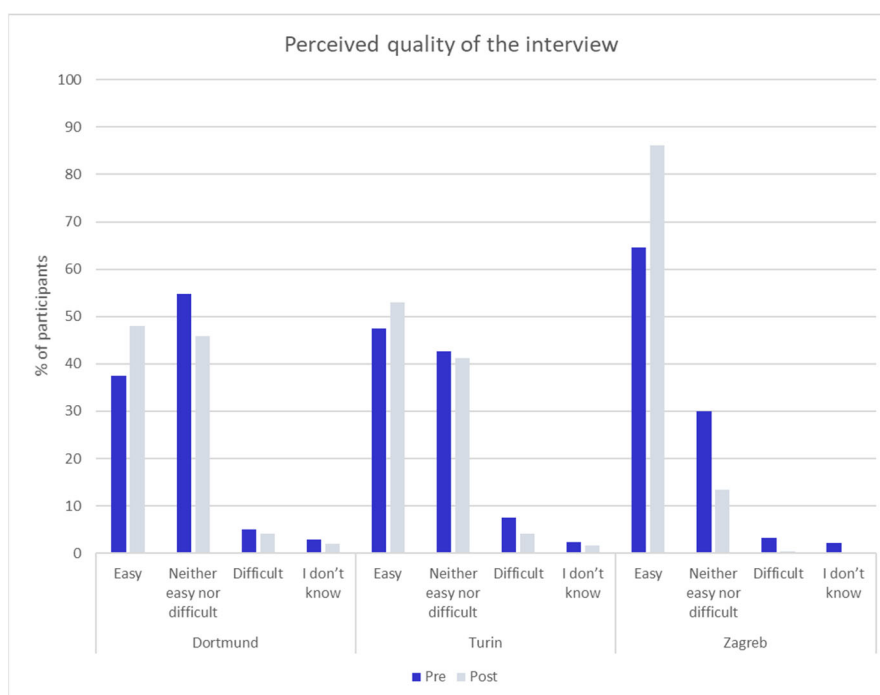


Figure 10. Distribution of participants' response regarding the perceived quality of the interview at pre 2019 and post-implementation 2022 assessment.

The information reported by the cities provides useful insights for future planning of questionnaires. Participants from each FRC complained about some aspects of the general

questionnaire such as the excessive length and the presence of uncomfortable questions. The content of the invitation letters was deemed too far from the actual content of the questionnaire. Some participants proposed the use of multimedia platforms for receiving and completing the questionnaire online.

Regardless of the final outcome, the entire procedure developed by each city has strengths, briefly summarized below.

Dortmund

Pre-implementation assessment: application of a door-to-door technique to directly approach the target population; organization of public events in the neighborhoods concerned in order to increase the sample size.

Post-implementation assessment: Master students re-contacted participants telephone and by e-mail. All participants were offered the option to participate in an online survey via Zoom in addition to the in-person option. All were in favor of using digital format, with many suggesting being interviewed by phone.

Turin

Pre-implementation assessment: Second sending of invitation letters following the unsatisfactory response of the population to the first sending; organization of public events in the neighborhoods concerned in order to increase the sample size.

Post-implementation assessment: Before the start of the survey, the surveying company has distributed letters to respondents who participated in the first phase of the survey.

Zagreb

Pre-implementation assessment: hiring specialized personnel to conduct the survey using the translated questionnaire.

Post-implementation assessment: the surveying company distributed letters to respondents who participated in the first phase of the survey reminding them of the first phase of the survey and inviting them to participate in the second phase. The letter briefly describes the project and its benefits for the local population.

Annex 3 - Descriptive and main analysis of data on socio-cultural inclusiveness from the GQ

City of Dortmund

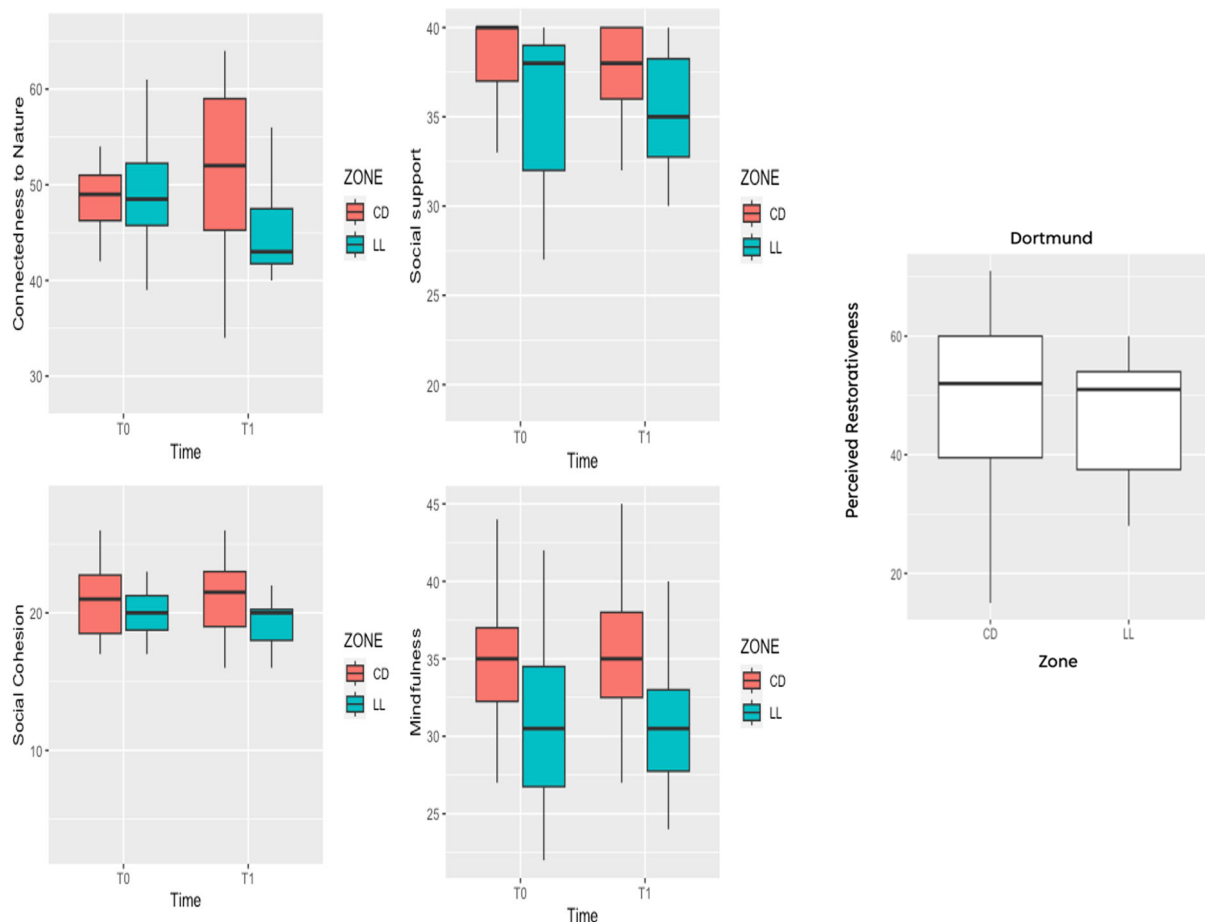


Figure 1. Left: boxplot of Connectedness to Nature, Social Support, Social Cohesion, and Mindfulness at T0 and T1 split by Zone (CD vs. LL) in the city of Dortmund. Right: Boxplot of Perceived restorativeness split by Zone (CD vs. LL) in the city of Dortmund.

The effect of Zone (CD vs. LL) was significant for the Social Support total score. The pairwise paired t-test for Zone showed significant difference between the CD group and LL group in the Social Support total score. No significant results were found in Social Cohesion total score, there were no difference between T0 and T1 neither between CD and LL. The effect of Zone (CD vs. LL) was significant for the Mindfulness total score.

The pairwise paired t-test for Zone showed a significant difference between the Mindfulness total score CD group and LL group for the Mindfulness total score at T1. Difference between the T0 and T1 were not found.

No significant differences between CD and LL were showed for Perceived Restorativeness total score.

City of Turin

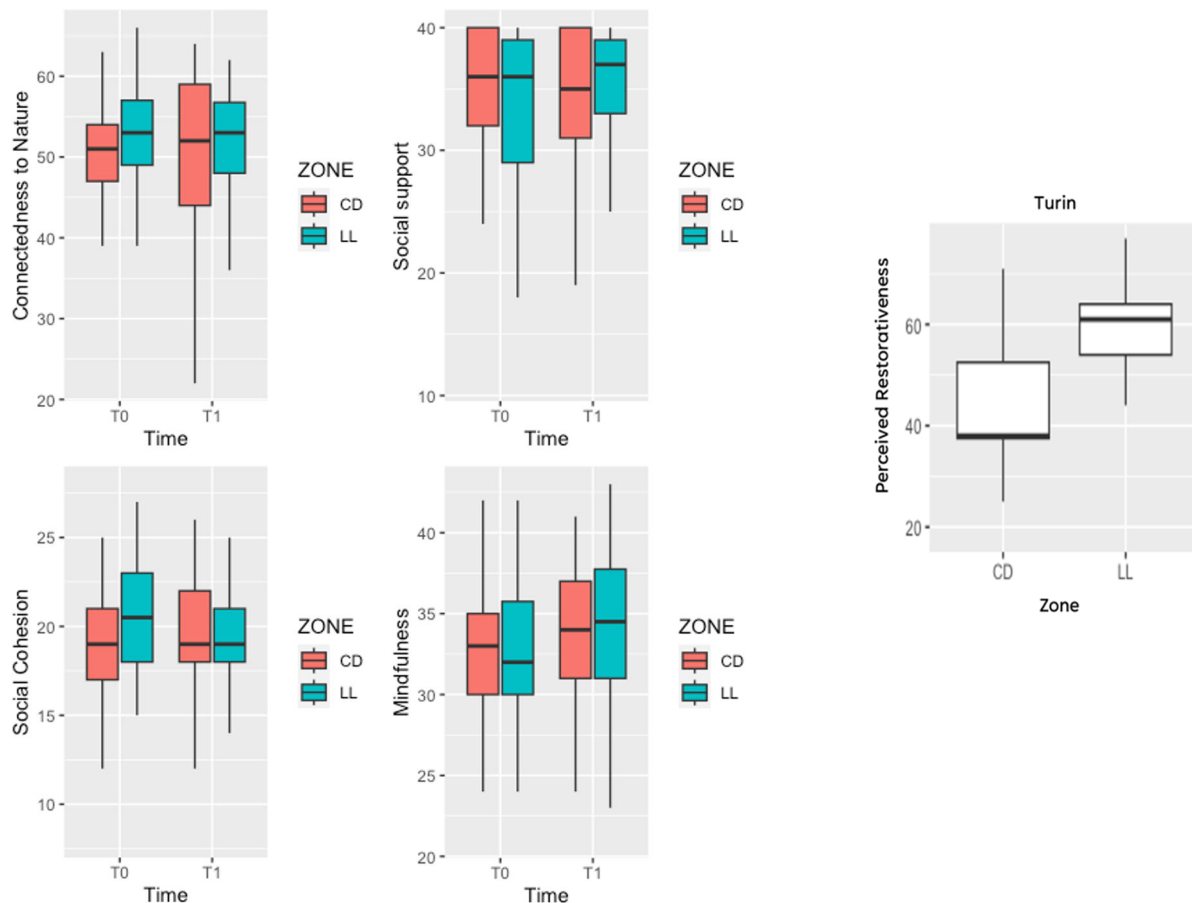


Figure 2. Left: Boxplot of Connectedness to Nature, Social Support, Social Cohesion, and Mindfulness at T0 and T1 split by Zone (CD vs. LL) in the city of Turin. Right: Boxplot of Perceived Restorativeness split by Zone (CD vs. LL) in the city of Turin.

No significant results were found in Connectedness to Nature total score, there were no difference between T0 and T1 neither between CD and LL. No significant results were found in Social Cohesion total score, there were no difference between T0 and T1 neither between CD and LL. The interaction between Time (T0 vs. T1) and Zone (CC vs. LL) was significant for the Social Support total score.

The simple main effect of the time variable was explored, and the effect of time was significant in the LL group. The pairwise comparisons between time point (T0 and T1) at each Zone group showed that the difference between T0 and T1 in the LL group in the Social Support total score was significant. The effect of Time (T0 vs. T1) was significant for the Mindfulness total score. The pairwise paired t-test for time showed a significant difference between the Mindfulness total score at T0 and the Mindfulness total score at T1. Difference between the CD group and LL group were not found.

A significant difference between CD and LL were showed for Perceived Restorativeness total score.

City of Zagreb

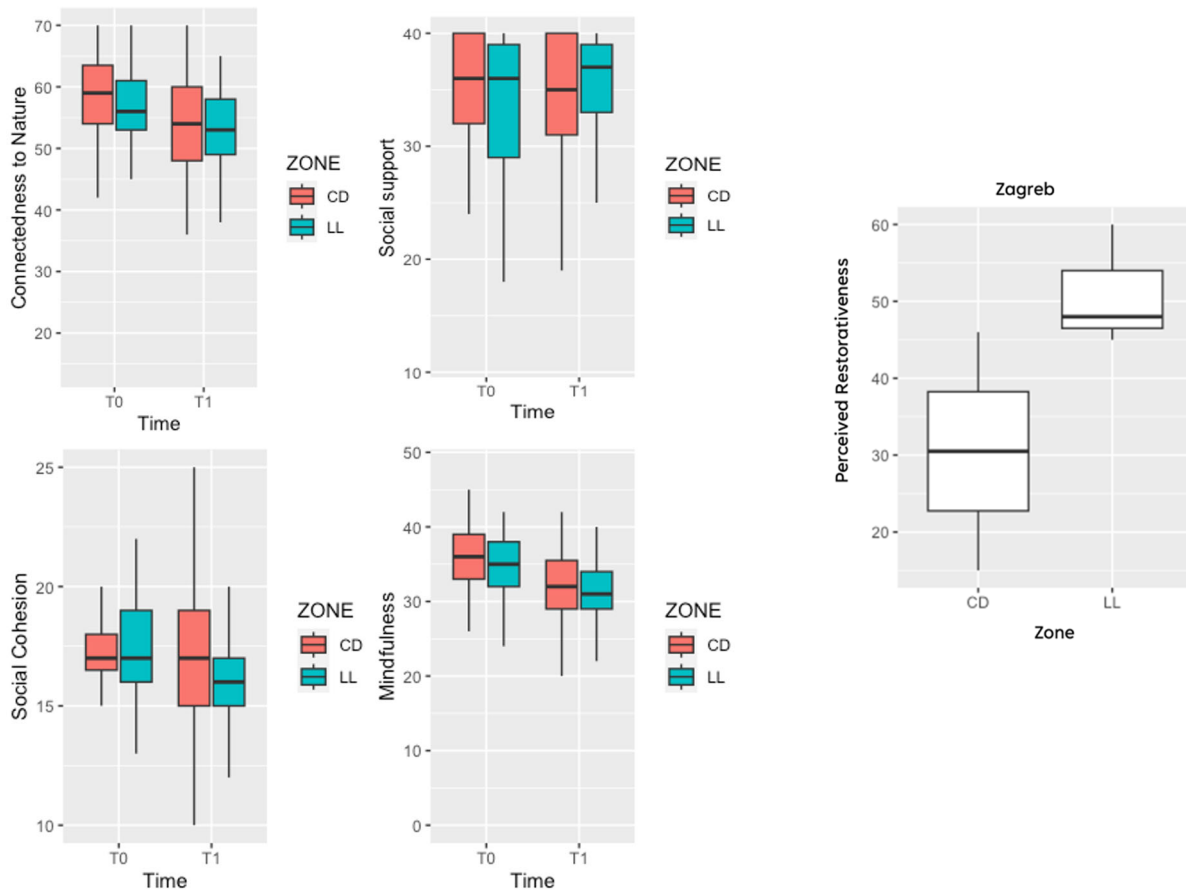


Figure 3. Boxplot of Connectedness to Nature, Social Support, Social Cohesion, and Mindfulness at T0 and T1 split by Zone (CD vs. LL) in the city of Zagreb. Boxplot of Perceived Restorativeness split by Zone (CD vs. LL) in the city of Zagreb.

The effect of Time (T0 vs. T1) was significant for the Connectedness to Nature total score. The pairwise paired t-test for time showed a significant difference between the Mindfulness total score at T0 and the Mindfulness total score at T1.

Difference between the CD group and LL group were not showed. No significant results were found in Social Support total score, there were no difference between T0 and T1 neither between CD and LL. The effect of Time (T0 vs. T1) was significant for the Social Cohesion total score. The pairwise paired t-test for time showed a significant difference between the Mindfulness total score at T0 and the Social Cohesion total score at T1. Difference between the CD group and LL group were not found.

The effect of Time (T0 vs T1) was significant for the Mindfulness total score. The pairwise paired t-test for time showed a significant difference between the Mindfulness total score at T0 and the Mindfulness total score at T1. Difference between the CD group and LL group were not found.

No significant differences between CD and LL were showed for Perceived Restorativeness total score.

Perceived social interaction

Table 1: Percentage of self-reported daily social interaction with neighbours for each district for each FRC.

Perceived social interaction			
Turin	CD	T0	56% daily interaction
		T1	39% daily interaction
	LL	T0	50% daily interaction
		T1	50% daily interaction
Dortmund	CD	T0	65% daily interaction
		T1	65% daily interaction
	LL	T0	65% daily interaction
		T1	75% daily interaction
Zagreb	CD	T0	35% daily interaction
		T1	23% daily interaction
	LL	T0	55% daily interaction
		T1	33% daily interaction

Annex 4 - Descriptive analysis of data on health and well-being from the GQ

For each of the health and well-being indicators, the descriptive statistics comparing baseline and post-implementation for the LL and CD are presented in barplots. The barplots present the results restricted to the sample of participants who responded to both the pre- and post-implementation questionnaire. This way, the bars in the graphs represent the level of health and well-being as was reported before and after implementation of the NBS by the same individuals. The number of participants (N) is presented in the figures. Following the figure presenting the descriptive statistics of each health indicator, the results of the effect analyses are presented in a table.

For each of the indicators, a multilevel generalized mixed model (GLMM) was fitted to analyse the effect of the implementation of the NBS on the health indicator, comparing the change in the health outcome from pre- to post-implementation assessment between the LL and the CD. The individual was added as random intercept, for which all participants could be included in these analyses (i.e., also those who did not participate in both the pre- and post- implementation assessment) because the model accounts for the data being nested within individual. The analyses are adjusted for age, gender and education level. The results for Dortmund (and in a lesser extent also Turin) should be interpreted with more caution due to the small sample size.

- Visits and satisfaction with green and blue spaces

8.31.4 - Frequency of use of green and blue spaces

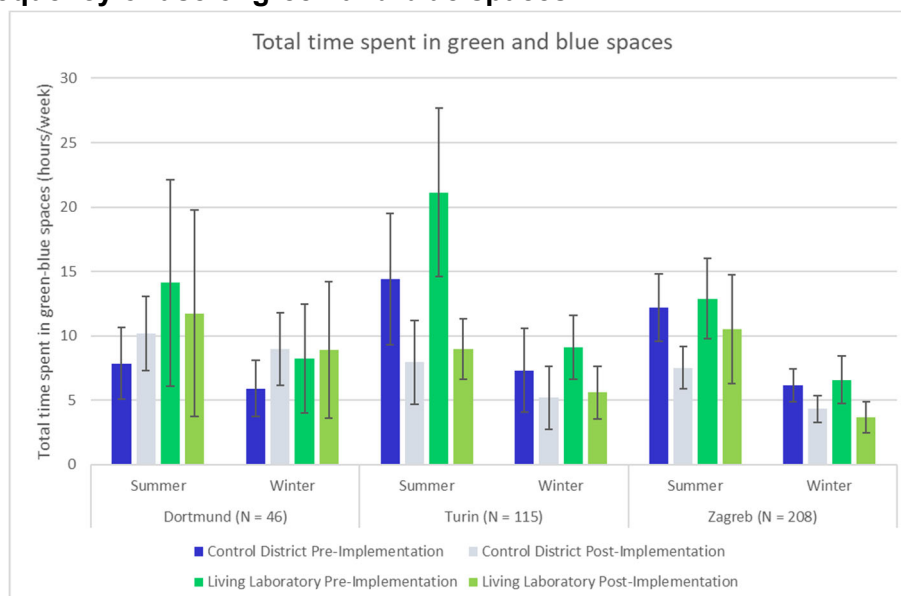


Figure 1. Time spent in natural spaces (parks, woods, agricultural fields, blue areas) in summer and winter, comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook’s KPI 8.31.4 - Frequency of use of green and blue spaces).

Table 1. Effect on time spent in natural spaces (parks, woods, agricultural fields, blue areas). Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Season	Beta	Std err	<i>t</i> (df)	<i>p</i>	95% CI	Adj R ²
Summer	Dortmund	-2,3578	3,6301	84,5856	0,5178	-9,3766; 4,8156	0,4020
	Turin	-2,5829	4,4088	216,9182	0,5586	-11,1769;6,1302	0,2695
	Zagreb	4,4716	2,5500	301,3375	0,0805	-0,5104;9,5083	0,3077
Winter	Dortmund	-0,6880	2,5991	87,6612	0,7919	-5,7144;4,4450	0,3238
	Turin	-1,4914	1,8205	254,8297	0,4134	-5,0487;2,0658	0,3261
	Zagreb	-0,4274	1,1715	203,7093	0,7156	-2,7193;1,8800	0,5252

8.33 - Satisfaction with green and blue spaces

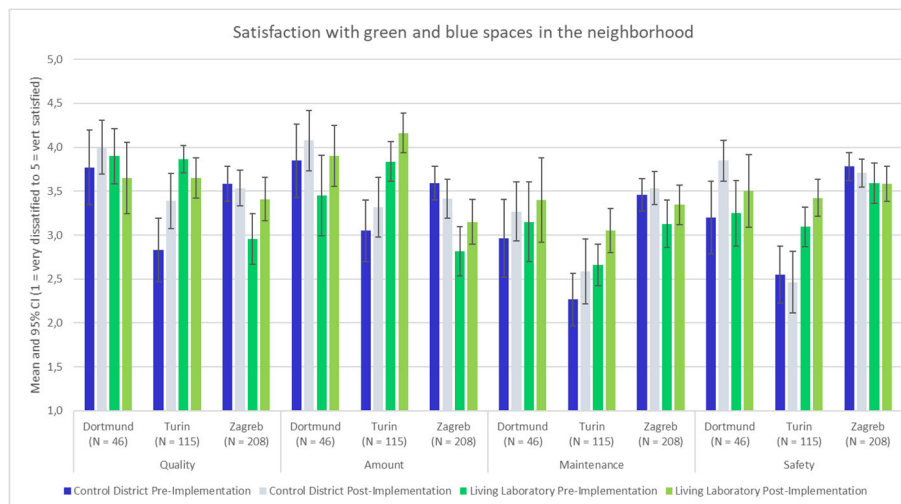


Figure 2. Satisfaction with natural spaces in the neighbourhood, comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook’s KPI 8.33 - Satisfaction with green and blue spaces).

Table 2. Effect on satisfaction with green and blue spaces in the neighbourhood. Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Domain	Beta	Std err	<i>t</i> (df)	<i>p</i>	95% CI	Adj R ²
Dortmund	Quality	-0,4828	0,3015	82,5251	0,1131	-1,0695;0,1078	0,2511
	Amount	0,0810	0,2885	70,8809	0,7796	-0,4934;0,6388	0,4806
	Maintenance	0,0635	0,3144	84,3219	0,8405	-0,5440;0,6925	0,3742
	Safety	-0,3509	0,3039	62,4469	0,2526	-0,9423;0,2492	0,4123
Turin	Quality	-0,8010	0,1938	207,4925	0,0001	-1,1791;-0,4205	0,4417
	Amount	-0,1134	0,1923	190,7895	0,5562	-0,4925;0,2616	0,5428
	Maintenance	0,0460	0,2037	225,1086	0,8216	-0,3520;0,4444	0,4079
	Safety	0,3437	0,2052	196,7060	0,0955	-0,0588;0,7444	0,4464
Zagreb	Quality	0,2955	0,1628	339,8428	0,0705	-0,0256;0,6136	0,4369
	Amount	0,2479	0,1599	341,7530	0,1221	-0,0697;0,5608	0,4586
	Maintenance	0,0405	0,1671	363,2975	0,8084	-0,2873;0,3672	0,3249
	Safety	0,1629	0,1559	302,6856	0,2971	-0,1418;0,4720	0,3293

22.12 Visual access to green space

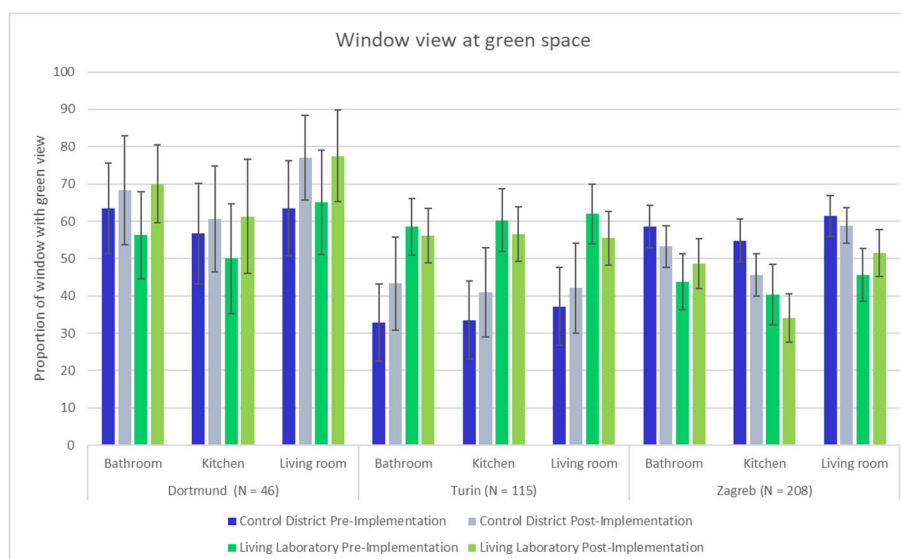


Figure 3. Self-reported amount of green space in the view from windows at home (bedroom, kitchen and living room) comparing pre- and post-implementation in the living lab and control districts for each city.

Table 3. Effect on visual access to green space from the home.

		Beta	Std_Err	t_df	p_value	CI	CI	Adj_R2
Bathroom	Dortmund	7,8173	8,8656	69,1542	0,381	-9,5996	25,0284	0,503
	Turin	-12,7353	5,7013	166,3491	0,0268	-23,8798	-1,572	0,6147
	Zagreb	4,1779	4,88	361,8847	0,3925	-5,458	13,7134	0,3408
Kitchen	Dortmund	7,2311	8,2206	62,7935	0,3824	-8,7659	23,324	0,6414
	Turin	-7,3937	6,5907	235,7585	0,2631	-20,2421	5,5783	0,4128
	Zagreb	-0,2657	4,9304	301,9876	0,9571	-9,9396	9,3773	0,4414
Living room	Dortmund	-0,7766	8,8733	71,3192	0,9305	-17,9375	16,8488	0,4526
	Turin	-10,0546	6,005	189,3801	0,0957	-21,7638	1,7598	0,5367
	Zagreb	3,6438	4,8054	402,0834	0,4487	-5,8298	13,0316	0,2444

– General Health

Energy (related to the Handbook’s KPI 21.3)

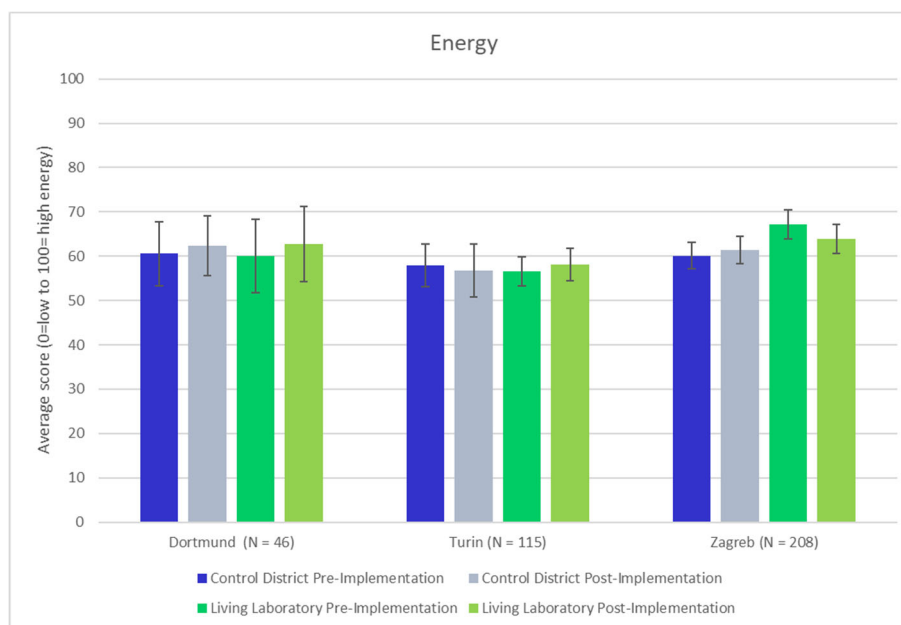


Figure 4. Self-reported energy (scale 0-100) comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook’s KPI 21.3).

Table 4. Effect on energy.

City	Beta	Std err	<i>t</i> (<i>df</i>)	<i>p</i>	95% <i>CI</i>	Adj R ²
Dortmund	1,1542	4,7644	60,4175	0,8094	-8,1787;10,4380	0,6215
Turin	1,8174	2,9602	219,8157	0,5399	-3,9889;7,5922	0,4027
Zagreb	-0,5256	2,4761	338,4355	0,8320	-5,3835;4,4427	0,3438

Emotional well-being (related to the Handbook's KPI 21.3)

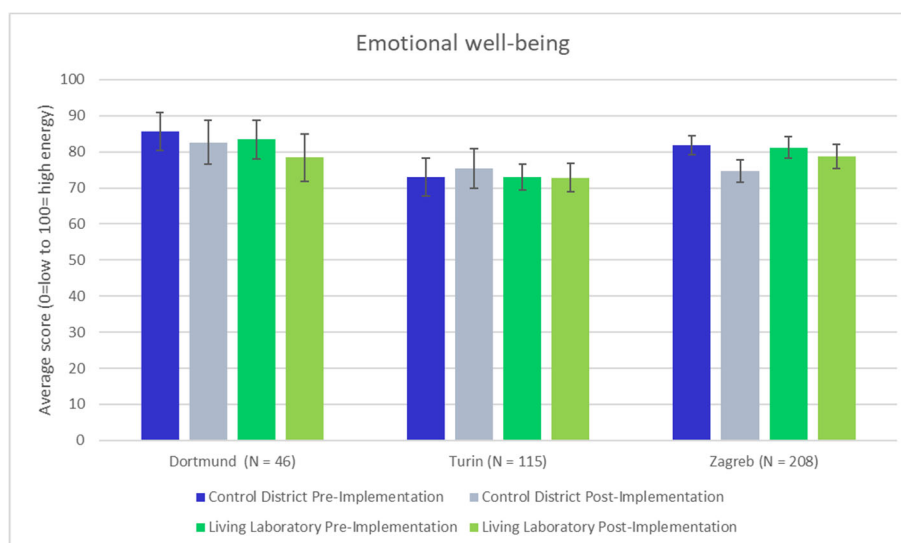


Figure 5. Self-reported emotional well-being (scale 0-100) comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook's KPI 21.3).

Table 5. Effect on emotional well-being.

City	Beta	Std err	<i>t</i> (<i>df</i>)	<i>p</i>	95% <i>CI</i>	Adj <i>R</i> ²
Dortmund	-1,9230	3,8667	57,1896	0,6209	-9,5046;5,6130	0,6105
Turin	-2,7226	3,1498	194,1409	0,3884	-8,9242;3,4191	0,4397
Zagreb	5,6922	2,2521	412,4131	0,0119	1,2922;10,1199	0,2919

Self-rated general health

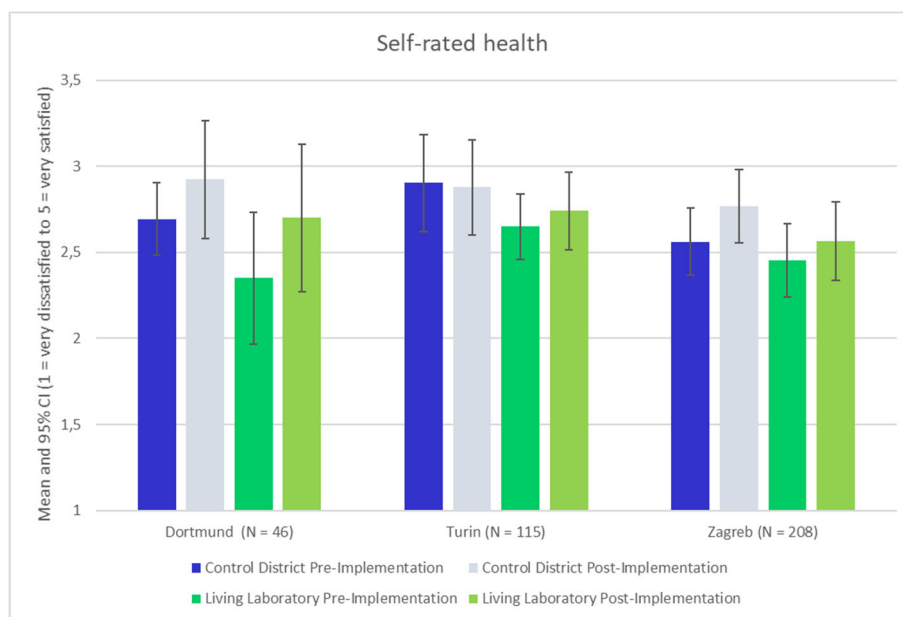


Figure 6. Average self-rated health (scale 1-5) comparing pre- and post-implementation in the living lab and control districts for each city.

Table 6. Effect on self-reported health. Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Beta	Std err	<i>t</i> (df)	<i>p</i>	95% CI	Adj R ²
Dortmund	-0,0235	0,2536	72,9643	0,9263	-0,5212;0,4692	0,4201
Turin	0,0016	0,1606	186,1457	0,9921	-0,3136;0,3149	0,5358
Zagreb	-0,1714	0,1117	268,5812	0,1259	-0,392;0,0467	0,7158

22.4 - Incidence of obesity

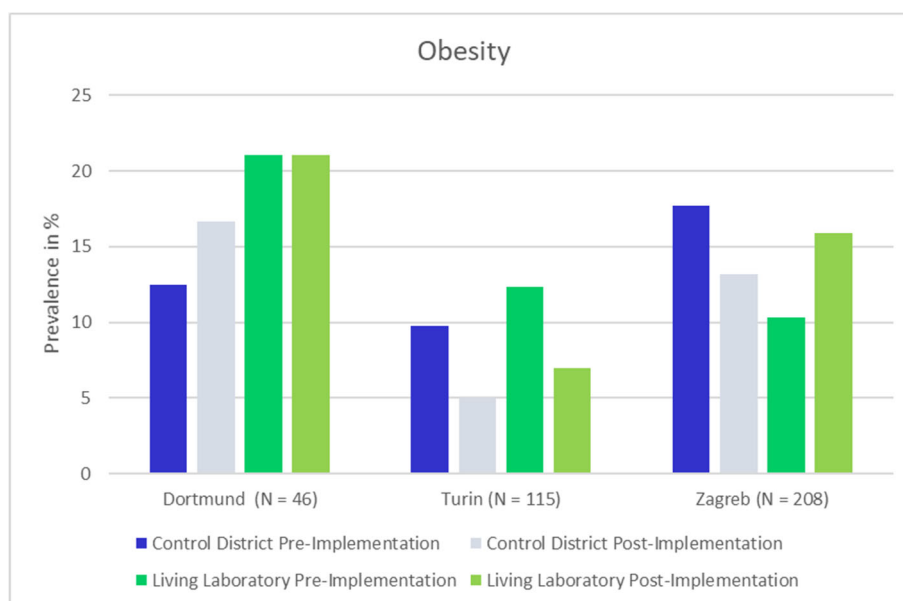


Figure 7. Prevalence of obesity comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook's KPI 22.4 - Incidence of obesity).

Somatization (22.10 - Somatization)

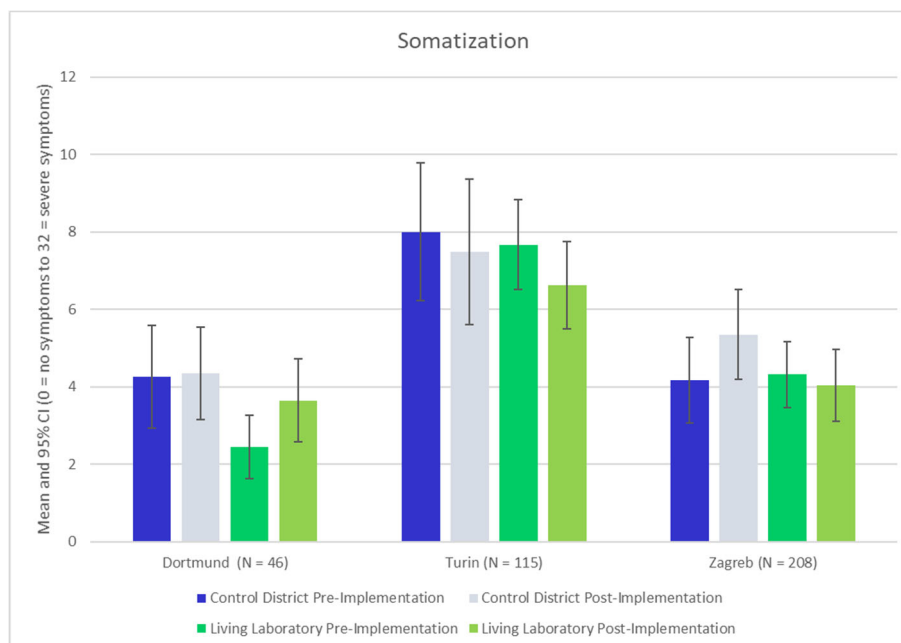


Figure 8. Severity of symptoms (scale 0-32) comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook's KPI 22.10 - Somatization).

Table 7. Effect on somatization. Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Beta	Std err	t (df)	p	95% CI	Adj R ²
Dortmund	0,8138	0,8810	46,7408	0,3604	-0,9179; 2,5302	0,7665
Turin	-0,3919	0,8908	166,3056	0,6606	-2,1312; 1,3544	0,5824
Zagreb	-2,1946	0,7011	272,5360	0,0019	-3,5948; -0,8216	0,5632

22.19 - Prevalence, incidence, morbidity and mortality of respiratory diseases

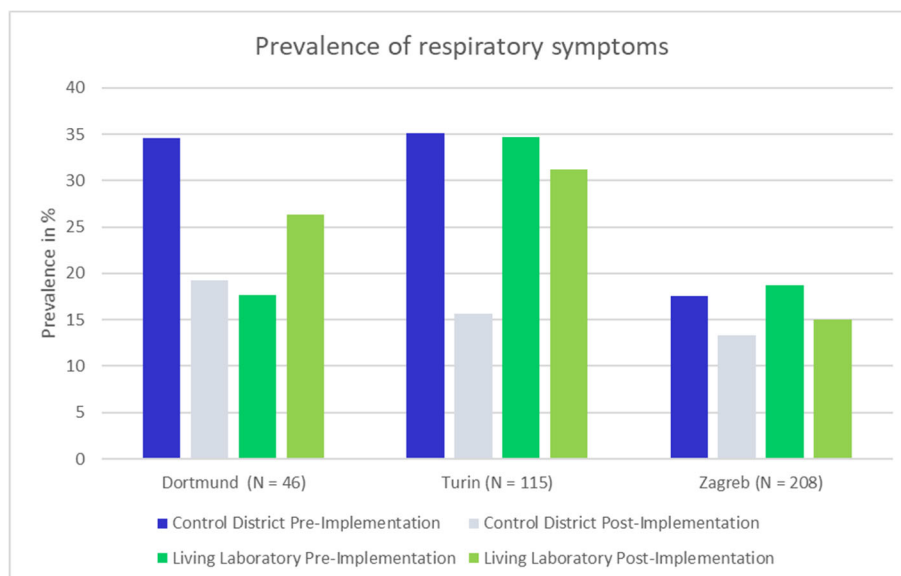


Figure 9. Prevalence of respiratory symptoms (asthma, shot breath or allergies) comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook's KPI 22.21 - Prevalence and incidence of autoimmune diseases).

Table 8. Effect on the prevalence of respiratory symptoms (asthma, shot breath and allergies). Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Beta	Std err	<i>t</i> (<i>df</i>)	<i>p</i>	95% <i>CI</i>	Adj <i>R</i> ²
Dortmund	-1,7443	1,1873	-1,4691	0,1418	0,0171; 1,7910	0,4744
Turin	-0,8362	0,7257	-1,1523	0,2492	0,1045; 1,7910	0,3075
Zagreb	-0,8435	1,1001	-0,7667	0,4432	0,0498; 1,7910	0,9804

- Mental Health and Well-being

21.2 - Level of chronic stress

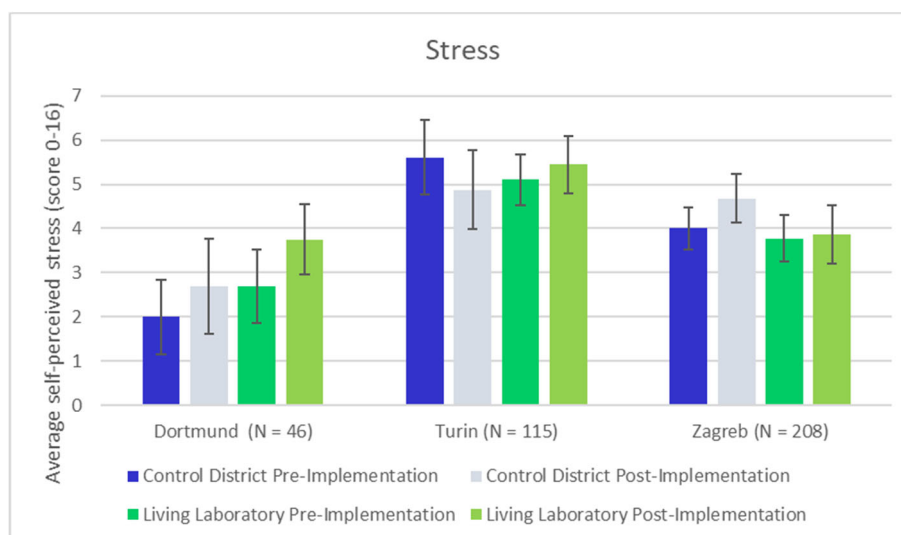


Figure 10. Self-perceived stress (score 0-16) comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook’s KPI 21.2 - Level of chronic stress).

Table 9. Effect of the NBS on self-perceived stress (score 0-16). Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Beta	Std err	<i>t</i> (<i>df</i>)	<i>p</i>	95% <i>CI</i>	Adj <i>R</i> ²
Dortmund	0,6837	0,6873	62,0023	0,3237	-0,6455; 2,0590	0,5122
Turin	0,8722	0,5500	222,8100	0,1142	-0,2080; 1,9450	0,3578
Zagreb	-1,0614	0,4203	414,5535	0,0119	-1,892; -0,2400	0,2671

Depressive symptoms

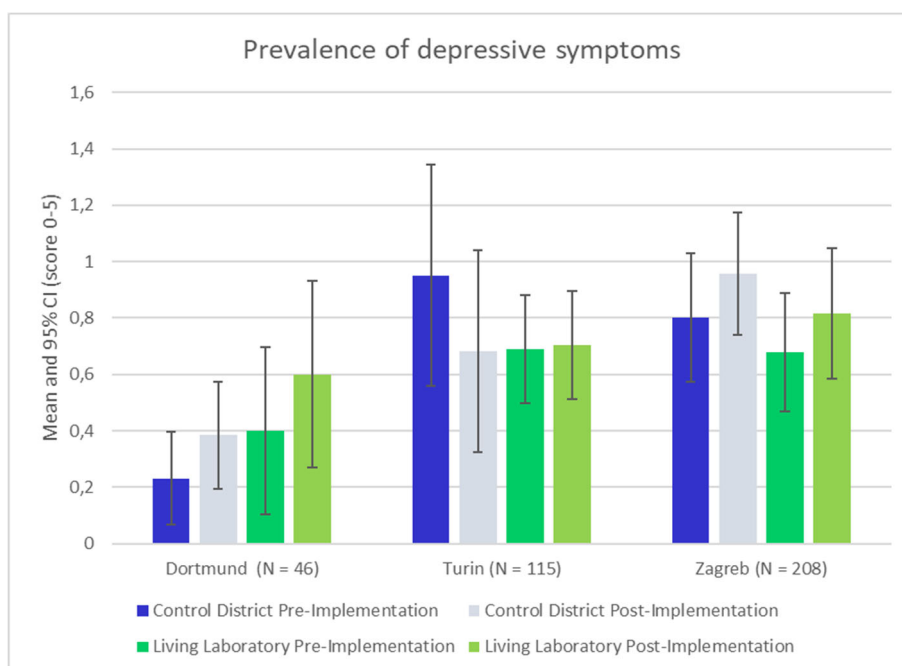


Figure 11. Depressive symptoms (scale 0-5) comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook's KPI 21.4 - Self-reported mental health and well-being).

Table 10. Effect on depressive symptoms (≥ 2 symptoms). Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Beta	Std err	t (df)	p	95% CI	Adj R ²
Dortmund	0,0294	0,1886	74,3033	0,8764	-0,3398; 0,3962	0,4494
Turin	0,3268	0,1909	166,0471	0,0887	-0,0462;0,7010	0,5044
Zagreb	-0,2804	0,1535	469,5844	0,0685	-0,5839;0,0199	0,2853

22.18 - Self-reported anxiety

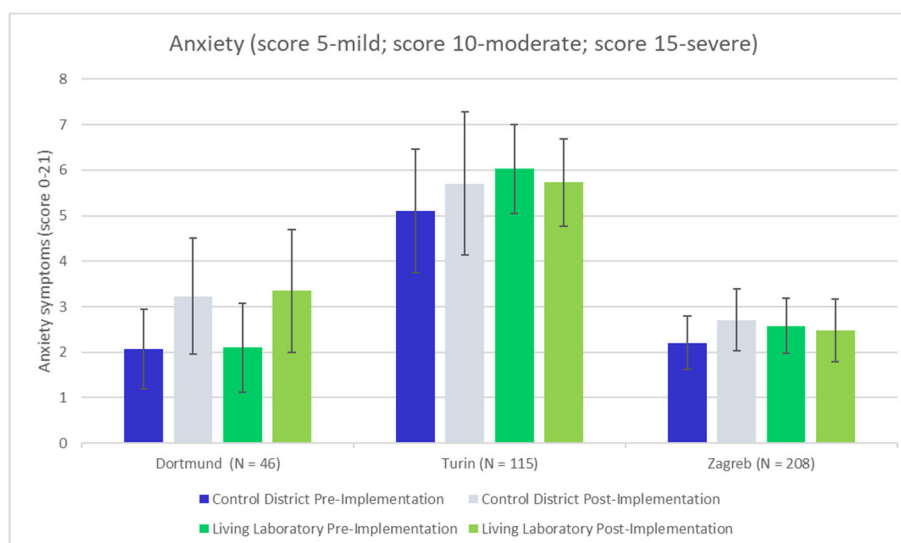


Figure 12. Anxiety symptoms (score 0-21) comparing pre- and post-implementation in the living lab and control districts for each city (related to the Handbook's KPI 22.18 Self-reported anxiety and 21.4 - Self-reported mental health and well-being).

Table 11. Effect of the NBS on anxiety symptoms (score 0-21). Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Beta	Std err	<i>t</i> (<i>df</i>)	<i>p</i>	95% <i>CI</i>	Adj <i>R</i> ²
Dortmund	0,2261	0,9624	50,5806	0,8152	-1,6586; 2,1174	0,5421
Turin	-0,4985	0,8414	252,0590	0,5541	-2,1391;1,1536	0,3182
Zagreb	-1,0061	0,4679	287,0911	0,0324	-1,9306; -0,0919	0,4835

- Physical Activity

22.1 Self-reported physical activity

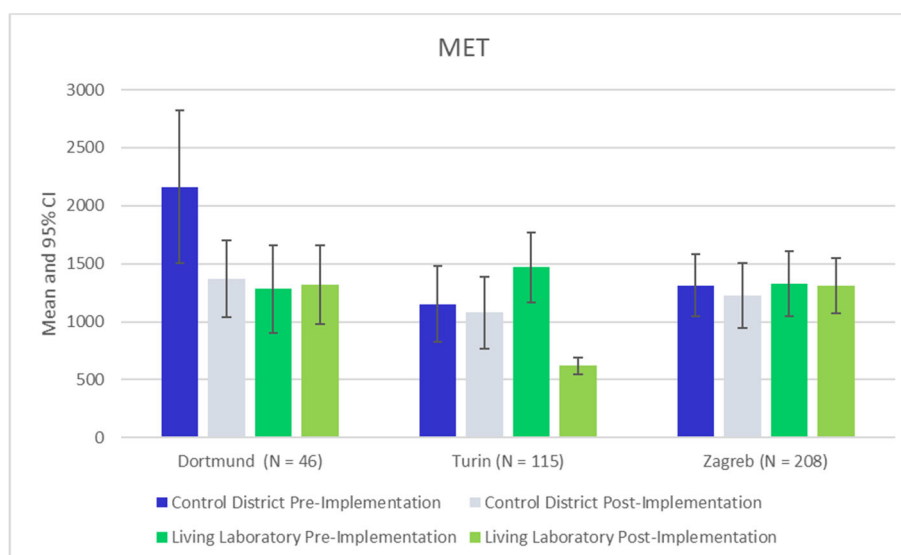


Figure 13. Mean of physical activity levels in Metabolic Equivalent of Tasks (METs)-minute/week (related to the Handbook's KPI 22.1 Self-reported physical activity).

Table 12. Effect of the NBS on physical activity levels (MET-minutes/week). Time (before vs after) * Group (LL vs CD) interaction of GLMM with subject as random intercept adjusted for age, gender, and education.

City	Beta	Std err	t (df)	p	95% CI	Adj R ²
Dortmund	533,8610	462,8781	100,0000	0,2515	-351,1164;1418,8385	0,0658
Turin	-527,3179	579,0135	172,7275	0,3637	-1649,8757;600,8057	0,2125
Zagreb	150,1623	253,2530	252,9991	0,5538	-344,7544;645,1731	0,3596

Premature deaths prevented by increased physical activity

To estimate the additional number of users of the LL, we used the number of visitors that was assessed via the SOPARC. This entailed some limitations:

- Pre-post SOPARC was only measured in two of the NBS that were implemented in the LL (in Dortmund only available for NBS1 and NBS6; in Turin for NBS2 and NBS6). For the NBS 3 (in both cities), only post-implementation visitor-count was available, and it was assumed that the number of active visitors at pre-implementation was zero. The sum of additional visitors in these NBS are taken as a proxy for the visitors in the entire LL.
- In Turin NBS6, there were counted fewer visitors, including fewer active visitors, in the post assessments (2021 and 2022) than in the pre assessment (2020). When considering all three NBS, however, there was an increase in visitors.
- The number of users that were observed should be understood within the context of the days on which the observations took place. First, the COVID-19 pandemic took place during the monitoring of the number of users at pre-implementation assessment (September 2020 for both NBS in Dortmund, October 2019 for NBS 2, and September 2020 for NBS 6 in Turin), and at the post-implementation assessment of NBS 2 in Turin (October 2021). The other post-implementation monitoring took place after the COVID-19 restrictions were lifted (March 2023 for NBS in Dortmund, October 2022 for NBS 6 in Turin). It could be that during the COVID-19 pandemic more people went outside compared to after the pandemic when people were going to work and school as usual. Second, the weather conditions differed greatly between pre- and post-implementation observation days. For example, pre-implementation assessment in Dortmund took place in September 2020 on days with good weather (sunny and around 20 degrees Celsius) compared to the observations post-implementation in March 2023 when the weather was rainy with temperatures around 9 degrees Celsius.
- The SOPARC has a count of visitors during the time of observation. Approximately, 4 hours a day were observed (this is very exact in Dortmund, much less in Turin). To estimate the average number of visitors per day, the average count obtained via the SOPARC was multiplied by 3.75 ($4h * 3.75 = 15\text{hours}$, this is from 6am till 21pm).

Furthermore, only visitors +18y were considered. Therefore, the children that visited the area (as counted with the SOPARC) were excluded from the analyses. The reason not to include children is that there has not (yet) been reported a clear relationship between physical activity in children and mortality.

The HIA was calculated for the “current situation”, considering the number of additional visitors that were observed in the NBS area. Certain campaigns could possibly increase the number of people becoming active in these areas, which would result in more elevated beneficial effects.

Annex 5 - Descriptive analysis of data on economy and labour market from the GQ

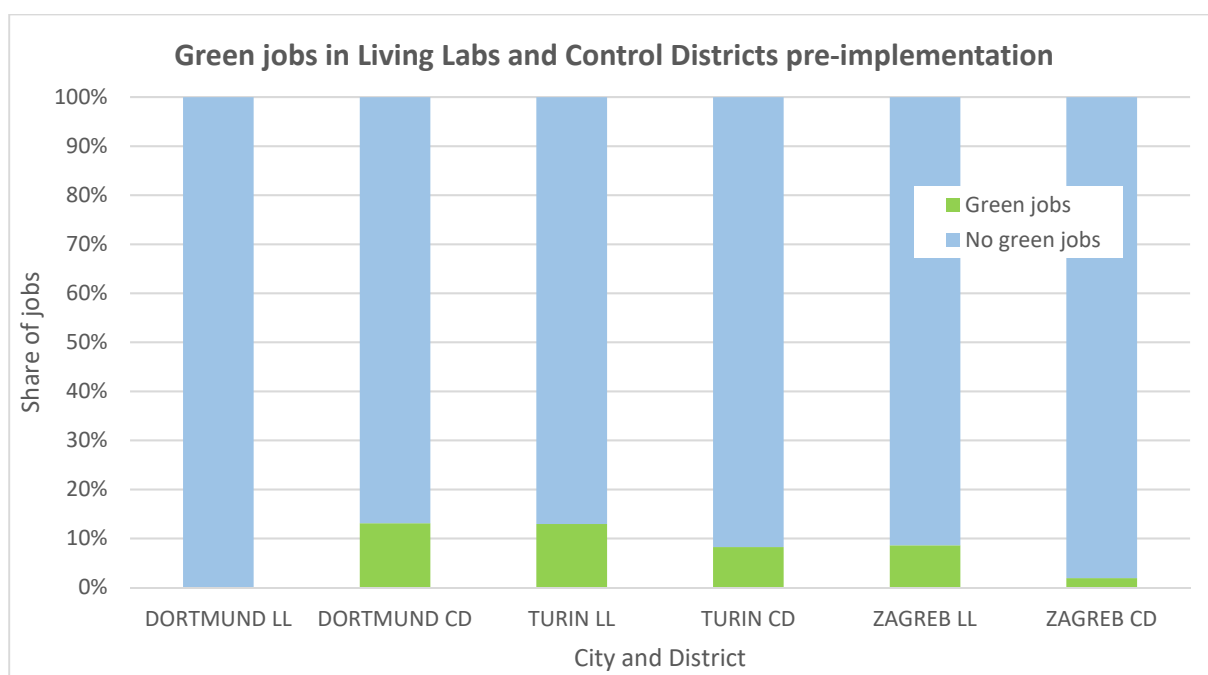


Figure 1. Green Jobs in responses by control district (CD) and Living Lab (LL) in each FRC.

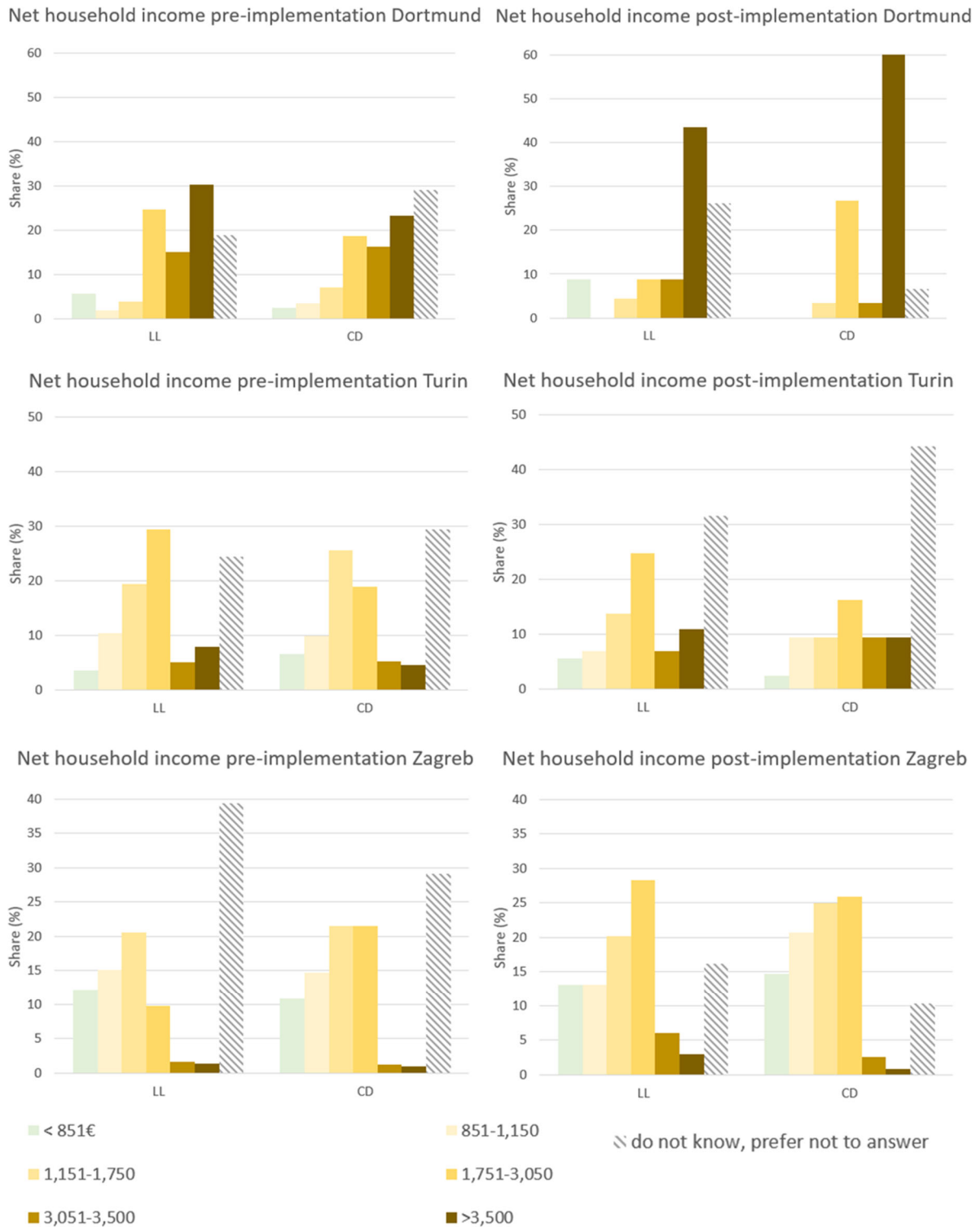


Figure 2. Net household income pre- and post-implementation in the Living Lab (LL) and Control District (CD) of the three Front Runner Cities Dortmund (top), Turin (middle), and Zagreb (bottom).