D4.3 WELLBASED Final Pilot Sites Analysis Report

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List of acronyms

- H2020 – Horizon 2020
- WP – Work Package
- Dx.x – Deliverable x.x
- NGO – Non-Governmental Organization
- SD – Standard Deviation
- PSQI – Pittsburgh Sleep Quality Index
- MPI - Multidimensional Prognostic Index
- CGA – Comprehensive Geriatric Assessment
- IoT – Internet of Things

- LoRaWAN – Long Range Wide Area Network
- ISRCTN – International Standard Randomised Controlled Trail Number.
- EUR – Euro
- GB – Great Britain
- TK – Türkiye
- tVOC - Total Volatile Organic compounds
- HU – Hungary
- EPOV – European Energy Poverty Observatory
- CO_2 – Carbon dioxide
- HR-QoL – Health-related Quality of life

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Executive summary

The overarching objective of WELLBASED is to propose the design, implementation, and evaluation of a novel, comprehensive urban programme, based on the social ecological model, to significantly reduce energy poverty and its effects on the citizen's health and well-being. The programme is implemented and evaluated in Valencia-Spain, Heerlen-Netherlands, Leeds-United Kingdom, Edirne-Turkey, Obuda-Hungary, and Jelgava-Latvia. This Deliverable 4.3 (D4.3) presents the final results of the evaluation of the impacts of WELLBASED on energy poverty, health and well-being in the six pilot sites.

The final analyses use the following data sources: self-reported questionnaires, health monitoring and IoT home devices. Data have been collected from September 2022 (M19) until August 2024 (M42). Descriptive data analyses are performed to define the study sample. Regression models are applied to study the effect of the intervention.

In total, 1350 participants distributed over the six pilot sites have provided informed consent to participate in the evaluation study, of which 661 are in the intervention group and 689 in the control group. About two third of the participants are female, the average age of the participants is about 50 years.

Overall, no statistically significant differences between the intervention and the control group are observed at 12-month follow-up. The change observed at 12-month and 18-month follow up was in favor of the intervention group, although not significant, with regard to self-perceived health, depression and anxiety outcomes. Similarly, results were in the positive direction for energy costs and coping behaviour at 18-month follow-up, however, also not statistically significant. Health monitoring values, such as blood pressure, slightly improve in some pilot sites, even though values were already within the normal range at baseline. The results suggest cost-effectiveness from a health-care perspective for the Edirne pilot site. There are relevant differences between pilot sites with regard to the observed effects of the intervention.

In summary, this is the final analyses report presenting the results of the WELLBASED project in the six pilot sites of the project. The results of this report provide insights into the effect of the WELLBASED urban programmes on health, well-being and energy use and behaviour, including cost-effectiveness of the urban programmes, within the context of an energy crisis in Europe. Although not significant, the WELLBASED programmes might have had small benefits for the participants. The period in which the WELLBASED project was implemented, in the midst of the energy crisis, likely has impacted the findings. Multi-level structural interventions might be needed to lift people out of energy poverty.

1. Introduction to the WELLBASED project

1.1 Objectives of the project

WELLBASED addresses Horizon 2020 Call: SC1-BHC-29-2020 – Innovative actions for improving urban health and well-being – addressing environment, climate and socioeconomic factors. The project aims to design, implement, and evaluate a novel, comprehensive urban programme, based on the social ecological model, to significantly reduce energy poverty and its effects on the citizen's health and well-being. The programme will be implemented and evaluated in six different pilot cities (Valencia – Spain, Heerlen - The Netherlands, Edirne – Turkey, Jelgava – Latvia, Obuda – Hungary, and Leeds – United Kingdom). The design of the urban programme was built on evidence-based approaches, representing not only different urban realities but also a diverse range of welfare and healthcare models.

2. Introduction to the deliverable

2.1 Deliverable objective and scope

The aim of this deliverable is to evaluate the WELLBASED urban programme, using a pre-post controlled design, measuring the benefits of the interventions implemented across the six pilot sites for participant's health, well-being, energy use and behaviour, including their cost-effectiveness. The specific objectives are:

1. To evaluate the benefits of the WELLBASED urban programme with regard to quality of life and indicators of health, well-being, energy use and behaviour.
2. To evaluate changes in indoor air quality among participants of the WELLBASED urban programme.
3. To evaluate the cost-effectiveness of the WELLBASED urban programme regarding health care costs.

2.2 Hypotheses

Our hypothesis is that participants in the intervention group (i.e. individuals benefiting from the WELLBASED urban program) have more favourable results with regard to indicators of health, well-being, quality of life, energy use and behaviour compared to people participating in the control group (i.e. individuals receiving no WELLBASED intervention). Furthermore, we hypothesise that the costs of health care will be lower for

the intervention group compared to the control group. We also hypothesise that indicators of energy efficiency improve in the intervention group.

2.3 Relation to other WPs and deliverables

This Deliverable is complemented by D4.4 'Data platform with data gathered' (M45), D4.5 'Qualitative Evaluation Report' (M45) and D4.6 'Report on status of posting results' (M45). The WELLBASED project will end in M48 (March 2025).

In general, this deliverable is strongly linked to WP4's tasks related to data analysis. It is also strongly related to WP3, who are responsible for implementation of the six urban programmes and the evaluation study, and monitoring of recruitment and data collection. Equally, the research results will be exploited in WP5 and WP6, being publicly shared in a Policy Briefing and in the final WELLBASED event. All WPs, tasks and deliverables that this deliverable relates to are presented in Table 1.

Table 1. Deliverable 4.3 in relation to other WPs and deliverables

WP	Deliverable/ Task	Description
WP3	D3.1	Implementation plan for each pilot site (Leader: LNV)
	D3.2	Midterm recruitment report (Leader: EMC)
	Task 3.2	Pilots' implementation and monitoring in the six adapted urban programmes (Leader: TNO)
	D3.3	Intermediary report on the implementation of the urban programme (Leader: ASIDEES)
	D3.4	Final report on the Implementation of the Urban Program (Leader: ASIDEES)
WP4	D4.1	Pilot sites evaluation framework (Leader: EMC)
	D4.2	Intermediate preliminary analysis report (Leader: EMC)

	Task 4.2	WELLBASED platform creation and data gathering (Leader: INCLIVA)
	Task 4.3	Data analysis: evaluation of the effects on health & well-being (Leader: EMC)
	Task 4.4	Data analysis: cost-effectiveness assessment (Leader: EMC)
	Task 4.5	Qualitative data collection and realist evaluation (Leader: UNIVLEEDS)
	D4.4	Data platform with data gathered (Leader: INCLIVA)
	D4.5	Qualitative Evaluation Report (Leader: UNIVLEEDS)
	D4.6	Report on status of posting results (Leader: EMC)
WP5	Task 5.2	Upscaling and replication (Leader: DEM)
	Task 5.3	Capacity-building webinars (Leader: ENC)
	Task 5.5	Policy Recommendations for the scaling up and transferability of evidence-based urban policies to reduce energy poverty (Leader: LNV)
	D5.5	Policy Recommendations (Leader: LNV)
WP6	Task 6.2	Communication activities (Leader: ENC)
	Task 6.3	Scientific and academic dissemination (Leader: EMC)
	Task 6.4	Exploitation, innovation and business models development (Leader: KVC)
	D. 6.3	WELLBASED exploitation strategy (Leader: KVC)
WP7	Task 7.2	Ethics management (Leader: INCLIVA)
	Task 7.4	Data management (Leader: INCLIVA)

3. Methodology

3.1 The WELLBASED Urban Programme

A detailed description of the WELLBASED Urban Programmes implemented in the pilot cities is presented in D3.1 'Implementation plan for each pilot site' and D3.4 'Final report on the Implementation of the Urban Program'.

3.2 Design, setting and procedures

The evaluation design framework has been described in D4.1 'Pilot sites evaluation framework'. In short, the evaluation of WELLBASED has a pre-post controlled design including three timepoints (baseline, 6, 12 and 18 months follow-up). Participants in the intervention group received the WELLBASED urban programme, while the control group received no WELLBASED interventions. The study was performed in six cities across Europe. The target population differed per pilot site (see Table 2). Participants were recruited in accordance with the capacity, organizational and contextual factors of each of the six pilot sites (see deliverables WP3).

Table 2. Overview target group per pilot site

Pilot site	Target group
Edirne (Turkey)	Low-income households in five neighbourhoods, where vulnerable groups, including Roma, are highly represented
Heerlen (the Netherlands)	Social housing tenants from two districts in the northern part of the city with low incomes, high energy bills, low energy measures and bad housing conditions
Jelgava (Latvia)	The most vulnerable households, described by low income levels, long-term unemployment (> 1 year), disabled people, poor housing quality, single-parent families, pensioners (especially suffering loneliness), and provided by the municipality
Leeds (UK)	Social housing tenants, managed by the City Council, with poor housing quality, classified as energy efficiency band D or below. Target group has different

	vulnerabilities: low income, older people, disabled people, single parents and recent migrants
Óbuda-Békásmegyer (Hungary)	Vulnerable inhabitants of Óbuda-Békásmegyer, the 3rd district of Budapest, characterised by low incomes, victims of domestic violence and/or drug abuse, households with disabled and/or chronically ill members, unemployed members, and single mothers
Valencia (Spain)	Three districts with high sociodemographic vulnerability, due to an aged population, lower incomes than the city average and higher percentages of people at risk of poverty

The inclusion and exclusion criteria are described in D4.1. In short, people were not eligible to participate if they had been beneficiaries of a previous similar intervention, when they had limitations preventing the adequate participation in the intervention actions proposed in the pilots (e.g., intellectual disabilities, unable to attend to workshops, training, meetings; very poor health conditions, severe language limitations preventing the minimum communication), or when their household was illegally connected to the electricity grid. The aim was to include a total of 1750 participants distributed across the six sites, 875 in each study group. Please see Deliverable 3.4, 3.3. and 3.2 for more information about the challenges in recruitment of participant and the strategies applied to mitigate these challenges. The final sample was lower than intended, with in total n=1350 participants proving informed consent.

3.3 Data collection and measures

Details of the evaluation study set-up are presented in D4.1 'Pilot sites evaluation framework'. Information on the recruitment strategies and implementation is presented in D3.1 'Implementation plan for each pilot site' and D3.2 'Midterm recruitment report'.

In short, the WELLBASED study sample is based on convenience sampling with a control and intervention group in each pilot study site. Participants could be included if they were considered vulnerable to energy poverty. Recruitment ended per July 1st, 2023, meaning consent had to be signed before that date. In some cases, in some sites, the consent was signed but the baseline questionnaire, health monitoring or installation of the home sensors was completed later in time.

The WELLBASED evaluation study ran parallel to the implementation of the WELLBASED interventions in the six pilot sites. A broad set of data was collected to be able to evaluate impact on several outcomes between and within study groups. Complementary methods were used. The data collection methods are presented in Table 3. The methods used were self-reported questionnaires for both study groups at baseline (T0), 6-month (T1), 12-month (T2) and 15 to 18-month (T3) follow-up, the latter depending on the month of recruitment. Additional health monitoring and Internet of Things (IoT) sensors were used to collect health and environmental data among intervention participants. The next sections of this chapter describe the methodology of each of the data sources used for the analyses in this deliverable.

Table 3. Overview data collection sources for WELLBASED evaluation study

Outcome categories*	Method	Frequency	Used in this deliverable?	Comments
Intervention and control group				
Indicators of health and well-being				
Health-related Quality of Life (HR-QoL), Depression, Anxiety and Stress Scales	Self-reported questionnaire	Every six months (baseline, 6 month-, 12 month-, 18-month follow-up)	✓	Baseline, 12- and 18- month measurement were used for analyses (see methods)
Health care use	Self-reported questionnaire	Every six months (baseline, 6 month-, 12 month-, 18-month follow-up)	✓	Baseline, and 12- month measurement were used for analyses (see methods)

Geriatric assessment	Self-report questionnaire among 65 years and older	Every six months (baseline, 6 month-, 12 month-, 18-month follow-up)	✓	Baseline and 12-month measurement were used for analyses (see methods)
Energy poverty				
Energy poverty indicators, coping behavior	Self-reported questionnaire	Every six months (baseline, 6 month-, 12 month-, 18-month follow-up)	✓	Baseline, 12- and 18- month measurement were used for analyses (see methods)
Energy efficiency				
Energy use and costs	Self-reported questionnaire	Every six months (baseline, 6 month-, 12 month-, 18-month follow-up)	✓	Baseline, 12- and 18- month measurement were used for analyses (see methods)
Exposure to interventions				
Exposure to interventions	Self-reported questionnaire	6 month-, 12 month-, 18-month follow-up	✓	12-month measurement were used for analyses (see methods)
Health monitoring (intervention group only)				

Peak flow, oxygen saturation, blood pressure and heart rate	Medical devices self-monitoring or research assistant monitoring	Every month	✓	First month (baseline) and last month (follow-up) was used
Sleep quality	Self-reported questionnaire	Every three months	✓	Baseline and 18-month measurements were used
Indoor air quality (intervention group only)				
Indoor indicators (temperature, CO2 and humidity)	IoT home sensors	Near real-time. The period of data availability depends on date of installation of the IoT sensor: range of 1-20 months data availability.	✓	First week average (baseline) and final week average (follow-up) were used for analyses (see methods)
Indicators related to outdoor environment and air quality	City-level data	n/a	Partially	Outdoor temperatures are included in this deliverable, to contextualize the indoor air quality measures
Exposure to the WELLBASED Urban Programs (intervention group only)				
Exposure	Pilot administration	n/a	✓	
* see table 4 to 7 for detailed information about the outcome instruments used per category				

3.3.1 Health, well-being, energy use and behaviour

Self-reported questionnaires (intervention and control group)

An individual-level self-reported questionnaire was used to collect data regarding individual health, well-being, energy behaviour and exposure to interventions. A household-level self-reported questionnaire was used to collect data regarding household characteristics and energy consumptions and costs. For details on the measurements used see D4.1 'Pilot sites evaluation framework', the trial registration (ISRCTN 14905838), the design paper published by Stevens et al (2022), and the Data Management Plan presented in D7.4 (1).

Table 4 presents an overview of outcome measures that were part of the WELLBASED self-reported questionnaires. In short, the individual questionnaire includes sociodemographic characteristics (e.g. education level), health and well-being outcomes (e.g. health-related quality of life, frailty, care use) and coping strategies (e.g. behaviour to deal with a cold home). In addition, the 6 (T1) and 12-month (T2) follow-up self-report questionnaires included a question where both intervention and control group participants could report any interventions they had received over the past six months, both WELLBASED and non-WELLBASED interventions. This question was included in the questionnaire, since, due to the energy crisis, many measures were implemented in different pilot sites by the (local) government to compensate households for the sharp increase in energy prices (non-WELLBASED interventions).

All participants were invited to complete the individual questionnaire.

The household questionnaire was to be completed by one member of the household (if more than one household member participated) and included an assessment of energy usage (e.g. energy source and use), energy costs and household characteristics (e.g. owned or rented). Participants were free to decide by themselves which of the participating household members would complete the household questionnaire.

For this deliverable, the collected self-reported individual and household questionnaire data of baseline (T0) and 12-month follow-up (T2) were used to evaluate the effectiveness of the interventions. At 6-month follow-up (T1) the interventions were not implemented or had only just started. Due to the prolongation of the recruitment period, the time between 12 month and final follow-up at 18 months (T3) was reduced to approximately 3 months (101.93 days (SD 41.62)). Analyses to evaluate the impact at 15 months follow-up are presented for a selected number of outcomes and presented in Annex G.

Table 4. Overview of outcomes assessed using self-reported questionnaires in both research conditions

Outcome	Instruments
Health and well-being	
Health-related Quality of Life (HRQoL)	EQ-5D-5L
Depression, Anxiety and Stress	Depression Anxiety Stress Scales 21 (DASS-21)
Frailty (only among adults 65 years or older)	Self-Administered Multidimensional Prognostic Index Brief version (SELFY-BRIEF-MPI)
Comorbidities	International Consortium for Health Outcomes (ICHOM) Overall Adult Health set
Health care use	
Care utilization	Modified SMRC Health Care Utilization questionnaire
Energy use and behaviour	
Energy consumption & costs	On grid (e.g. electricity, gas, heat) and off-grid (e.g. bottled gas, coal) energy consumption
Coping behaviours	Self-reported scale
Energy poverty indicators	European Statistics on Income and Living conditions survey (EU-SILC)
Exposure to interventions	
Received interventions	Project-designed question

Health monitoring (intervention group only)

In the intervention condition, so called health monitoring was performed to collect additional data on relevant health outcomes (see table 5). This included monthly measures of peak flow, oxygen saturation (SpO_2), blood pressure and heart rate.

Peak flow and SpO_2 were measured in a resting position and after a six minutes' walk. Blood pressure and heart rate were measured three times in a resting position with a three-minute interval. Health monitoring devices (e.g. peak flow device) were used to collect these data. Data was obtained manually by the participant him/herself or obtained by a nurse, research assistant or physician during scheduled visits. Data were reported in the WELLBASED platform.

The averages of three blood pressure measurements for each participant were used to determine whether a participant suffers from hypertension (systolic BP > 140 mmHg or diastolic BP > 90 mmHg) or hypotension (2). Also, the average of the heart rate, SpO_2 and peak flow measurements were obtained. Averages are used to determine whether a participant suffers from tachycardia (heart rate > 90 bpm), bradycardia (heart rate < 50 bpm) and hypoxemia (SpO_2 < 92%).

Sleep quality was measured with a self-report questionnaire called the Pittsburgh Sleep Quality Index (PSQI), with a three-month interval.

Table 5. Overview of the outcomes assessed using health monitoring in the intervention group

Outcome	Instruments
Health monitoring	
Peak flow	Self-monitoring using medical devices or research assistant monitoring. Measured in a resting position and after a six minutes' walk.
Oxygen saturation	Self-monitoring using medical devices or research assistant monitoring. Measured in a resting position and after a six minutes' walk.
Blood pressure	Self-monitoring using medical devices or research assistant monitoring. Measured three times in a resting position with a three-minute interval.

Heart rate	Self-monitoring using medical devices or research assistant monitoring. Measured three times in a resting position with a three-minute interval.
Sleep quality	Pittsburgh Sleep Quality Index (PSQI)

3.3.2 Indoor air quality (intervention group only)

Among participants in the intervention condition, indoor air quality was measured using IoT home sensors that collect indoor temperature, humidity and CO_2 at household level (see table 6). In each household one device was installed. Data was collected near real-time (minimal once per hour). Sensors were preferably positioned in the main corridor of the dwelling at a height of ~ 1, 5 meters. In case the corridor location was not possible or far away from the other rooms, the device was installed in the living room, away from windows and kitchen.

Data were available for different time periods for each pilot, depending on the purchase of the devices and installation.

Minimum (18 degrees Celsius) and maximum (24 degrees Celsius) temperature, CO2 levels (maximum 1000 ppm), and humidity (30-70%) were set following the World Health Organisation's recommendations (4).

Table 6. Overview of the outcomes assessed using home devices in the intervention group

Outcome	Instruments
Indoor air quality	
Temperature	Home sensor
Humidity	Home sensor
CO2	Home sensor

3.3.3 Cost-effectiveness

Information on health care use was used from the self-report questionnaires to perform the cost-effectiveness analyses. In addition, pilot sites registered per participant the intervention actions they provided. In addition, they provided the (estimated) costs for each of the intervention actions performed as part of their Urban Program.

3.3.4 Exposure to the WELLBASED Urban Program

Pilot coordinators have registered for each participant which activities (i.e. interventions) as part of the WELLBASED Urban program (WUP) in that site were provided. Based on this administration of participation to these interventions an overview was made of the exposure of participants in each pilot. Following the development of the WUP in each site using the socio-ecological model (see also Deliverable 2.3) the implemented interventions have been classified according to the layers of this model (see table 7). For details on the types of activities we refer to the Deliverables of Work package 3, amongst others D3.1.

Table 7. Overview of the outcomes assessed regarding exposure to the WELLBASED urban program in the intervention group

Outcome	Instruments
WELLBASED Urban Program	
Layer 1 Individual Lifestyle factors	Practices oriented to improve individual behavior regarding health, energy efficiency, energy costs, residential comfort, etc. ➔ **WUP activities:** Energy audit, Access Home Sensor Data, HealthCoaching, Energy advice Bills, Training Materials
Layer 2 Social and Community networks	Activities oriented to strengthen communities, mainly those oriented to promote community support and mutual aid, and therefore moving from individual to collective support approach ➔ **WUP activities:** Attendances at one or more group meetings.
Layer 3 Living and working conditions	Practices oriented to improve the access to a dignified work and life conditions, e.g. comfortable and healthy homes and workplaces

	→ **WUP activities:**
	      o **Structural Interventions** includes: Heating System, Home Insulation, Windows Replacement, Front Door Replacement, Door Replacement, Personalized Home Renovation, Handy Man Services
	      o **Domestic Appliances Replacement** includes: Washing machine, stove, Air conditioner, Air purifier, Fridge, Dish Washer, Oven **Energy Kit** includes just Energy Kit

Layer 4 General socio-economic, cultural and environmental conditions (not used in the WELLBASED Urban programs)*	Practices that aim to make structural changes on the socio-economic context, mainly referring to both energy and to household policies
* Although part of WELLBASED Urban Programs, layer 4 interventions are not included in research study since most of them have started after data collection period, their effects are long term, and they are targeted to all citizens.	

3.4 Statistical analyses

3.4.1 Recruitment and retention

An overview of recruitment and retention during the study period is provided based on response to the baseline, 6- month, 12-month and 15-month self-report questionnaires.

3.4.2 Baseline characteristics

The baseline characteristics of the overall sample on all assessed variables are presented using descriptive statistics. Descriptives statistics were used to calculate the mean values and distributions per variable at baseline. T-Tests were used for continuous variables and Chi-Square tests for categorical variables to test for differences in characteristics between the intervention and control condition participants at baseline. A p-value of < 0.05 was considered significant. Per pilot descriptives are presented in the Annexes.

3.4.3 Health, well-being, energy use and behaviour

The first aim of the evaluation study was to evaluate the WELLBASED urban programme with regard to impact on health-related quality of life and indicators of health, well-being, energy use and behaviour. In all analyses, $p < 0.05$ was considered as statistically significant. Gender stratified outcomes for the overall sample are presented in Annex G.

Intervention and control group

First, to evaluate the change within both intervention and control group from baseline to 12-month follow-up Chi-Square tests were performed. In D4.5 a more elaborate analyses of the within-group change is performed to integrate the findings of the qualitative interviews.

Second, a comparison between intervention and control group at 12-month follow-up was performed to estimate effects on health and well-being outcomes, and energy outcomes. To estimate the effect of the intervention across the different pilot sites and to investigate potential heterogeneity in the effect across the different pilot sites, due to differences in implementation of the intervention, we fitted (generalized) linear mixed models including a random intercept for pilot site and a random slope for the intervention effect. We additionally adjusted for age, income, gender and baseline value of the outcome of interest. We reported the average intervention effect across all sites, including 95% confidence interval, and the intervention effect at the different pilot sites quantified by the estimates of the mode of the random slope of the intervention effect at that site. Intervention effects were estimated at 12-month follow-up. For a selection of outcomes, the estimates at 15-month follow- up were calculated (see Annex G). Odds Ratio (OR) or Beta coefficients (beta) and 95% Confidence Intervals (95%CI) are presented.

The Selfy-MPI brief instrument was implemented among older people in both research conditions to assess frailty. Due to the low numbers of older people only descriptive results can be presented.

Intervention group

Health monitoring (peak flow, blood pressure, heart rate variability) was available in the intervention group. Differences between baseline and follow-up were evaluated.

The sample consisted of individuals with multiple measurements of the health monitoring outcomes (i.e. month 1, month 2, month 3, etc). A selection was made to include only individuals who had a follow-up time of >= 200 days.

For each outcome (oxygen saturation, blood pressure and heart rate variability) the average of the second and the third repetition of the measurement is calculated, following the recommendation of the European Society for Hypertension. In case there are no repetitions 2 and 3, the 1st was taken.

Baseline was defined as the first health monitoring moment or the average of the first two health monitoring moments when they were less than 100 days apart. Follow-up was defined as the last monitoring moment or the last two monitoring moments when they were less than 100 days apart. Data on age and sex were obtained from the baseline self-reported questionnaire.

To estimate change in health monitoring outcomes over time first, paired samples t-tests were performed to compare baseline, and 12-month follow-up change in the outcomes of oxygen saturation, blood pressure and heart rate variability for the overall intervention group sample.

Second, paired t-tests were used to analyse health monitoring outcomes of oxygen saturation, blood pressure and heart rate variability per country, per gender (men/women) and by age group and country (<60 years vs >=60 years of age).

3.4.4 Indoor air quality

The second aim of the evaluation study was the evaluation of indoor air quality among participants of the WELLBASED urban programme.

Indoor Air Quality was only assessed in the intervention group. Means and standard deviations (SDs) were used to describe three outcomes for each pilot site: indoor temperature, indoor humidity, indoor carbon dioxide content. Line graphs were used to visualize the outcome changes from baseline to follow-up per pilot site. Per air quality indicator (indoor temperature, humidity and CO_2) one graph is presented in the annex. This pilot-specific graph represents the average value of the indicator among all households participating in that pilot site. Outdoor temperatures at city-level are included to contextualize the indoor temperature results in each pilot site.

Baseline was defined using the average per day based on the first week of data available. Follow-up was defined using the average per day based on the last week of data available.

First, a paired samples t-test was conducted to compare the three indicators of temperature, humidity and CO2 between baseline and follow-up. Second, repeated Measures ANOVA was performed with season (season at baseline and season at follow-up) as a within-subject factor as covariate for the three indicators between baseline and follow-up.

3.4.5 Cost-effectiveness

The third objective was to evaluate the cost-effectiveness of the WELLBASED urban programme regarding cost-effectiveness. First three pilot sites were chosen with a complementary set of Urban Programs to be evaluated, all other pilots health care costs are presented in the Annexes.

Then, health care costs were calculated. The healthcare costs per individual participant is calculated by multiplying resource use (e.g. doctor appointments, hospital admissions) with corresponding unit prices. Also, the costs of the WELLBASED Urban Programs were calculated.

The data from the EQ-5D-5L is used to calculate utility values for each of the pilot sites. Using the Incremental Cost Effectiveness Ratio (ICER) the cost-effectiveness was of the WELLBASED Urban Programs, taking into account health care costs and intervention costs, was calculated as final step.

3.4.6 Intervention exposure

Intervention exposure according to pilot administration (intervention group only) and self-report via the questionnaire (both intervention and control group) is presented using descriptive statistics.

Intervention exposure according to pilot site administration was grouped according to the socio-ecological model (see table 7). A per protocol analyses was performed to investigate a potential dose-response relationship between the number of layers (i.e. level of exposure to the intervention) of the intervention and the outcomes of interest, using (generalized) linear models for the primary outcomes. These models included the number of layers of the intervention, age, gender, income, baseline value of the intervention and site. Potential heterogeneity in the association between the number of layers in the interventions across the different sites was not possible due to the relatively low number of pilot sites and multiple layers of the intervention.

3.4.7 Data management

Data from all pilot sites were combined and data management and analyses were conducted through the WELLBASED repository, operated by INCLIVA. The IoT sensors were connected to the Smart City (SMC) Platform, operated by ASIDEES, through LoRaWAN (Valencia, Leeds, Edirne), Sigfox (Jelgava) and Proprietary (Obuda, Heerlen) networks. The data were automatically transferred to the SMC platform, from where data were transferred to the WELLBASED repository. For details on data management see D7.4. Data analysis was conducted using SPSS and R studio. Data cleaning and analyses were performed

between March 2024 until October 2024. Exchange rates for the Pound, Lira and Forint were calculated on June 6th, 2023, using Google currency convertor and set at 1 Pound GB = 1, 16 EUR, 1 Lira TK = 0,039 EUR, 1 Forint HU = 0, 0027 EUR. This information was used to calculate energy costs. All data was handled confidentially, and scientific data was used pseudo-anonymously for this Deliverable.

3.5 Ethical procedures

Ethical committee procedures were followed on all sites. Inclusion of participants at a site could start after ethical approval by the local review board (available in D7.3). The names of the review boards and the approval references are:

- Valencia, Spain: Ethics committee for research with medicines of the university clinical hospital of Valencia, ref. no. 2021/316;
- Heerlen, The Netherlands: Medical Ethical Committee (MEC) – Erasmus University Medical Center Rotterdam, ref. no. MEC-2022–0150;
- Leeds, United Kingdom: Ethics committee University of Leeds—AREA (Faculties of Business, Environment and Social Sciences), ref. no. 21–070;
- Edirne, Turkey: Trakya University Edirne Clinical Studies Ethical Committee, ref. no. 07/01;
- Obuda, Hungary: Scientific and Research Ethics Committee of the Medical Research Council of Hungary, ref. no. 332/2022, and;
- Jelgava, Latvia: Central Medical Ethics committee of Latvia, ref. no. 01–29.1.2/2267.

Informed consent was collected on paper by a research assistant.
Participants could stop their participation at any time during the study, without disclosing reasons for withdrawal.

4. Findings

4.1 Recruitment and retention

Details about the recruitment strategies of each pilot site have been described in D3.1 'Implementation plan for each pilot site' and in D3.2 'Midterm Recruitment Report'. Inclusion of participants ended July 1st, 2023. A total number of 1235 participants have completed the baseline self-report questionnaire of the WELLBASED study: 600 people in the intervention group and 635 in the control group. Table 8 provides an

overview of the distribution of response rates over all pilot sites for the self-report questionnaires at 6-month, 12-month and 18-month follow-up.

When looking at the retention rate, the target of 80% retention was reached at T2 and almost reached with 77% at T3.

Table 8. Overview data collection for the total sample and per pilot site at baseline, 6, 12 and 18 months (n=1235)

	Valencia	Heerlen	Edirne	Jelgava	Obuda	Leeds	Total
Baseline							
Baseline (To) total	322	199	245	157	112	200	1235
Intervention group	145	117	122	124	82	10	600
Control group	177	82	123	33	30	190	635
6-month follow-up							
6-month follow-up (T1) total	217	160	239	152	102	116	1004
Intervention group	116	95	119	119	77	4	539
Control group	101	65	120	33	25	112	465
Retention %	67%	80%	98%	97%	91%	58%	81%
12-month follow-up							
12-month follow-up (T2) total	240	144	235	148	100	106	988
Intervention group	111	84	114	117	75	5	514
Control group	129	60	121	31	25	101	474
Retention % based on T0	75%	72%	96%	94%	89%	53%	80%

Retention % based on T1	111%	90%	98%	97%	98%	91%	98%
18-month follow-up							
18-month follow-up (T3) total	222	139	237	148	99	88	948
Intervention group	112	82	115	116	74	4	510
Control group	110	57	122	32	25	84	438
Retention % based on T0	69%	70%	97%	94%	88%	44%	77%
Retention % based on T2	93%	97%	101%	100%	99%	83%	96%

4.2 Baseline characteristics of the study population

Socio-demographic and lifestyle characteristics

The sociodemographic characteristics of the entire study population (all pilot sites) at baseline by intervention/control group are depicted in Table 9. Overall, the participants were often unemployment and or with a low income. Also, the participants were on average overweight and a high percentage had 2 or more chronic conditions. Differences between intervention and control group were observed at baseline for age, education level, income, dwelling type, tenure status and time spent inside (p <0.001).

Table 9. Sociodemographic and lifestyle characteristics entire sample by intervention and control group WELLBASED at baseline (T0) (n=1235)

	Intervention group N=600 (48.6%)	Control group N=635 (51.4%)	P-value
Gender[a], *n (%)*			0.98
Female	390 (65.6%)	412 (65.6%)	
Male	205 (34.4%)	216 (34.4%)	

Age (years)[a]				
	Mean (SD)	51.4 (16.8)	47.6 (14.9%)[a]	**<0.001**
	Older people (>65 years)	129 (21.6%)	74 (11.8%)	**<0.001**
Marital status[a], n (%)				0.07
	Married	265 (44.5%)	246 (39.4%)	
	Single, separated, divorced or widowed	331 (55.5%)	378 (60.6%)	
Educational level [b], n (%)				**<0.001**
	Post-secondary or lower	351 (58.8%)	483 (76.9%)	
	Higher education	246 (42.2%)	145 (33.1%)	
Household income category[c], n (%)				**<0.001**
	1-3	376 (63.2%)	461 (73.6%)	
	4-6	147 (24.7%)	124 (19.8%)	
	7-9	72 (12.1%)	41 (6.6%)	
Paid work[c], n(%)				**0.02**
	Yes, by respondent only	113 (19%)	135 (21.5%)	
	Yes, by respondent's partner only	37 (6.3%)	34 (5.4%)	
	Yes, by respondent and their partner	99 (16.7%)	67 (10.7%)	
	No	345 (58.1%)	391 (62.4%)	
Household composition[d], n (%)				0.10
	Single-adult with children	27 (5.2%)	51 (9.1%)	
	Single-adult without children	119 (23.1%)	130 (23.3%)	
	Two or more adults with children	170 (32.9%)	175 (31.3%)	
	Two or more adults without children	200 (38.8%)	203 (36.3%)	
Migration background[b], n (%)				0.05
	Yes	113 (19%)	148 (23.5%)	
	No	483 (81%)	481 (76.5%)	
Belonging to an ethnic minority[e], n (%)				0.82
	Yes	26 (5.2%)	28 (4.9%)	
	No	477 (94.8%)	547 (95.1%)	
Dwelling type[e] , n (%)				**<0.001**
	Detached	138 (24.6%)	173 (33.4%)	
	Semi-detached/terraced	125 (22.3%)	49 (9.5%)	
	Apartment or flat	281 (50.2%)	284 (54.8%)	

	Other	16 (2.9%)	12 (2.3%)	
Tenure status[e], *n (%)*				**<0.001**
	Owner	281 (54.1%)	203 (36.3%)	
	Rented at market rate	115 (22.2%)	162 (28.9%)	
	Reduced rent/social housing/free rent	113 (21.8%)	169 (30.2%)	
	Other	10 (1.9%)	26 (4.6%)	
BMI (kg/m2), *mean (SD)*		27.6 (5.4)	27.9 (6.3)	0.35
No. of chronic conditions [g]				**0.004**
0		89 (14.9%)	126 (20%)	
1-2		232 (38.7%)	193 (30.6%)	
3 or more		278 (46.4%)	312 (49.4%)	
Smoker [g]				0.10
yes		154 (25.7%)	190 (30.1%)	
no		319 (53.3%)	299 (47.3%)	
ex-smoker		126 (21%)	143 (22.6%)	
Average time spent inside the house during daytime [g]				**<0.001**
0-3 hours		46 (7.7%)	27 (4.3%)	
3-6 hours		221 (37.1%)	188 (30%)	
6-9 hours		185 (31.1%)	192 (30.7%)	
> 9 hours		143 (24%)	219 (35%)	
Note: Bold printed values indicate statistical significance. [a] 12 missing [b] 10 missing [c] 14 missing [d] 160 missing [e] 157 missing [f] 26 missing [g] 5 missing				

Health-related quality of life, health and well-being

With regards to health measures (Table 10), participants experienced most problems in the domain of pain/discomfort as measured by the EQ5D. A quarter to a third of the participants experienced depressive symptoms, anxiety or stress. The participants in the intervention compared to the control group overall seemed to have slightly less problems on HRQoL domains and measures of anxiety, stress and depression.

Table 10. Health and well-being outcomes entire sample by intervention and control group WELLBASED at baseline (n=1235)

	Intervention group N=600 (48.6%)	Control group N=635 (51.4%)	P-value
Health-related Quality of Life			
Overall HRQoL[a], n(%)			**<0.001**
No or slight problems (1-10)	471 (78.8%)	443 (70%)	
Moderate, severe or extreme problems (11-25)	127 (21.2%)	190 (30%)	
Mobility[b], n(%)			**0.15**
No or slight problems	492 (82.3%)	502 (79.1%)	
Moderate, severe or extreme problems	106 (17.7%)	133 (20.9%)	
Self-care[c], n(%)			**<0.001**
No or slight problems	572 (95.7%)	571 (90.1%)	
Moderate, severe or extreme problems	26 (4.3%)	63 (9.9%)	
Usual Activities[c], n(%)			**0.02**
No or slight problems	510 (85.3%)	510 (80.4%)	
Moderate, severe or extreme problems	88 (14.7%)	124 (19.6%)	
Pain/Discomfort[c], n(%)			**0.04**
No or slight problems	414 (69.2%)	404 (63.7%)	
Moderate, severe or extreme problems	184 (30.8%)	230 (36.3%)	
Anxiety/Depression[a], n(%)			**<0.001**
No or slight problems	477 (79.8%)	450 (71.1%)	
Moderate, severe or extreme problems	121 (20.2%)	183 (28.9%)	
EQ VAS[d], mean (SD)	**70.1 (19.5)**	**66.7 (20.7)**	**0.004**
Depression[e]			**<0.001**
Normal or mild	464 (77.5%)	404 (64%)	
Moderate, severe or extreme	135 (22.5%)	227 (36%)	
Anxiety[e]			**<0.001**
Normal or mild	400 (66.8%)	360 (57.1%)	
Moderate, severe or extreme	199 (33.2%)	271 (42.9%)	
Stress[f]			0.27
Normal or mild	466 (77.9%)	474 (75.2%)	

Moderate, severe or extreme	132 (22.1%)	156 (24.8%)	

Note: Bold printed values indicate statistical significance. [a] 4 missing [b] 2 missing, [c] 3 missing, [d] 8 missing, [e] 5 missing, [f] 7 missing

Frailty in older adults

The Selfy-MPI brief instrument was implemented among older people in both research conditions to assess frailty. Due to the low numbers of older people only descriptive results can be presented (table 11).

In the intervention group at baseline 22.4 % have a risk moderate-severe in everyday abilities daily living skills, 21.6% in instrumental skills, 22.4% in mobility, 44.8% in cognitive abilities, 67.2% in nutrition, 90.3% in comorbidity, 35.8% are Poly pharmacologically treated and 50.7% are socially isolated. At 12-months 13.6% have a moderate-severe risk in daily living skills, 19.0% in instrumental skills, 24.5% in mobility, 46.2% in cognitive skills, 69.4% in nutrition, 93.9% in comorbidity, 46.3% are Poly pharmacologically treated and 42.2% are socially isolated.

In the control group, 28.1% have a moderate-severe risk in daily life skills, 24.4% in instrumental skills, 31.7% in mobility, 52.4% in cognitive skills, 74.4% in nutrition, 81.7% in comorbidity, 46.3% are Poly pharmacologically treated and 59.8% are socially isolated. At 12-months 14.7% of the elderly have a moderate-severe risk in daily living skills, 21.3 % in instrumental skills, 21.3 % in mobility, 66.7 % in cognitive skills, 73.3 % in nutrition, 89.3 % in comorbidity, 44 % are Poly pharmacologically treated and 56% are socially isolated.

Table 11. Frailty among older adults (>=65 y/o)

	Intervention group		Control group	
	Baseline (n=134)	**12-month follow-up (n=147)**	**Baseline (n=82)**	**12-month follow-up (n=75)**
	n (%)	**n (%)**	**n (%)**	**n (%)**
Activities of Daily Living	30 (22.4)	20 (13.6)	23 (28.1)	11 (14.7)

	Mean (sd)		Mean (sd)	
Instrumental Activities of Daily Living	29 (21.6)	28 (19.0)	20 (24.4)	16 (21.3)
Mobility	30 (22.4)	36 (24.5)	26 (31.7)	16 (21.3)
Cognition	60 (44.8)	68 (46.2)	43 (52.4)	50 (66.7)
Nutrition	90 (67.2)	102 (69.4)	61 (74.4)	55 (73.3)
Comorbidity	121 (90.3)	138 (93.9)	67 (81.7)	67 (89.3)
Polypharmacy	48 (35.8)	68 (46.3)	38 (46.3)	33 (44)
Social isolation	68 (50.7)	62 (42.2)	49 (59.8)	42 (56)
	Mean (sd)		**Mean (sd)**	
Selfy-brief-mpi (moderate-severe risk)	0.48 (0.12)	0.44 (0.17)	0.49 (0.10)	0.45 (0.15)

Energy poverty indicators

With regard to energy poverty indicators (Table 12), participants experienced energy poverty on several of the indicators. When comparing intervention to control group participants, there were significant differences in the indicators 'dwelling comfortable warm in winter time' (p <0.001), 'arrears on utility bills' (p <0.001), 'equipped with heating facilities' (p <0.001), 'equipped with cooling facilities' (p <0.001) and home satisfaction (p = 0.004), with more people in the control group experiencing difficulties.

Table 12. Energy poverty indicators (n=1235)

	Intervention group N=600 (48.6%)	Control group N=635 (51.4%)	p-value
Dwelling comfortable warm in winter time[a]			**<0.001**
Yes	281 (47.1%)	233 (37%)	

No	316 (52.9%)	396 (63%)	
Dwelling comfortably cool in summer time[a]			0.50
Yes	190 (31.8%)	189 (30%)	
No	407 (68.2%)	440 (70%)	
Presence of leak/damp/rot[b]			0.66
Yes	240 (47.6%)	244 (49%)	
No	264 (52.4%)	254 (51%)	
Arrears on utility bills[c]			**<0.001**
Yes, once	40 (7.7%)	77 (13.8%)	
Yes, twice or more	153 (29.5%)	222 (39.6%)	
No	326 (62.8%)	261 (46.6%)	
Equipped with heating facilities [c]			**<0.001**
Yes, central heating or similar	251 (48.4%)	267 (47.7%)	
Yes, other fixed heating	169 (32.6%)	136 (24.3%)	
Yes, non-fixed	90 (17.3%)	110 (19.6%)	
No	9 (1.7%)	47 (8.4%)	
Equipped with air conditioning (cooling) facilities[d]			**<0.001**
Yes	107 (20.6%)	72 (13%)	
No	412 (79.4%)	482 (87%)	
Equipped with adequate electrical installations [e]			0.26
Yes	371 (72.7%)	354 (69.5%)	
No	139 (27.3%)	155 (30.5%)	
Home satisfaction [f]			**0.004**
(very) dissatisfied	209 (35.2%)	269 (43.4%)	
(very) satisfied	384 (64.8%)	351 (56.6%)	
Note: Bold printed values indicate statistical significance. [a] 9 missing, [b] 233 missing, [c] 156 missing, [d] 162 missing, [e] 216 missing, [f] 22 missing			

Energy consumption and costs

With regard to energy consumption and costs (Table 13), the number of participants using derived heat or other energy sources (p <0.001) was higher in the intervention group. The monthly electricity, gas and total energy costs (p <0.001) were higher in the control group compared to the intervention group.

Table 13. Energy consumption and costs (n=1235)

	Intervention group	Control group	p-value
	N=600 (48.6%)	**N=635 (51.4%)**	
Household energy source			
Electricity[a], n (%)	509 (100%)	539 (99.8%)	0.33
Gas[b], n (%)	185 (36.4%)	218 (40.4%)	0.18
Derived heat/ district heating[a], n (%)	102 (20%)	36 (6.7%)	**<0.001**
Other[c] (e.g. oil/petroleum products, renewables or coal products), n (%)	213 (41.7%)	128 (23.1%)	**<0.001**
Monthly energy consumption			
Electricity[d] (kWh), mean (SD)	250.7 (184.8)	265.3 (199.5)	0.46
Gas[e] (m^3), mean (SD)	35.2 (58.5)	41.0 (64.5)	0.57
Derived heat[f] (kWj), mean (SD)	74.6 (43.6)	0	0.13
Monthly energy costs,			
Electricity[g] (€), mean (SD)[a]	53.4 (56.4)	80.4 (78.5)	**<0.001**
Gas[h] (€), mean (SD)[b]	68.5 (79.3)	99.9 (83.6)	**<0.001**
Derived heat[i] (€), mean (SD)	73.0 (63.2)	55.9 (39.3)	0.07
Other sources[j] (€), mean (SD)[c]	13.1 (7.8)	9.1 (17.4)	0.64
Total energy costs, mean (SD) (249 missing)	91.0 (98.0)	115.6 (119.3)	**<0.001**
Received support towards energy bills			
Fixed amount of money, n (%) (205 missing)	91 (17.8%)	79 (14.5%)	0.14
Percentage of costs refunded, n (%) (205 missing)	64 (12.5%)	12 (2.2%)	**<0.001**
In kind contribution, n (%) (193 missing)	65 (12.7%)	83 (14.9%)	0.30
Other type of support, n (%) (208 missing)	31 (6.1%)	55 (10.1%)	**0.02**

Note: Bold printed values indicate statistical significance. [a]186 missing, [b] 188 missing, [c] 169 missing, [d] 598 missing, [e] 241 missing, [f] 125 missing, [g] 76 missing, [h] 74 missing, [i] 8 missing, [j] 311 missing

Energy coping behaviors

With regard to coping behaviours (Table 14), the frequency of adopting all behaviours was significantly different between the intervention and control group. For example, compared to the intervention group

participants those in the control group more often went to bed in the daytime to keep warm or did not prepare food at home to safe costs.

Table 14. Energy-related coping strategies in the past 12 months (n=1181)

	Intervention group N=600 (48.6%)	Control group N=635 (51.4%)	p-value
Wearing extra clothes to keep warm [a]			**<0.001**
Never or rarely	160 (26.8%)	109 (17.4%)	
Sometimes, often or always	437 (73.2%)	519 (82.6%)	
Turning heating/cooling off to save money [b]			**<0.001**
Never or rarely	182 (30.5%)	113 (18%)	
Sometimes, often or always	316 (53%)	396 (63.1%)	
Not an option in my dwelling	98 (16.4%)	119 (18.9%)	
Heating/cooling only one room of the house to save money [a]			**0.01**
Never or rarely	182 (30.5%)	161 (25.6%)	
Sometimes, often or always	333 (55.8%)	344 (54.8%)	
Not an option in my dwelling	82 (13.7%)	123 (19.6%)	
Going to bed in the daytime to keep warm [c]			**<0.001**
Never or rarely	424 (71.1%)	299 (47.7%)	
Sometimes, often or always	172 (28.9%)	328 (52.3%)	
Going to a public building to keep warm/cool [c]			**<0.001**
Never or rarely	539 (90.4%)	499 (79.6%)	
Sometimes, often or always	57 (9.6%)	128 (20.4%)	
Going to a neighbour or friends/relatives house to keep warm/cool [a]			**<0.001**
Never or rarely	519 (87.1%)	500 (79.5%)	
Sometimes, often or always	77 (12.9%)	129 (20.5%)	
Bathing/showering less to save money [a]			**<0.001**
Never or rarely	503 (84.3%)	363 (57.8%)	
Sometimes, often or always	94 (15.7%)	265 (42.2%)	

			<0.001
Turning off lights in rooms that are being used to save money [c]			**<0.001**
Never or rarely	208 (34.9%)	153 (24.4%)	
Sometimes, often or always	388 (65.1%)	474 (75.6%)	
Not cooking/eating cold food to save money [c]			**<0.001**
Never or rarely	535 (89.6%)	451 (72%)	
Sometimes, often or always	62 (10.4%)	175 (28%)	
Avoided going to the doctor to save money [a]			**<0.001**
Never or rarely	397 (66.5%)	491 (78.2%)	
Sometimes, often or always	35 (5.9%)	67 (10.7%)	
Health care is for free in my country	165 (27.6%)	70 (11.1%)	
Note: Bold printed values indicate statistical significance. [A] 10 missing, [b] 11 missing, [c] 12 missing			

Summary

Overall, socio-demographic characteristics indicated the vulnerability of our sample. Around 60% of the participants reported having a low income, being unemployed or having a low education level. Also, almost half of the sample reported having 3 or more chronic conditions. Also, the participants were on average overweight and over 45% percentage had 2 or more chronic conditions. About 30-40% reported depressive, anxiety or stress problems. More than half of the sample was not comfortably warm in their home during wintertime and about 40% reported damp an/or leak problems.

At baseline the intervention and control group participants differed on several characteristics and measured outcome indicators. For example, more intervention participants were home owners, had a slightly higher education level or income. Overall, participants in the intervention group reported better health and well-being at baseline compared to the control group participants. For example, a lower percentage of people in the intervention group reported problems on self-care, pain/discomfort, depression and anxiety compared to the control group participants.

With regard to energy indicators, participants in the intervention group reported more often being comfortably warm in winter time, having less often arrears on utility bills, compared to the control group participants. Monthly energy costs were on average lower among intervention group participants. Also, intervention group participants less often reported having to perform coping behaviour, such as wearing extra clothes to stay warm, compared to the control group.

The comparability between both research groups at baseline differed per pilot site (see Annexes). In Heerlen, Edirne, Jelgava and Obuda the intervention and control group were generally comparable with regard to general characteristics as well as outcomes assessed. In Valencia, the intervention and control group showed differences at baseline while in Leeds the number of participants in the intervention group was too low to perform adequate comparisons.

The differences between intervention and control group participants at baseline were accounted for in the analyses using the self-report questionnaire data, by adding the baseline value of the outcome to the models as well as some of the most important covariates.

4.3 Health, well-being, energy use and behaviour outcomes

The first aim of the evaluation study was to evaluate the impact of the WELLBASED Urban Programs on a range of health, well-being and energy indicators. Gender stratified outcomes for the overall sample are presented in Annex G.

Health-related quality of life, health and well-being

First, analyses were performed with baseline and follow-up values within the intervention group and within the control group separately (table 15). The significant p-values indicate that the change from problems to no-problems, as well as the change from no-problems to problems is significant. In D4.5 a more detailed analysis are performed to evaluate the direction of these changes.

Both groups reported a better self-perceived health when comparing baseline and follow-up (Table 16).The absolute number of participants experiencing problems related to health-related quality of life and depression, anxiety and stress, were lower at 12-month follow-up in the control group. In the intervention group, the absolute number of participants reporting severe problems with overall health-related quality of life including the mobility, self-care and usual activities dimensions was higher, but lower for the other outcomes such as depression and anxiety.

Table 15. Health-related quality of life at baseline and 12-month follow-up

	Intervention group			Control group		
	Baseline (n=514)	12-month follow-up (n=514)	p-value[a]	Baseline (n=474)	12-month follow-up (n=474)	p-value[a]
Problems in overall HrQoL[c]			**<0.001**			**<0.001**
Moderate to extremely severe problems, n (%)	105 (20.9%)	115 (22.9%)		128 (27.6%)	98 (21.1%)	
Mobility [d]			**<0.001**			**<0.001**
Moderate to extremely severe, n (%)	87 (17.3%)	108 (21.5%)		94 (20.2%)	76 (16.3%)	
self-care[c]			**<0.001**			**<0.001**
Moderate to extremely severe problems, n (%)	19 (3.8%)	52 (10.3%)		43 (9.3%)	45 (9.7%)	
Usual activities[c]			**<0.001**			**<0.001**
Moderate to extremely severe problems, n (%)	72 (14.3%)	87 (17.3%)		83 (17.9%)	73 (15.7%)	
Pain/ Discomfort[c]			**<0.001**			**<0.001**
Moderate to extremely severe problems, n (%)	148 (29.4%)	144 (28.6%)		163 (35.1%)	118 (25.4%)	
Anxiety/ depression[c]			**<0.001**			**<0.001**
Moderate to extremely severe problems, n (%)	100 (19.9%)	87 (17.3%)		122 (26.3%)	86 (18.5%)	
EQ VAS[e]						
EQ VAS[e] , mean SD	70.68 (18.99)	71.02 (19.64)	0.70	66.65 (20.38)	68.01 (18.65)	0.11

[a] p-value based Chi-Square test using complete cases only. Bold printed values indicate statistical significance. [b] p-value based on paired samples T-test using complete cases only. Bold printed values indicate statistical significance. [c] 21 missing [d] 20 missing [e] 106 missing [f] 18 missing [g] 19 missing

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Table 16. Depression, anxiety and stress at baseline and 12-month follow-up

	Intervention group			Control group		
	Baseline (n=514)	12-month follow-up (n=514)	p-value*	Baseline (n=474)	12-month follow-up (n=474)	p-value*
Depression			**<0.001**			**<0.001**
Moderate to extreme [a], n (%)	115 (22.8%)	100 (19.8%)		150 (32.3%)	116 (25.0%)	
Anxiety			**<0.001**			**<0.001**
Moderate to extreme [b], n (%)	168 (33.3%)	111 (22.0%)		193 (41.5%)	117 (25.2%)	
Stress			**<0.001**			**<0.001**
Moderate to extreme, [c] n (%)	110 (21.8%)	72 (14.3%)		104 (22.4%)	53 (11.4%)	
* p-value based Chi-Square test using complete cases only. Bold printed values indicate statistical significance [a] 106 missing [b] 18 missing [c] 19 missing						

Second, changes in the health and well-being outcomes between the control and intervention group at 12-month follow-up (corrected for age, gender, education and baseline status of the outcome measure) were calculated (table 17 and 18). Analyses were performed for each pilot site separately and all pilots together.

At 12-month follow-up there were no significant differences in quality of life and its dimensions, including self-perceived health (EQ VAS), comparing the intervention and the control group for the overall sample. In Valencia, the odds for moderate to extremely severe problems in health-related quality of life were higher in the intervention group compared to the control group. Results in other pilots were mixed and not significant (table 17).

At 12-month follow-up there were no significant differences in depression, anxiety and stress between the intervention and the control group for the overall sample (table 18). In Valencia, the odds for problems with regard to depression, anxiety and stress was higher in the intervention group compared to the control group. Results in other pilots are mixed. in the intervention group.

Table 17. Health-related quality of life, differences between intervention and control group

	Valencia (n=240)	Heerlen (n=144)	Edirne (n=235)	Jelgava (n=148)	Obuda (n=100)	Leeds (n=106)	All pilots(n=988)	
	OR* (95% CI)						OR* (95% CI)	p value
Overall HrQoL [a]								
Moderate to extremely severe problems	**17.37 (6.97 - 43.30)**	1.10 (0.46 - 2.64)	1.13 (0.55 - 2.33)	4.28 (0.58 - 31.57)	2.65 (0.72 - 9.80)	0.60 (0.22 - 1.63)	2.41 (0.68 - 8.51)	0.17
Mobility [b]								
Moderate to extremely severe problems	**55.01 (16.52 - 183.14)**	1.42 (0.51 - 3.93)	1.18 (0.54 - 2.57)	11.82 (0.89 - 156.83)	4.55 (0.94 - 22.19)	1.00 (0.29 - 3.39)	4.47 (0.91 - 21.99)	0.07
Self-care [a]								
Moderate to extremely severe problems	**107.50 (13.37 - 864.18)**	1.26 (0.22 - 7.16)	1.44 (0.63 - 3.31)	2.91 (0.20 - 41.94)	0.47 (0.10 - 2.34)	0.17 (0.03 - 1.00)	2.13 (0.25- 17.81)	0.49
Usual activities [a]								
Moderate to extremely severe problems	**28.35 (7.66 - 104.88)**	0.97 (0.38 - 2.46)	1.17 (0.57 - 2.39)	5.01 (0.42 - 60.52)	2.20 (0.50 - 9.76)	0.89 (0.25 - 3.14)	2.81 (0.64 - 12.26)	0.17
Pain/ Discomfort [a]								
Moderate to extremely severe problems	**13.83 (6.35 - 30.12)**	1.09 (0.47 - 2.52)	0.88 (0.45 - 1.70)	2.96 (0.70 - 12.48)	2.11 (0.62 - 7.16)	0.59 (0.21 - 1.69)	1.98 (0.66 - 5.88)	0.22
Anxiety/ Depression[a]								
Moderate to extremely severe problems	42.92 (13.22 - 139.36)	0.71 (0.27 - 1.85)	0.57 (0.30 - 1.09)	1.96 (0.47 - 8.22)	1.06 (0.27 - 4.08	0.10 (0.05 - 0.19)	1.27 (0.25 - 6.51)	0.78

	Beta[+] (SE)[*]						Beta[+] (SE)[*]	p-value
EQ VAS[c]								
Score	-2.00 (1.39)	-1.25 (1.94)	3.05 (1.60)	1.99 (1.41)	3.58 (1.59)	-0.84 (2.66)	0.75 (1.79)	0.37

*Values are random-intercept linear mixed model regression coefficients adjusted for age, gender, income and baseline value of the outcome of interest. Results are presented as Odds Ratios (OR) for categorical variables and Beta's for continuous variables including a 95% Confidence Interval (CI) or Standard Error (SE). Bold printed values indicate statistical significance.

[a] 88 missing [b] 87 missing [c] 167 missing

Table 18. Depression, anxiety and stress, differences between intervention and control group

	Valencia (n=240)	Heerlen (n=144)	Edirne (n=235)	Jelgava (n=148)	Obuda (n=100)	Leeds (n=106)	All pilots (n=988)	
	OR* (95% CI)						OR* (95% CI);	p value
Depression[a]								
Moderate to extreme	**2.39 (1.28-4.47)**	0.60 (0.27 - 1.35)	0.68 (0.37 - 1.30)	0.92 (0.33 - 2.62)	0.85 (0.36 - 2.04)	**0.36 (0.14 - 0.89)**	0.81 (0.38 - 1.75)	0.59
Anxiety[a]								
Moderate to extreme	**3.50 (1.85 - 6.63)**	0.70 (0.30 - 1.63)	0.63 (0.34 - 1.17)	0.89 (0.32 - 2.54)	1.18 (0.44 - 3.18)	**0.24 (0.10 - 0.56)**	0.86 (0.34 - 2.20)	0.76
Stress[b]								
Moderate to extreme	**41.94 (7.30 - 240.84)**	0.46 (0.12 - 1.84)	1.13 (0.36 - 3.60)	0.84 (0.17 - 4.15)	2.54 (0.71 - 9.06)	0.24 (0.04 - 1.47)	1.58 (0.29 - 8.68)	0.60

*Values are random-intercept linear mixed model regression coefficients adjusted for age, gender, income and baseline value of the outcome of interest. Results are presented as Odds Ratios (OR) for categorical variables and Beta's for continuous variables including a 95% Confidence Interval (CI). Bold printed values indicate statistical significance [a] 84 missing [b] 86 missing

Health monitoring (intervention group only)

Blood pressure and heart rate

The number of subjects with initial assessment and the final one are shown in each of the tables corresponding to health measurements: Blood Pressure, Heart Rate, Pulse oximetry and Peak-Flow. The descriptives are presented as a whole, separate by city of origin, gender and age. The results indicated an improvement of Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) in two of the sites (Valencia and Edirne) but no changes were observed in the other sites. Similarly, the results indicated a trend to increased heart rate in some cities (table 19 and 20).

Table 19. Blood pressure by pilot site

	Systolic Blood Pressure (SBP)				Diastolic Blood Pressure (DBP)			
	Baseline	12-month follow-up	P value	N	Baseline	12-month follow-up	P value	N
Valencia	123,0	117,1	**<0.001**	134	80,8	75,7	**<0.001**	134
Leeds	116,7	119,3	0,293	8	80,8	82,2	0,691	8
Obuda	122,5	123,0	0,608	76	76,7	76,6	0,958	76
Jelgava	123,0	124,0	0,331	115	77,7	77,7	0,924	115
Heerlen	135,0	137,9	0,076	25	77,9	79,8	0,316	25
Edirne	131,5	123,3	**<0.001**	116	84,5	79,4	**<0.001**	116
Note: A blood pressure value in the range of 100-140 (SBP) and 50-90 (DBP) is considered within the normal range. Note: Bold printed values indicate statistical significance.								

Table 20. Heart rate measurements by pilot site

	Heart rate			
	Baseline	12-month follow-up	P value	N
Valencia	73,7	75,1	0,088	134
Leeds	79,5	77,3	0,577	8
Obuda	77,0	78,6	**0,037**	76
Jelgava	70,4	71,9	**0,047**	115
Heerlen	78,0	78,5	0,859	25
Edirne	82,8	80,8	0,102	116
Note: Heart rate value in the range of 50-110 is considered within the normal range. Note: Bold printed values indicate statistical significance.				

Table 21. Blood pressure measurements by pilot site and sex

		Systolic Blood Pressure (SBP)				Diastolic blood pressure (DBP)			
	Sex	Baseline	12-month follow-up	P value	N	Baseline	12-month follow-up	P value	N
Valencia	M	129,8	119,9	**<0.001**	40	81,8	75,6	**<0.001**	40
	F	119,9	115,9	**0,008**	93	80,4	75,6	**<0.001**	93
Leeds	M	117,8	124,4	**0,036**	2	80,6	82,6	0,356	2
	F	122,1	120,8	0,625	3	83,3	83,3	0,991	3
Obuda	M	126,4	126,3	0,924	23	78,4	79,1	0,547	23
	F	120,5	121,2	0,665	50	75,6	75,5	0,913	50
Jelgava	M	128,8	124,6	**0,011**	28	78,9	76,5	**0,027**	28
	F	121,1	123,7	**0,026**	87	77,3	78,1	0,313	87
Heerlen	M	145,1	144,5	0,479	6	81,1	83,8	0,762	6
	F	132,0	135,5	0,201	17	78,4	78,8	0,069	17
Edirne	M	131,9	121,9	**<0.001**	58	84,3	79,6	**0,003**	58
	F	131,5	124,9	**0,017**	56	84,5	79,3	**0,001**	56
Note: A blood pressure value in the range of 100-140 (SBP) and 50-90 (DBP) is considered within the normal range. Note: Bold printed values indicate statistical significance.									

When results are split up per site and for male (M) and female (F) (table 21) an improvement of SBP and DBP in Valencia and Edirne was observed for both sexes. A trend to increment heart rate in some pilot sites was observed, and more in men (table 22).

When studying blood pressure and heart rate per age and per pilot, we observed an improvement of SBP and DBP in two of the cities (Valencia and Edirne) in the two groups of age. Also, a trend to increment heart rate in some pilots was observed among the people <60 year old (table 23 and 24).

Table 22. Heart rate measurements by pilot site and sex

	Sex	Baseline	12-month follow-up	P value	N
Heart rate					
Valencia	M	73,0	74,0	0,512	40
	F	74,0	75,7	0,114	93
Leeds	M	82,5	92,3	0,097	2
	F	81,1	74,8	0,497	3
Obuda	M	74,6	77,4	0,069	23
	F	78,0	79,0	0,266	50
Jelgava	M	70,4	72,2	0,316	28
	F	70,4	71,8	0,088	87
Heerlen	M	70,4	78,2	0,651	6
	F	80,3	78,9	0,627	17
Edirne	M	81,1	81,3	0,652	58
	F	84,4	80,3	**0,008**	56

Note: Heart rate value in the range of 50-110 is considered within the normal range. Note: Bold printed values indicate statistical significance.

Table 23. Blood pressure measurements by pilot site and age

		Systolic Blood Pressure (SBP)				Diastolic Blood Pressure (DBP			
	Age	Baseline	12-month follow-up	P value	N	Baseline	12-month follow-up	P value	N
Valencia	<60	119,3	114,9	**0,004**	97	81,5	76,1	**0,000**	97
	>=60	132,7	122,9	**0,000**	36	79,3	74,3	**0,000**	36
Leeds	<60	109,6	112,5	0,300	3	77,1	82,7	0,095	3
	>=60	136,5	136,9	0,959	2	89,9	83,6	0,536	2
Obuda	<60	119,3	119,7	0,701	42	76,8	77,1	0,723	42
	>=60	126,5	126,9	0,861	31	76,1	76,0	0,973	31
Jelgava	<60	120,3	121,2	0,433	64	78,5	78,5	0,960	64
	>=60	126,3	127,4	0,540	51	76,7	76,8	0,931	51
Heerlen	<60	129,6	135,3	0,256	13	75,7	79,4	0,602	13
	>=60	143,7	142,6	0,358	10	84,4	81,3	0,279	10
Edirne	<60	125,4	122,1	**0,040**	85	82,8	79,2	**0,002**	85
	>=60	148,7	127,3	**0,000**	29	88,7	80,1	**0,001**	29

Note: A blood pressure value in the range of 100-140 (SBP) and 50-90 (DBP) is considered within the normal range. Note: Bold printed values indicate statistical significance.

Table 24. Heart rate measurements by pilot site and age

	Age	Baseline	12-month follow-up	P value	N
Valencia	<60	74,1	77,0	**0,003**	97
	>=60	72,5	70,2	0,205	36
Leeds	<60	82,5	86,2	0,599	3
	>=60	80,4	75,1	0,764	2
Obuda	<60	76,6	77,9	0,245	42
	>=60	77,3	79,3	0,075	31
Jelgava	<60	72,8	75,1	**0,050**	64
	>=60	67,4	68,0	0,528	51
Heerlen	<60	81,8	81,4	0,667	13
	>=60	71,9	74,6	0,491	10
Edirne	<60	82,4	80,9	0,188	85
	>=60	83,5	80,6	0,413	29

Note: Heart rate value in the range of 50-110 is considered within the normal range. Note: Bold printed values indicate statistical significance.

Pulse-oximetry (SpO-2) and peak flow

Pulse-oximetry (SpO-2) and peak flow was assessed in the intervention group only. Normal peak flow measures range between the values of 400-700.

The Pulse-oximetry (SpO-2) and peak flow measurements indicated improvement of both respiratory parameters in Obuda (table 25). When split up for each gender, an improvement of both respiratory parameters in Obuda and Edirne was observed for men and women (table 26). Similarly in Obuda and Edirne an improvement was observed among both age groups (table 27).

Table 25. Pulse-oxymetry (SpO2) and peak flow measurements by city

	SpO2				PeakFlow			
	Baseline	12-month follow-up	P value	N	Baseline	12-month follow-up	P value	N
Valencia	97,6	98,0	**0,038**	134	374,9	383,9	0,243	134
Leeds	98,5	98,1	0,222	8	434,7	455,6	0,499	8
Obuda	97,3	97,3	0,864	76	566,5	620,0	**0,000**	76
Jelgava	96,1	96,0	0,683	115	365,8	371,5	0,302	115
*Heerlen**	97,7	96,0	**0,000**	44	-	-	-	0
Edirne	98,0	97,3	**0,000**	116	232,3	327,9	**0,000**	116

Note: Higher values indicate relatively better SpO2 or Peak Flow. Note: Bold printed values indicate statistical significance.* Heerlen did not implement Peak Flow measurements.

Table 26. Pulse-oxymetry (spo2) and peak flow measurements by pilot and sex

		SPO2				PEAKFLOW			
	Sex	Baseline	12-month follow-up	P value	N	Baseline	12-month follow-up	P value	N
Valencia	M	97,5	97,7	0,434	40	457,1	472,4	0,349	40
	F	97,7	98,2	0,068	93	340,5	345,6	0,555	93
Leeds	M	98,5	98,3	0,500	2	668,8	696,3	**0,000**	2
	F	98,6	97,6	0,147	3	295,8	266,7	0,293	3
Obuda	M	97,5	98,0	0,213	23	698,0	763,6	**0,017**	23
	F	97,2	97,0	0,275	50	509,3	557,8	**0,001**	50
Jelgava	M	95,8	95,0	0,318	28	487,5	511,8	**0,041**	28
	F	96,2	96,3	0,616	87	326,6	326,4	0,974	87
*Heerlen**	M	97,8	96,4	**0,005**	12	-	-	-	0
	F	97,7	95,8	**0,000**	31	-	-	-	0
Edirne	M	98,0	97,2	**0,000**	58	260,5	351,4	**0,000**	58
	F	97,9	97,3	**0,001**	56	201,3	300,6	**0,000**	56

Note: Higher values indicate relatively better SpO2 or Peak Flow. Note: Bold printed values indicate statistical significance.* Heerlen did not implement Peak Flow measurements.

Table 27. Pulse-oxymetry (spo2) and peak flow measurements by pilot and age

		SPO2				PEAKFLOW			
	Age	Baseline	12-month follow-up	*P value*	N	Baseline	12-month follow-up	*P value*	N
Valencia	<60	98,0	98,1	0,395	97	398,3	407,6	0,295	97
	>=60	96,9	97,9	0,064	36	314,3	319,5	0,747	36
Leeds	<60	98,5	97,6	0,212	3	427,5	420,0	0,805	3
	>=60	98,6	98,3	0,205	2	471,3	466,3	0,903	2
Obuda	<60	97,7	97,8	0,507	42	655,2	719,6	**0,001**	42
	>=60	96,8	96,6	0,483	31	451,6	491,3	**0,018**	31
Jelgava	<60	96,7	96,3	0,310	64	417,4	421,6	0,613	64
	>=60	95,3	95,6	0,565	51	301,0	308,8	0,292	51
*Heerlen**	<60	97,7	96,1	**0,005**	27	-	-	-	0
	>=60	97,7	95,8	**0,001**	17	-	-	-	0
Edirne	<60	98,2	97,3	**0,000**	85	245,5	337,1	**0,000**	85
	>=60	97,3	97,3	0,550	29	196,7	295,3	**0,000**	29

Note: Higher values indicate relatively better SpO2 or Peak Flow. Note: Bold printed values indicate statistical significance.* Heerlen did not implement Peak Flow measurements.

Sleep

Sleep quality was assessed in the intervention group only using the Pittsburg Sleep Quaity Index (PSQI). The number of subjects with initial assessment and the 12-month follow-up one are shown in each of the tables corresponding to sleep quality per pilot site and overall, as well as per gender and age. In Valencia and Edirne an improvement of sleep quality was observed, also for both men and women (table 28 and table 29). An improvement of sleep quality was observed in both Valencia and Edirne for participants below 60 years of age (table 30).

Table 28. Sleep quality scores

	Baseline	12-month follow-up	P value	N
Total Score				
Valencia	8,9	6,9	**0,000**	129
Leeds	7,5	9,1	0,071	4
Obuda	6,0	6,3	0,516	70
Jelgava	5,5	5,4	0,790	116
Heerlen	9,0	9,0	0,866	70
Edirne	9,4	6,7	**0,000**	115
Overall	7,8	6,8	**0,000**	504

Note: a lower score on the PSQI indicates better sleep quality. Note: Bold printed values indicate statistical significance.

Table 29. Sleep quality per pilot site and per sex

	Sex	Baseline	12-month follow-up	P value	N
Total Score					
Valencia	M	7,4	5,1	**0,000**	37
	F	9,5	7,6	**0,000**	92
Leeds	M	5,5	8,0	**0,000**	2
	F	9,5	10,3	0,500	2
Obuda	M	5,9	5,7	0,652	22
	F	6,3	6,7	0,412	45
Jelgava	M	4,7	4,7	1,000	30
	F	5,7	5,7	0,741	86
Heerlen	M	8,6	8,0	0,514	23
	F	9,2	9,4	0,791	46
Edirne	M	8,9	6,3	**0,000**	60
	F	9,9	7,2	**0,001**	53

Note: a lower score on the PSQI indicates better sleep quality

Table 30. Sleep quality per pilot site and per age group

	Age	Baseline	12-month follow-up	P value	N
Total Score					
Valencia	<60	9,4	7,0	**0,000**	93,0
	>=60	7,6	6,6	0,070	36,0
Leeds	<60	11,5	13,5	0,156	2,0
	>=60	3,5	4,8	0,500	2,0
Obuda	<60	5,6	5,8	0,575	40,0
	>=60	7,0	7,1	0,880	27,0
Jelgava	<60	4,9	4,7	0,435	68,0
	>=60	6,2	6,5	0,668	48,0
Heerlen	<60	10,3	10,1	0,802	40,0
	>=60	7,3	7,5	0,950	30,0
Edirne	<60	9,0	6,4	**0,000**	84,0
	>=60	10,4	7,8	**0,013**	29,0
Note: a lower score on the PSQI indicates better sleep quality					

Energy poverty indicators, consumption, costs and coping

Energy poverty indicators, consumption, costs and coping were assessed in both the control and the intervention group. Table 31-33 presents the first analyses in which changes between baseline and 12-month follow-up in energy outcomes, for the intervention and control group are evaluated separately. In both groups, compared to baseline a higher absolute number of participants indicates being more comfortably warm and cool at 12-month follow-up, and lower total energy costs.

Table 31. Energy poverty indicators at baseline and 12-month follow-up

	Intervention group			Control group		
	Baseline (n=514)	12-month follow-up (n=514)	p-value[a]	Baseline (n=474)	12-month follow-up (n=474)	p-value[a]
Comfortably warm in winter time			**<0.001**			**<0.001**
Yes, n (%)	243 (48.1%)	316 (62.6%)		163 (35.5%)	272 (59.3%)	
Comfortably cool in summer time[b]			**<0.001**			**<0.001**
Yes, n (%)	162 (32.1%)	184 (36.4%)		120 (26.1%)	245 (53.4%)	
Note: Bold printed values indicate statistical significance. [A] p-value based on Chi-Square test [b] 24 missing.						

Table 32. Energy costs at baseline and 12-month follow-up

	Intervention group			Control group		
	Baseline (n=514)	12-month follow-up	p-value[b]	Baseline (n=514)	12-month follow-up	p-value[b]
Total energy costs in Euro's[a]*, mean (SD)	99.57 (91.77)	94.87 (99.57)	0.45	120.45 (110.78)	102.72 (90.30)	**0.02**
*Total energy costs include costs for electricity, gas, derived heat and other energy sources. Note: Bold printed values indicate statistical significance. [a] 501 missing [b] p-value based on paired samples T-test						

Table 33. Energy coping behavior at baseline and 12-month follow-up

	Intervention group			Control group		
	Baseline (n=514)	12-month follow-up	p-value[b]	Baseline (n=514)	12-month follow-up	p-value[b]
Coping behaviours (sum 0-50)[a], mean (SD)	23.12 (6.83)	19.85 (7.95)	**<0.001**	25.90 (7.88)	21.22 (8.14)	**<0.001**
Note: Bold printed values indicate statistical significance.. [a] 23 missing, a sum score was calculated based on all individual coping behaviours [b] p-value based on paired samples T-test						

In the second analyses, when evaluating the change comparing the intervention and control group, there were no significant differences regarding the energy poverty indicators 'comfortably warm in winter time' and 'comfortably cool in summer time' in the overall sample (Table 34). In Valencia, the intervention group participants were significantly less comfortably warm and cool compared to the control group participants at 12-month follow-up, while in Edirne and Leeds, they were significantly more comfortably warm and in Edirne also cool.

The total energy costs (Table 35) increased at 12-month follow-up in the overall sample and in all pilots separately, although not statistically significant.

In the overall sample, intervention group participants adopted slightly less coping behaviours at 12-month follow-up compared to control group participants, although not statistically significant (Table 36). The same applies when looking at the pilots separately, except for Obuda, where intervention group participants adopted slightly more coping behaviours.

Table 34. Energy poverty indicators at 12-month follow-up, differences between intervention and control group

	Valencia (n=240)	Heerlen (n=144)	Edirne (n=235)	Jelgava (n=148)	Obuda (n=100)	Leeds (n=106)	All pilots(n=988)	
	OR* (95% CI)						OR* (95% CI)	p value
Comfortably warm in winter time[a]								
Yes	**0.09 (0.04 - 0.17)**	0.90 (0.43 - 1.88)	**4.87 (2.44 - 9.72)**	0.31 (0.07 - 1.42)	1.92 (0.73 - 5.05)	**2.32 (1.18 - 4.59)**	0.87 (0.24 - 3.11)	0.83

Comfortably cool in summer time[a]								
Yes	**0.03 (0.01 - 0.05)**	0.91 (0.47 - 1.76)	**2.73 (1.40 - 5.32)**	1.33 (0.59 - 3.02)	0.54 (0.22 - 1.35)	0.41 (0.23 - 0.71)	0.51 (0.14 - 1.86)	0.31

*Values are random-intercept linear mixed model regression coefficients adjusted for age, gender, income and baseline value of the outcome of interest. Note: Bold printed values indicate statistical significance.[a] 90 missing

Table 35. Energy costs at 12-month follow-up, differences between intervention and control group

	Valencia (n=240)	Heerlen (n=144)	Edirne (n=235)	Jelgava (n=148)	Obuda (n=100)	Leeds (n=106)	All pilots(n=988)	
	Beta[+] (SE)						Beta[+] (SE)	p-value
Total energy costs in Euro's*[a]	17.01 (0.05)	16.25 (0.10)	16.86 (0.10)	16.82 (0.07)	17.06 (0.09)	16.20 (0.09)	16.70 (8.13)	0.14

*Total energy costs include costs for electricity, gas, derived heat and other energy sources

[+] Values are random-intercept linear mixed model regression coefficients adjusted for age, gender, income and baseline value of the outcome of interest.
Note: Bold printed values indicate statistical significance. [a] 520 missing

Table 36. Energy poverty coping behaviours at 12-month follow-up, differences between intervention and control group

	Valencia (n=240)	Heerlen (n=144)	Edirne (n=235)	Jelgava (n=148)	Obuda (n=100)	Leeds (n=106)	All pilots(n=988)	
	Beta* (SE)						Beta* (SE)	p-value
Coping behaviours (sum 0-50)[a]	6.64 (0.71)	-0.97 (1.16)	-3.57 (0.74)	-0.44 (1.05)	0.63 (1.20)	-4.64 (2.14)	-0.39 (1.79)	0.57

* Values are random-intercept linear mixed model regression coefficients adjusted for age, gender, income and baseline value of the outcome of interest. a sum score was calculated based on all individual coping behaviours.

Note: Bold printed values indicate statistical significance. [a] 89 missing

Summary

Health and well-being outcomes

We first explored the changes in health and well-being outcomes within the intervention and control group separately. The findings showed that between baseline and follow-up, in both groups, participants changed in both directions for most health and well-being outcomes. For example, a number of participants with a baseline health-related quality of life 'moderate or extremely severe problems' moved at follow-up to 'no or slight problems', but an almost comparable number of participants categorised at baseline with 'no or slight problems' changed to 'moderate to extremely severe problems' at follow-up.

For the overall health-related quality of life outcome and the health-related quality of life domains, the absolute numbers showed less people with problems at follow-up in the control group compared to baseline. While in the intervention group more people reported problems on the health-related quality of life outcomes at follow-up compared to baseline. The absolute number of people with 'moderate to extreme' depression, anxiety, stress was lower, at 12-month follow-up compared to baseline, both in the intervention and control group.

Secondly we explored, the changes in health and well-being outcomes between baseline and follow-up were evaluated comparing the intervention and control group. The hypotheses were that the participants in the intervention group would have better health and well-being outcomes compared to the control group. Overall, none of the health and well-being outcomes showed statistically significant changes when comparing intervention to the control group at 12- month.

The perceived well-being scale, depression and anxiety results were in positive direction for the overall intervention group compared to control group. The other outcomes were in negative direction for the intervention group compared to control group. However, none were significant.

The per pilot evaluation showed that in Valencia, after 12-months, the odds for having problems with regard to health-related quality of life, depression, anxiety and stress were higher in the intervention group compared to the control group. Results in other pilots were mixed and non-significant.

In addition we explored the results at 18-month follow-up. Similarly as at 12-month follow-up, none of the health and well-being outcomes showed statistically significant changes when comparing the overall intervention and control group.

However, results do seem to suggest an improvement in outcomes at 18-months, when comparing the results at the 12- and 18 month evaluation point. For example the odds ratio for the intervention group, compared to control group, with regard to reporting 'moderate to extremely severe problems' for overall

health related quality of life was 2.41 at 12 month follow-up and 0.80 at 18-month follow-up, for depression 0.82 to 0.72, and for stress 1.58 to 1.15.

The health outcomes assessed in the intervention group, oxygen saturation, heart rate and blood pressure, were considered within the range of healthy values in most pilot sites at baseline. Some values of these health indicators were slightly improved, at follow-up. For example, in Valencia blood pressure decreased and pulse-oximetry values improved. In Edirne improvement in blood pressure and heart rate were observed. With regard to sleep quality an improvement over all pilot sites was observed looking at the average score. Also, in Valencia and Edirne an improvement in sleep score was observed.

Energy poverty, consumption, costs and coping

Also for energy outcomes we first explored the changes in the outcomes from baseline to follow-up within the intervention and control group separately. A higher absolute number of participants in the intervention and in the control group indicated feeling comfortable warm in wintertime or comfortably cool at summertime at follow-up compared to baseline. Similarly, the participants reported slightly less energy costs and also less coping behaviour at follow-up in both research groups.

Secondly we evaluated the change comparing the intervention and control group. There were no significant differences regarding the energy poverty indicators 'comfortably warm in winter time' and 'comfortably cool in summer time' between intervention and control group at 12-month follow-up. The results suggest less comfort in the intervention group, but not significant. In Valencia, the intervention group participants were less comfortably warm and cool compared to the control group participants at 12-month follow-up, in Edirne they were more comfortably warm and cool, and in Leeds they were more warm in winter but less cool in summer.

Energy costs were higher in the intervention group compared to the control group between baseline and 12-month follow up. This was also observed in each of the pilot site intervention groups compared to their respective control groups. With regard to coping behaviour, such as wearing extra clothes, an decrease was observed in the intervention group, but not significant.

At 18-month follow up no significant changes between intervention and control group were observed with regard to the comfortably warm/ cool indicators, costs and coping behaviour. The odds ratio suggest an improvement in feeling comfortable warm in winter, but a decrease in feeling comfortable cool in summer, in the intervention group compared to control group at 18-months. Energy costs had decreased in intervention group, compared to control group, as well as the number of coping behaviours. However, all these changes were non-significant.

4.4 Indoor Air Quality (intervention group only)

The second objective was to evaluate the impact of the WELLBASED Urban Programs on Indoor air Quality (IAQ). These data were available only in the intervention group

The data collection period across the pilots differed greatly and can be seen in table 37. The data collection range was from a minimum of 1 to 20 months of indoor air quality data.

Table 38 show the percentage of households in each of the four seasons during the first (W_1) and last week (W_2) of indoor air quality monitoring.

Table 39 shows a paired sample t-test of the average temperature (C°), Relative Humidity (%) and CO_2 (ppm) in the first week (W1) of monitoring compared with the last week (W2) monitoring across all pilots. It should be noted that seasonal effect in this analysis was not considered.

Table 40 show an ANOVA summary table of the interaction between temperature, relative humidity, CO2 and season. When the p-value is significant (below 0.05) it suggests that the change over time is due to seasonal variation. For example, take the Heerlen pilot, in table 24 there is a significant p-value of 0.023 for the interaction of temperature*season. The statistically significant interaction suggests that the rise in temperature (see table 22) is affected by seasonal variation across the first (W1) and last (W2) week of monitoring. In the other pilot sites there was no effect of season, any effect might be due to the intervention, however no significant changes were observed.

Table 37. Data collection period

	Data availability, range in months
Valencia	2-20
Heerlen	3-18
Leeds	4-18
Edirne	1-13
Obuda	13
Jelgava	2-20
Total[3]	1-20

Table 38 Percentage of homes in each season during first and last week of monitoring

	Season W_1 (%)				Season W_2 (%)			
	Spring	**Summer**	**Autum**	**Winter**	**Spring**	**Summer**	**Autum**	**Winter**
Valencia	38.8	18.6	0	42.6	27.9	63.6	3.9	4.7
Heerlen	80.1	0.0	0.0	19.9	4.1	94.9	0.0	1.0
Leeds	24.0	72.0	4.0	0.0	0.0	0.0	24.0	76.0
Edirne	0.0	71.0	29.0	0.0	22.6	32.3	22.6	22.6
Obuda	0.0	100	0.0	0.0	0.0	100	0.0	0.0
Jelgava	45.1	16.4	11.5	27.0	0.8	95.9	2.5	0.8

Table 39 Temperature, Relative humidity and CO2 in the first and last week of monitoring, paired sample t-test

	Temperature in °C (Mean±SD)			Relative Humidity in % (Mean±SD)			CO_2 in ppm (Mean±SD)		
	W_1*	W_2**	P-value	W_1	W_2	P-value	W_1	W_2	P-value
Valencia[a]	21.98± 3.90	26.81± 3.1	**<0.001**	57.09± 9.25	62.12± 6.11	**<0.001**	864.14± 425.69	632.32± 309.83	**<0.001**
Heerlen[b]	20.29± 2.45	24.03± 1.72	**<0.001**	42.72± 6.77	65.96± 6.26	**<0.001**	610.16± 325.69	707.90± 673.24	**0.034**
Leeds[c]	16.73± 3.41	20.76± 2.14	**<0.001**	55.17± 9.22	60.08± 7.51	**0.021**	843.19± 242.65	717.60± 436.74	0.265
Edirne[d]	27.80± 3.36	26.77± 6.46	0.433	53.73± 7.05	45.44± 12.39	**0.004**	1089.28± 307.80	1088.42± 527.84	0.997
Obuda[e]	27.40± 0.84	27.81± 1.29	0.054	46.05± 2.52	42.12± 4.09	**<0.001**	500.58± 87.89	570.23± 235.95	**0.038**
Jelgava[f]	21.46± 2.47	24.05± 1.41	**<0.001**	41.93± 7.81	55.47± 5.95	**<0.001**	774.72± 253.15	600.64± 141.65	**<0.001**
Overall[g]	21.68± 3.81	24.95± 3.06	**<0.001**	47.42± 10.02	59.70± 9.73	**<0.001**	719.48± 352.09	658.70± 474.05	**0.010**

[a] Valencia has n=129 cases [b] Heerlen has n=196 cases [c] Leeds has n=25 Temperature cases, n=24 Relative Humidity cases and n=5 CO_2 cases. [d] Edirne has n=31 Temperature cases, n=31 Relative Humidity cases and n=8 CO_2 cases. [e] Obuda has n=34 cases [f] Jelgava has n=120 cases [g] Total Temperature cases n=535, total Relative Humidity cases n=534 and total CO_2 cases n=492. *W_1 First week of IoT monitoring **W_2 Last week of IoT monitoring Note: Bold printed values indicate statistical significance.

Table 40 Temperature, Relative Humidity and CO2 interaction with season type

Interaction terms	Valencia	Heerlen	Leeds	Edirne	Obuda	Jelgava
	P-value	P-value	P-value	P-value	P-value	P-value
Season*Temperature	0.646	**0.023**	-	0.685	-	0.931
Season*Relative Humidity	0.851	**<0.001**	-	0.695	-	0.122
Season*CO$_2$	0.926	**<0.001**	-	-	-	0.052
- Indicates that there were not enough cases available for analyses Note: Bold printed values indicate statistical significance.						

Summary

Air quality was assessed in the intervention group. Overall a change in temperature between baseline and follow-up was observed. In most pilots an increase in temperature and humidity was observed when comparing the first week and last week of measurement data. The graphs per pilot (Annexes) show per pilot both the outdoor temperature and the indoor indicators. In Valencia visually a strong impact of the outdoor temperature on the indoor indicators was visible (see Annexes). While for example in Obuda the outdoor temperature in winter did not lead to extreme low indoor temperatures. When corrected for season, there was no significant intervention effect observed.

4.5 Cost-effectiveness

A cost-effectiveness analysis was conducted for the pilots in Heerlen (The Netherlands), Valencia (Spain), and Edirne (Turkey). The selection of the pilots was primarily guided by two main criteria: data availability and diversity of intervention.

1.   Data availability; specifically, the total sample size achieved for each pilot in both groups (Intervention Group (IG) and Control Group (CG)).

2.   Diversity of intervention deployed, showing different nature of the energy poverty interventions subjected to cost-effectiveness analysis.

Sample sizes in Heerlen, Valencia and Edirne pilots were sufficient to provide statistical power and therefore significant comparability between the intervention and the control groups. In contrast, Leeds, Jelgava, and Obuda pilots did not reach sufficiently sample size to guarantee statistical comparability (refer to table 8).

Regarding the types of interventions deployed, the selected pilots represent different intervention approaches:

- Heerlen: Open talks/ group meetings about energy efficiency. Health-Cafés were organised to share lessons learned, experiences, energy tips and Q&A on energy poverty with participants.
- Valencia: Delivery of energy efficiency kits, energy efficiency advice, energy bills optimization, energy audits at home, group meetings about energy efficiency, express home renovation, handy man services and access to home sensor data (temperature, CO2, humidity).
- Edirne: Energy audits at home, structural home improvements (heating system replacement, home insulation, windows replacement), group meetings about energy efficiency and access to home sensor data (temperature, CO2, humidity).

As observed in Figure a, the selected pilots range from simple interventions (in Heerlen) and moderate interventions (in Valencia) to more structural and technologically complex interventions like those involving structural retrofitting actions (in Edirne).
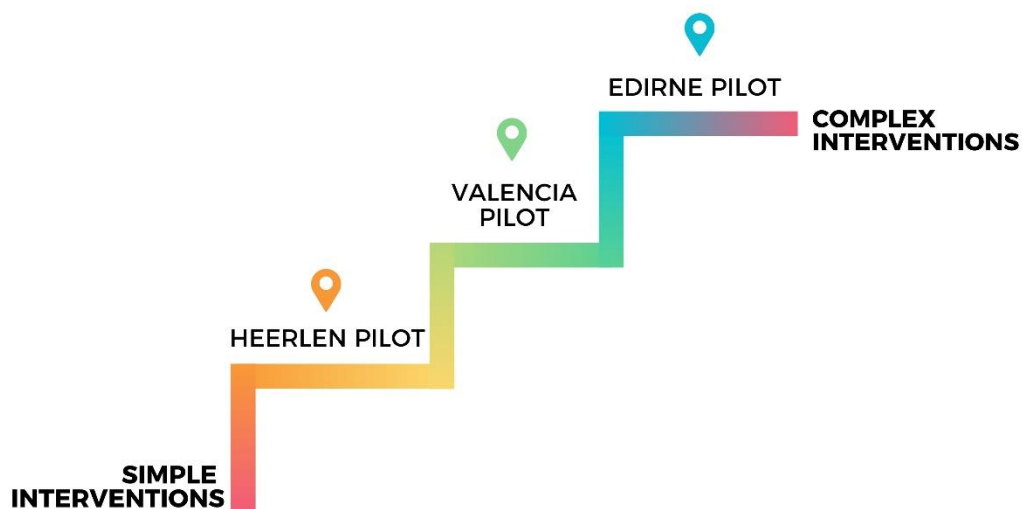
Figure a. Degree of complexity of the interventions

For further details on the interventions conducted within each pilot, including comprehensive descriptions of the WUP at each pilot site, see D3.4.

The results from the pilots in Heerlen, Valencia and Edirne are presented below with an analysis of healthcare costs, intervention costs, health utility gained per pilot, and, ultimately, the ICER (Incremental Cost-Effectiveness Ratio) calculations.

Health care costs

The healthcare costs were determined by multiplying the resource use (number of appointments with health care professionals and number of hospitalized nights) with the corresponding unit prices for 2024. Resource use was collected using 3 items of the SMRC Health Care utilization questionnaire regarding the number of doctor appointments, accident and emergency visits as well as the number of days hospitalized in the last 6 months.

Table 41 shows the resource use at baseline and the 12-month follow-up for the intervention group in the total sample and the results of the paired t-test. Table 42 shows the resource use at baseline and 12-month follow-up for the control group in the sample and the results of the paired t-test.

When considering the total samples, results show that: for both intervention and control group, the mean number of doctor appointments decreased, but this reduction was only significant in the case of the control group. The number of accident and emergency visits also decreased, and in this case, this reduction was significant in both groups. Finally, the number of days spent in hospital increased for the intervention group, with no statistical significance, but it decreased significantly in the control group.

Table 41 Resource use of intervention participants at baseline and at 12-month follow-up (n= 504)

	n (paired)	Baseline, Mean (SD)	12-month follow-up, Mean (SD)	p-value[+]
Number of doctor appointments	504	3.4 (5.2)	2.9 (5.6)	0.13
Number of Accident & Emergency visits	504	0.7 (2.3)	0.3 (0.8)	**0.002**
Number of days hospitalised	500	0.4 (2.0)	0.5 (3.8)	0.57

Table 42 Resource use of control participants at baseline and at 12-month follow-up (n=463)

	n (paired)	Baseline, Mean (SD)	12-month follow-up, Mean (SD)	p-value[+]
Number of doctor appointments	463	3.1 (8.0)	1.9 (3.6)	**0.001**
Number of Accident & Emergency visits	462	0.7 (1.6)	0.4 (1.1)	**<0.001**
Number of days hospitalised	458	0.7 (3.3)	0.2 (1.6)	**0.003**
Note: Bold printed values indicate statistical significance. [+] P-value based on paired t-test				

To estimate health care costs, the unit prices of the three mentioned costs were used. Unit prices are based on the 2024 Dutch unit prices that are provided by the Dutch Guidelines for carrying out economic evaluations. The Dutch unit prices of 2024 were then adjusted using the Organisation for Economic Co-operation and Development (OECD) Purchasing Power Parities (PPPs) for the actual individual consumption to reflect the 2024-unit prices in the countries of the other pilot sites (Spain and Turkey). Exchange rates to convert the Lira euros were applied as described in the methods section. As the Dutch unit prices are already from 2024, there is no need to adjust for inflation.

Table 43 shows the calculated unit prices used for the evaluation of the resource use in the three pilot sites chosen for the cost-effectiveness analysis. The calculated unit prices are rounded off by 2 decimals in the table, however, calculations are done with the entire number.

Table 43 Unit prices used for the evaluation of resource use of each country (for 2024, in euros) .

	Heerlen (The Netherlands)	Valencia (Spain)	Edirne (Turkey)
OECD PPP's 2022	reference	0.586	6.087
Doctor appointments	120	70.32	28.49
Accident & Emergency visits	258	151.19	61.25
Number of days hospitalised	644	377.38	152.88

The following tables (Table 44 until 49) show the mean use of the three resources per participant at baseline and 12-month follow-up. For each pilot site there are two tables: one for the intervention group and one for the control group. With these mean resource use, the health care costs per participant at baseline and follow-up were calculated as well as the change in health care costs between baseline and follow-up. Calculations were made multiplying the mean resource use by the unit price.

Participants in the intervention group in the Valencia pilot site (Table 46) reported an average of 4,29 doctor appointments at baseline. When this figure is multiplied by the unit cost of €70,32, the mean cost amounts to 301,67 euros. At follow-up, the mean cost is reduced to 256,67euros, reflecting a decrease of 45,01 euros. Likewise, average figures for accident and emergency visits and days hospitalized also decrease, resulting in further reductions of 98,27 and 75,48 euros, respectively, between baseline and follow-up. When combining all three health resources, the total reduction in costs for the intervention group in the Valencia pilot amounts to 218,75 euros per participant, compared to savings of 328,30 euros in the control group.

Similarly, the intervention group participants in Edirne pilot site (Table 48) reported a mean of 2,05 number of doctor appointments at baseline. When multiplied by the unit price (28,48 euros), the mean costs are 58,40 euros. At follow-up the mean costs are 30,48 euros, resulting in a decrease of 27,92 euros. In terms of accidents and emergency visits and number of days hospitalised, the mean numbers also decrease leading to a reduction of 25,11 and 13,76 euros respectively between baseline and follow-up. Combining the three health resources, the total decrease in the Edirne pilot intervention group is 66,79 euros per participant. The control group also saved 166,18 euro per participant.

On the contrary, in the Heerlen pilot site, neither the intervention nor the control groups experienced any savings in total health costs. The only savings recorded in the control group amounted to 169,20 euros per participant for doctor's appointments, resulting from a decrease in the mean number of visits from 4,19 at baseline to 2,78 at follow-up.

Please note that all numbers in the tables below are rounded off for practical reasons, but calculations are performed with the entire number.

Table 44 Heerlen Intervention group – healthcare costs per participant at baseline and at 12-month follow-up

	n (paired)	Baseline			12-month follow-up			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	83	2.98	120	357.60	4.39	120	526.80	169.20
Accident & Emergency visit	84	0.31	258	79.98	0.33	258	85.14	5.16
Number of days hospitalised	84	0.27	644	173.88	1.87	644	1204.28	1030.40
				611.46			1816.22	1204.76

Table 45 Heerlen control group – healthcare costs per participant at baseline and at 12-month follow-up

	n (paired)	Baseline			12-month follow-up			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	59	4.19	120	502.80	2.78	120	333.60	-169.20
Accident & Emergency visit	59	0.24	258	61.92	0.27	258	69.66	7.74
Number of days hospitalised	59	0.25	644	161	0.78	644	502.32	341.32
				725.72			905.58	179.86

Table 46 Valencia Intervention group – healthcare costs per participant at baseline and at 12-month follow-up

	n (paired)	Baseline			12-month follow-up			Δ Health care costs (euro)
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	
Number of doctor appointments	111	4.29	70.32	301.67	3.65	70.32	256.67	-45.01
Accident & Emergency visit	111	1.11	151.19	167.82	0.46	151.19	69.55	-98.27
Number of days hospitalised	111	0.33	377.38	124.54	0.13	377.38	49.06	-75.48
				594.03			375.27	-218.75

Table 47 Valencia control group – healthcare costs per participant at baseline and at 12-month follow-up

	n (paired)	Baseline			12-month follow-up			Δ Health care costs (euro)
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	
Number of doctor appointments	129	2.64	70.32	185.64	1.73	70.32	121.65	-63.99
Accident & Emergency visit	129	0.91	151.19	137.58	0.31	151.19	46.87	-90.71
Number of days hospitalised	129	0.47	377.38	177.37	0.01	377.38	3.77	-173.60
				500.60			172.30	-328.30

Table 48 Edirne Intervention group – healthcare costs per participant at baseline and at 12-month follow-up

	n (paired)	Baseline			12-month follow-up			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	113	2.05	28.48	58.40	1.07	28.49	30.48	-27.92
Accident & Emergency visit	112	0.99	61.25	60.65	0.58	61.25	35.52	-25.11
Number of days hospitalised	109	0.4	152.88	61.15	0.31	152.88	47.39	-13.76
				180.19			113.40	-66.79

Table 49 Edirne Control group – healthcare costs per participant at baseline and at 12-month follow-up

	n (paired)	Baseline			12-month follow-up			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	119	2.33	28.49	66.38	1.07	28.49	30.48	-35.89
Accident & Emergency visit	119	0.97	61.25	59.41	0.64	61.25	39.20	-20.21
Number of days hospitalised	116	0.91	152.88	139.12	0.19	152.88	29.05	-110.07
				264.91			98.73	-166.18

Costs of the WELLBASED Urban Program

The total intervention cost for each pilot was determined by calculating the costs associated with each intervention individually. This calculation included the following cost components: total personnel costs required for implementing the interventions, total material costs involved in executing the actions, and other related expenses incurred in, such as transport, venue rental, and similar operational costs.

The following tables 50, 51 and 52 present a detailed analysis of the total costs associated with the interventions, as well as the cost per participant for each pilot site.

Firstly, we examine the case of Heerlen (Table 50), where "simple" interventions were implemented, resulting in a total cost of 1.597 euros or 19 euros per participant. Secondly, the pilots in Valencia (Table 51) and Edirne (Table 52) deployed moderate or complex interventions, addressing various layers of the socio-ecological model (see Section 4.3, Exposure to the WELLBASED Urban Programme, and D3.4).

Edirne adopted a mixed model that incorporated not only straightforward interventions but also structural actions within households, such as the replacement of heating systems, home insulation, and window replacement. Similarly, Valencia implemented a mixed model, although with less emphasis on structural renovations, focusing instead on targeted actions within layer 3 of the socio-ecological model.

Table 50 Heerlen– Intervention total cost and per participant (in euros)

Intervention	Costs (€)
Open talks/Group meeting about energy efficiency	315
Open talks/Group meeting about energy efficiency	222
Open talks/Group meeting about energy efficiency	277
Open talks/Group meeting about energy efficiency	222
Open talks/Group meeting about energy efficiency	561
Total cost of intervention	1.597
Intervention cost per participant (n=84)	19

Table 51 Valencia– Intervention total cost and per participant (in euros)

Intervention	Costs (€)
Delivery of energy efficiency kit	35.176
Energy efficiency advice, energy bills optimization	27.243
Energy audit at home	23.896
Group meetings about energy efficiency&health through the "Citizen School for the Right to Energy"	18.546
Express home Renovation	16.899
Handy Man Services	520
Access to home sensor data (temperature, CO2, humidity)	33.560
Total cost of intervention	179.181
Interventions cost per participant (n=111)	1.614

Table 52 Edirne– Intervention total cost and per participant (in euros)

Intervention	Costs (€)
Energy audit at home	4000
Structural home improvement: heating system replacement	48.231
Structural home improvement: home insulation	13.000
Structural home improvement: windows replacement	6.400
Group meeting about energy efficiency	600
Access to home sensor data (temperature, CO2, humidity)	77.711
Total cost of intervention	149.942
Interventions cost per participant (n=113)	1.326

Health utility values

Health utility values obtained by the EQ-5D-5L instrument at baseline and 12-month follow-up are presented in Table 53 for the intervention group and in Table 54 for the control group. The formula used to calculate the health utility values is based on the Dutch tariff for the Five-Level Version of EQ-5D (Versteegh et al., 2016). Healthy utility values are between 1 and 0; 1 represents full health and 0 is a state as bad as being dead (EuroQoL, 2024). Values below 0 are considered a state that is as bad as being dead (EuroQol, 2024).

The incremental health utility values indicate the improvement in quality of life (QoL) achieved when the intervention was applied compared to the baseline condition. Table 53 and 54 presents the effects on QoL outcomes (expressed as the utility score) among participants across different groups. As shown, there was an increase in the utility score when comparing T2 with T0 in both the intervention and control groups within the Heerlen and Edirne pilots. In Edirne, the increase in the utility score was more pronounced in the intervention group than in the control group, whereas in Heerlen, the control group exhibited a greater increase in the utility score.

In contrast, in the Valencia pilot, only participants in the control group experienced an increase in the utility score when comparing the values of this variable between T0 and T2.

Table 53 Utility scores (EQ-5D-5L) of intervention group participants at baseline and at 12-month follow-up (n=503)

	n	Baseline	12-month follow-up	Δ Utility score
Heerlen (The Netherlands)	84	0.66	0.66	0.0008
Valencia (Spain)	111	0.74	0.68	-0.06
Edirne (Turkey)	111	0.71	0.80	0.09

Table 54 Utility scores (EQ-5D-5L) of control group participants at baseline and at 12-month follow-up (n=464)

	n	Baseline	12-month follow-up	Δ Utility score
Heerlen (The Netherlands)	60	0.64	0.66	0.02
Valencia (Spain)	129	0.73	0.86	0.13
Edirne (Turkey)	119	0.73	0.77	0.03

Incremental cost-effectiveness-ratio (ICER)

Calculating the incremental cost-effectiveness ratio (ICER) is a critical step in assessing the effectiveness and feasibility of interventions. This ratio compares the costs and effects between the intervention group and the control group in each pilot, thereby facilitating the identification of the most desirable option.

The necessary values from both the intervention and control groups for the calculation of the ICER are presented in the following tables (Tables 55 and 56).

Table 55 Intervention group values for calculating the ICER (n=308)

	n	Δ Total costs (= Δ Health care costs + intervention cost) (euro)	Δ Utility score
Heerlen (The Netherlands)	84	1.223,77	0.0008
Valencia (Spain)	111	1.395,45	-0.06
Edirne (Turkey)	113	1.260,14	0.09

Table 56 Control group values for calculating the ICER (n=307)

	n	Δ Total costs (= Δ Health care costs) (euro)	Δ Utility score
Heerlen (The Netherlands)	59	179,86	0.02
Valencia (Spain)	129	-328,30	0.13
Edirne (Turkey)	119	-166,18	0.03

The ICER is calculated as the ratio of the change in total costs to the change in utility score across groups.

$$ICER = \frac{C(IG) - C(CG)}{E(IG) - E(CG)} = \frac{\Delta C}{\Delta E}$$

Where:

- ΔC\Delta CΔC (Delta Cost) is the difference in costs between the intervention and the control group.

- ΔE\Delta EΔE (Delta Effectiveness) is the difference in effectiveness between the intervention and the control group

The cost-effectiveness results are shown in Table 57, 58 and 59.

As seen in Tables 57 and 58, in the Heerlen and Valencia pilots, the intervention group is less effective (i.e. UTILITY(IG) - UTILITY(CG) < 0) and has higher total costs than the control group. No ICER is calculated. In these cases, the intervention is not cost-effective, as its implementation would lead to a reduction in the perceived quality of life (QoL) outcomes and to an increase in total costs.

In the Edirne pilot (see Table 59), the intervention group demonstrates a higher perceived increase in QoL compared to the control group (i.e., UTILITY(IG) - UTILITY(CG) > 0), although at a higher cost. In Edirne, the ICER value of 23.772 euros represents the additional cost for each unit of health gained by the intervention group compared to the control group.

Table 57 Heerlen incremental cost-effectiveness ratio (ICER)

	Intervention	Control	ICER
Incremental total cost	1.223,77	179,86	
Incremental utility score	0.0008	0.02	-

Table 58 Valencia incremental cost-effectiveness ratio (ICER)

	Intervention	Control	ICER
Incremental total cost	1.395,45	-328,30	
Incremental utility score	-0.06	0.13	-

Table 59 Edirne incremental cost-effectiveness ratio (ICER)

	Intervention	Control	ICER
Incremental total cost	1.260,14	-166,18	23.772
Incremental utility score	0.09	0.03	

In this context, it is essential to assess whether this health gain remains cost-effective for Edirne. To do so, we calculate Turkey's Cost-Effectiveness Threshold (CET). The CET indicates the maximum acceptable monetary value for one Quality Adjusted Life Year (QALY) of health gains. This threshold is commonly used to evaluate healthcare interventions and treatments, having been widely validated, and therefore appropriate for assessing the interventions in Edirne. Nevertheless, it is important to recognize that interventions targeting energy poverty provide not only health benefits, but they also have an impact on energy costs by improving energy efficiency and may reduce the need for social tariffs dedicated to electricity supplies, as observed in the Valencia pilot. Therefore, it is needed to highlight that WELLBASED interventions yield not only health benefits but also economic and social advantages.

Since Turkey lacks a fixed CET indicating the maximum amount decision-makers are willing to pay per additional unit of health, we refer to international recommendations. In this case, the WHO recommends setting the CET between 1 and 3 times the country's GDP per capita. Assuming these recommendations and a GDP of 14.010 euros in Turkey (EUROSTAT, 2023), this translates to a CET range of 14.010 to 42.030 euros, which has been represented in Figure b. This range reflects the willingness to pay between 14.010 and 42.030 euros for each additional unit of QoL gained.
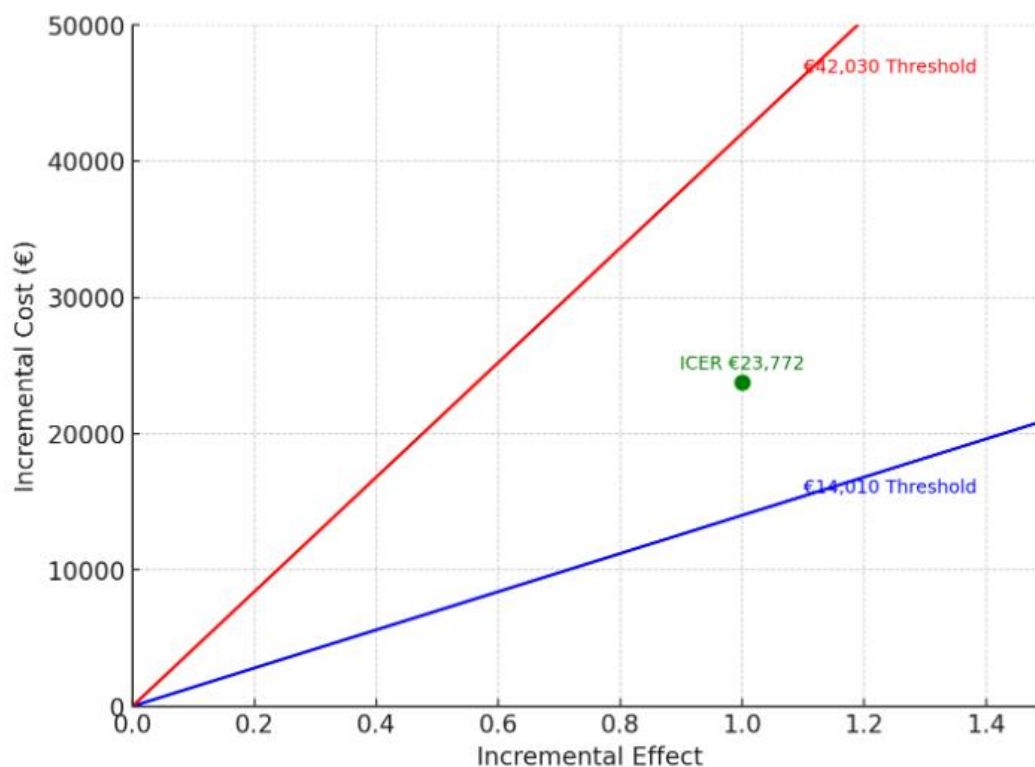
Figure b. Edirne incremental cost-effectiveness (ICER) Plane.

Therefore, if we follow the cost-effectiveness threshold of 3 times the GDP per capita of the country (42.030 euros), given that the ICER is below the cost-effectiveness threshold, each unit of health gained is justified in terms of cost, and the intervention would be considered cost-effective.

In contrast, under a threshold of 1 time the GDP per capita (14.010 euros) the ICER point of 23.772 exceeds the cost-effectiveness threshold, meaning that the interventions in Turkey would not be cost-effective; in other words, the expenditure per unit of health gained would not be justified.

Summary

A cost-effectiveness analysis was conducted for the pilots in Heerlen (The Netherlands), Valencia (Spain), and Edirne (Turkey). Full information for all pilots is available in the Annexes. After implementing the interventions (12-month follow-up), healthcare costs decreased compared to baseline in the intervention group in the Valencia and Edirne pilots, while the perceived quality of life improved in Heerlen and Edirne, but not in Valencia.

Particularly, the total reduction in healthcare costs (aggregating all health resources) for the intervention group in the Edirne pilot amounted to 66,79 euros per participant. Alongside, the reported quality of life for this group increased by 0,09 points compared to the baseline. Similarly, the intervention group in Valencia achieved significant healthcare savings of 218,75 euros per participant, although their quality of life showed a slight decline of -0,06 points compared to baseline. In contrast, while the intervention group in Heerlen did not report healthcare savings, it achieved a gain in quality of life of 0,0008 points per participant after the 12-month follow-up.

When comparing intervention and control groups, it was observed that healthcare cost savings in Valencia were higher in the control group than in the intervention group, along with greater health gains. Meanwhile, in Heerlen, the intervention group incurred higher healthcare costs than the control group but also achieved greater health improvements. Lastly, in Edirne, the intervention group reported higher cost savings and health gains than the control group at the 12-month follow-up.

Therefore, after confirming that the ICER in Edirne is below a cost-effectiveness threshold set at 3 times Turkey's GDP per capita, the intervention in this pilot can be considered cost-effective. The interventions in this pilot were a mix of basic and more complex interventions designed to address different layers of the socio-ecological model, which had a cost per person of 1.326 euros, comparable to the cost of 1.614 euros per participant in the Valencia pilot, which also adopted a mixed model of interventions.

4.6 Exposure to the WELLBASED Urban Program

Table 60 shows an overview of the different layers of the socioecological model, and the number of intervention group participants who received interventions across the different layers according to the pilot site administration. In total, 83.3% of intervention group participants received one or more interventions at the individual layer, and 48.3% attended at least one group meeting (community layer). Structural interventions were provided to 25% of intervention group participants, 11.7% had one or more domestic appliances replaced, and 44.8% received an Energy Kit.

Table 61 shows an overview of the level of exposure to the WELLBASED interventions among the intervention group participants. The majority (54.5%) received 3 to 4 WELLBASED interventions during the 12-month intervention period, and 18.2% received 5 to 6 different interventions.

Table 62 shows an overview of interventions received, according to the participants as indicated in the self-report questionnaires. Here we see that many control group participants also received several interventions during the WELLBASED intervention period, mostly energy efficiency advice and other interventions (not further specified).

Table 60 Number of participants who received specific interventions, also categorized per layer.

	Valencia (N=145)	Heerlen (N=117)	Edirne (N=122)	Jelgava (N=124)	Obuda (N=82)	Leeds (N=10)	Total (N=600)
Layer 1 - Individual (total)	145 (100%)	n.a.	122 (100%)	124 (100%)	82 (100%)	1 (0.1%)	500 (83.3%)
Energy Audit	145 (100%)	n.a.	122 (100%)	124 (100%)	82 (100%)	n.a.	496 (82.6%)
Access Home Sensor Data	120 (82.8%)	n.a.	120 (98.4%)	123 (99.2%)	n.a.	n.a.	363 (60.5%)
Energy Advice Bils	145 (100%)	n.a.	n.a.	51 (41.%)	n.a.	n.a.	196 (32.7%)
Training Materials	n.a.	n.a.	n.a.	124 (100%)	n.a.	n.a.	124 (20.7%)
Health Coaching	n.a.	n.a.	n.a.	n.a.	n.a.	1 (0.1%)	1 (0.2%)
Layer 2 - Community	61 (42.1%)	36 (30.8%)	120 (98.4%)	n.a.	73 (89.0%)	n.a.	290 (48.3%)
Layer 3.1 - Structural Interventions (total)	12 (8.3%)	n.a.	122 (100%)	n.a.	6 (7.3%)	10 (100%)	150 (25%)
Heating System	n.a.	n.a.	122 (100%)	n.a.	n.a.	10 (100%)	132 (22%)

Home Insulation	n.a.	n.a.	24 (19.7%)	n.a.	n.a.	10 (100%)	34 (5.7%)
Windows Replacement	n.a.	n.a.	15 (12.3%)	n.a.	n.a.	n.a.	15 (2.5%)
Front Door Replacement	n.a.	n.a.	n.a.	n.a.	3 (3.7%)	n.a.	3 (0.5%)
Door Replacement	n.a.	n.a.	n.a.	n.a.	3 (3.7%)	n.a.	3 (0.5%)
Personalized Home Renovation	7 (4.8%)	n.a.	n.a.	n.a.	n.a.	n.a.	7 (1.2%)
Handy Man Services	5 (3.4%)	n.a.	n.a.	n.a.	n.a.	n.a.	5 (0.8%)
Layer 3.2 - Domestic Appliances Replacemetn	n.a.	n.a.	n.a.	n.a.	70 (85.4%)	n.a.	70 (11.7%)
Washing machine	n.a.	n.a.	n.a.	n.a.	7 (8.5%)	n.a.	7 (1.2%)
Stove	n.a.	n.a.	n.a.	n.a.	19 (23.2%)	n.a.	19 (3.2%)
Air conditioner	n.a.	n.a.	n.a.	n.a.	25 (30.5%)	n.a.	25 (4.2%)
Air purifier	n.a.	n.a.	n.a.	n.a.	1 (1.2%)	n.a.	1 (0.2%)
Fridge	n.a.	n.a.	n.a.	n.a.	14 (17.1%)	n.a.	14 (2.3%)
Dish Washer	n.a.	n.a.	n.a.	n.a.	3 (3.7%)	n.a.	3 (0.5%)
Oven	n.a.	n.a.	n.a.	n.a.	1 (1.2%)	n.a.	3 (0.5%)
Layer 3.3 - Energy Kit (total)	145 (100%)	n.a.	n.a.	124 (100%)	n.a.	n.a.	269 (44.8%)

Layer 3 (total) = Layer 3.1 + 3.2 + 3.3	145 (100%)	n.a.	122 (100%)	124 (100%)	76 (92.7%)	10 (100%)	477 (79.5%)
n.1 Interventions	133 (91.7%)	n.a.	98 (80.3%)	124 (100%)	76 (92.7%)	0	431 (71.8%)
n.2 Interventions	12 (8.3%)	n.a.	9 (7.4%)	0	0	10 (100%)	31 (51.2%)
n.3 interventions	0	n.a.	15 (12.3%)	0	0	0	15(2.5%)
4 or more interventions	0	n.a.	0	0	0	0	0

Table 61 Level of exposure to all the interventions

	Valencia (N=145)	Heerlen (N=117)	Edirne (N=122)	Jelgava (N=124)	Obuda (N=82)	Leeds (N=10)	Total (N=600)
0 interventions	0	0	0	0	0	0	0
1-2 interventions	0	32 (27.4%)	2 (1.6%)	0	13 (15.9%)	10 (100%)	57 (9.5%)
3-4 interventions	84 (57.9%)	4 (3.4%)	96 (78.7%)	74 (59.7%)	69 (84.1%)	0	327 (54.5%)
5-6 interventions	35 (24.2%)	0	24 (19.7%)	50 (40.3%)	0	0	109 (18.2%)
7 or more interventions	26 (17.9%)	0	0	0	0	0	26 (4.3%)

Table 62 Self-reported exposure to interventions during the past six months at 6-month and 12-month follow-up (n=1235)

	6-month follow-up (n=1004)		12-month follow-up (n=988)	
	Intervention (n=539)	Control (n=465)	Intervention (n=514)	Control (n=474)
Received intervention	n (%)	n (%)	n(%)	n(%)
Energy efficiency advice	201 (37.3%)	55 (11.8%)	202 (39.3%)	56 (11.8%)
Energy Audit	155 (28.8%)	3 (0.7%)	145 (28.2%)	5 (1.1%)
Delivery of energy efficiency kit	174 (32.3%)	12 (2.6%)	148 (28.8%)	13 (2.7%)
Energy efficiency group meeting	122 (22.6%)	3 (0.7%)	196 (38.1%)	3 (0.6%)
Support for replacement of domestic appliances	68 (12.6%)	23 (5.0%)	55 (10.7%)	17 (3.6%)
Windows replacement	25 (4.6%)	13 (2.8%)	10 (2.0%)	5 (1.1%)
Home insulation	22 (4.1%)	13 (2.8%)	15 (2.9%)	7 (1.5%)
Heating system replacement	16 (3.0%)	3 (0.7%)	90 (17.5%)	7 (1.5%)
Access to home sensor data	157 (29.1%)	21 (4.5%)*	191 (37.2%)	14 (3.0%)*
Other intervention	201 (37.3%)	345 (74.2%)	87 (17.0%)	365 (77.0%)
* In Heerlen participants in both conditions were able to access their home sensor data				

The effect of different levels of intervention exposure on various health, well-being and energy outcomes were explored for the overall sample. A distinction was made between participants who received interventions on 1 layer, 2 layers or 3 layers of the socio-ecological model. Table 63 shows the results of the per-protocol analysis. Overall, the results Odds Ratio's for having received three layers of interventions indicate better health outcomes than the Odds Ratio's when receiving one layer of interventions for some of the outcomes. In the case of stress and being comfortably cool in summer time, receiving interventions on 3 layers resulted in worse outcomes. Total energy costs significantly increased when receiving interventions on 1 layer of the socio-ecological model, but they significantly reduced when receiving interventions across 3 layers of the model. For the other outcomes, no significant effect of receiving interventions on 1, 2 or 3 layers was observed.

Table 63 Health, well-being and energy poverty outcomes at 12-month follow-up, exposure to the interventions

Outcome	All pilots (n=988)		
	WELLBASED intervention exposure		
	1 layer	2 layers	3 layers
	OR[+] (95% CI); p-value		
Moderate to severe problems with overall HrQoL[a]	**2.49 (1.02 - 6.11); 0.04**	1.31 (0.73 - 2.34); 0.36	1.35 (0.82 - 2.20); 0.24
Moderate to extreme depression[b]	1.06 (0.42 - 2.66); 0.91	0.61 (0.36 - 1.04); 0.07	0.85 (0.56 - 1.30); 0.46
Moderate to extreme anxiety[b]	0.74 (1.12 - 2.72); 0.81	0.77 (0.47 - 1.27); 0.31	0.93 (0.62 - 1.39); 0.71
Moderate to extreme stress[c]	0.81 (0.17 - 3.79); 0.79	1.00 (0.54 - 1.84); 0.99	**2.06 (1.24 - 3.43); 0.005**
Comfortably warm in winter time[d]	1.62 (0.70 - 3.76); 0.26	1.07 (0.68 - 1.70); 0.77	1.02 (0.68 - 1.53); 0.92
Comfortably cool in summer time[d]	0.91 (0.43 - 1.92); 0.80	**0.39 (0.26 - 0.59); <0.001**	**0.44 (0.30 - 0.64); <0.001**
Total energy costs[e] **	**61.08 (23.18); 0.009**	-7.19 (9.13); 0.43	**-20.70 (9.52); 0.03**
Coping behaviours (sum 0 – 50)[f]	1.75 (1.06); 0.10	0.53 (0.57); 0.36	-0.68 (0.51); 0.18

Note: Bold printed values indicate statistical significance.

*reference group is the control group

**Total energy costs include costs for electricity, gas, derived heat and other energy sources

*Values are logistic regression coefficients adjusted for age, gender, education and baseline status of the outcome measure.

[+] Values are random-intercept linear mixed model regression coefficients adjusted for age, gender, income and baseline value of the outcome of interest.

[a] 84 missing [b] 80 missing [c] 82 missing [d] 86 missing [e] 518 missing [f] 89 missing

Summary

The WELLBASED Urban Programs consisted of intervention actions, following the layers of the socio-ecological model (see also D 2.1 and others). Pilot kept administration of the implemented interventions. Almost all participants in the intervention group received an individual layer (e.g. energy audit or energy advice) intervention according to the pilot administration. Half of the participants received a community

intervention (e.g. group meetings). About one third of the participants received larger structural interventions (e.g. insulation, new heating system), almost half of the participants received an energy kit. Structural interventions with replacement of heating systems or insulation were performed in Edirne and Leeds (see also amongst other D3.1).

Participants in both research groups also reported themselves which interventions they received. Here, it was observed that in both intervention and control group people reported having received interventions. Over 80% of control group participants reported receiving 'other interventions'.

When evaluating the exposure to interventions on the outcomes, results were mixed. Overall, participants who received multiple interventions indicated less comfort during summertime compared to the control group participants. On the other hand, participants who received multiple interventions indicated a significant decrease in energy costs, compared to the control group.

5. Key conclusions & recommendations

In this Deliverable 4.3 provides a complete overview of the characteristics of the participants in the WELLBASED evaluation study and the impact of the WELLBASED Urban Program on a broad range of health, well-being and energy indicators. The information in the evaluated study was collected using several methods including self-report questionnaires, health monitoring and home sensor devices. This Deliverable is completed with Deliverable D4.5, in which the results from the interviews performed with participants in the intervention group are presented. Together these Deliverables provide valuable insights in the situation of people living in energy poverty in the past years and the impact as well as experiences of participants with the WELLBASED Urban Programs. Here we will present a summary and interpretation of findings. Also, recommendations for future research are discussed.

The findings of the WELLBASED evaluation study indicate some health and well-being improvement for participants in the intervention group compared to control group, although most were not statistically significant. For example, with regard to the assessment of self-perceived health, depression and anxiety,an improvement for the intervention group compared to the control group was observed. Results also suggest a trend towards improvement at 18-month follow-up for health-related quality of life. For other outcomes, for example dimensions of health-related quality of life, such as mobility or self-care, the direction of the findings was mixed. Within the intervention group an improvement in sleep quality was observed. For energy outcomes, a suggested positive impact of the intervention on comfort in wintertime, costs and coping behaviour was observed after 15-months, although also not significant. There were noteworthy differences in the outcomes between pilot sites. Specifically, the Valencia pilot site presented decreases for some outcomes (e.g. health-related quality of life), while for other outcomes improvements (e.g. sleep) were observed. An overview of main findings is presented in Annex J.

Interpretation

When interpretating the results from the WELLBASED evaluation study it is important to take into account the contextual period in which the evaluation study was performed. The WELLBASED evaluation study was performed after **the COVID- crisis and in the middle of the energy-crisis**. Both caused significant impact on people's lives across Europe, amongst others energy costs and costs of living. During the study period this rise of (attention to) energy (poverty) also caused several policy actions to be implemented to support people living in energy poverty, or prevent people from moving into energy poverty.

These societal actions to which both intervention and control group participants were exposed likely impacted the potential of the evaluation study to capture the impact of the WELLBASED programs in the setting of a controlled trail. Both in relation to health, well-being and energy, as well as to cost-effectiveness outcomes. We will discuss two of the most important consequences of the situation.

First, due to the situation across Europe, **health of people in both intervention and control group may have been affected**. The number of people changing in health and well-being conditions between baseline and follow-up, in both positive and negative direction, in both groups, seems to reflect this.

Second, the **implementation of policy actions potentially may have affected the effect** the WELLBASED Urban Programs could achieve. For example in Valencia the "Right to Energy" approach was actively implemented. In Heerlen several structures were in place to support people in energy poverty. On the one hand, given the attention for energy poverty, part of the intervention information provided by WELLBASED might have already been known by participants (see also D4.5). This was also reflected in the interviews (see D4.5). The added value of the WELLBASED Urban Program was there with potentially limited.

In addition, the self-reported **exposure** to interventions indicated a high percentage of participants in the control group receiving 'other' interventions. It is assumed that participants in the control group referred to these actions taken by governments when they indicated having received other interventions. This diminishes the differences between the WELLBASED Urban Programs and the general actions implemented, and there with the ability to observe differences between both research groups. However, on a positive note, all interventions seem to benefit those who receive them to some extent, as we observed also improvements in the control group.

Some considerations are also in place with regard to the **implementation of the evaluation study** and used measurements. A controlled trial was performed in the six pilot sites. The pilots are different in their socio-economic and cultural context. This provides opportunity to implement the WELLBASED Urban Programs in different context, but also poses challenges for comparability of results from a quantitative perspective. The qualitative work presented in D4.5 helps to gain more insight in the experiences of people across these different settings and the cultural influences.

There were differences between the pilots regarding the **recruitment** strategies. For example, in Turkey a randomised approach was taken to define the intervention and control group. This resulted in a sample at baseline that was more comparable on background characteristics and outcome indicators. In Valencia, different approaches were used to recruit the participants in the intervention and control group, the comparability of both groups at baseline was less. Although we could correct for these differences between

pilot sites in the analyses, the underlying socio-economic and cultural difference may influence the findings observed.

As was described in previous deliverables (e.g. D3.1, D3.2, D3.4), pilot sites experienced several challenges to recruit participants. For future studies among this population a combination of strategies may be used. Participatory approaches and co-design of interventions may also be used to involve the target population.

Considering data collection, we combined several methodologies and a broad range of **outcome indicators**. Nevertheless, we had to be selective in the measures we included to prevent a high participant burden. Depression, anxiety and stress specific scales (DASS-21) as well as the comfort indicators and the coping behaviour measure seemed to capture people's well-being. Based on our experiences and the results obtained, some measures might have been relevant to include when studying this topic. Specifically, measurements, such as loneliness or social support. Sleep was only assessed in the intervention condition, but might be a relevant indicator to include. Also, problems due to heat instead of cold weather may be included. More extensive measures to capture the support people received, would help gain more insight in what happened in the control group.

The results underline the **vulnerability** of this specific target population. The participants were for a large part unemployed and/or had a low income. Most people suffered from one or more chronic health conditions and a high percentage reported already anxiety, stress or depressive symptoms at baseline. Support for this group of people needs to be provided from a multilevel and holistic approach. A combination of intervention on several domains might be needed, for example budget coaches, social support and health counselling. Structural level interventions, e.g. housing improvement, such as performed in Edirne and Leeds, are needed to make a significant impact on people's lives. In both Edirne and Leeds more people reported to be comfortable warm in winter. However, resources to perform these interventions need to be secured.

The findings suggested that **heat** problems may be more significant than problems due to cold, in line with the experiences expressed by participants (see D 4.5). Most of the WELLBASED interventions were not specifically targeted at heat problems. Participants indicated that they were less comfortable cool in summer, compared to the comfort they experienced in winter. This may align with the changes in climate, resulting in higher temperature, especially in the warmer countries such as Spain and Turkey. It would be useful for future intervention and research studies to further investigate the impact of heat and related interventions.

Methodological considerations

The WELLBASED evaluation study was one of the first to evaluate in six countries energy poverty and health, and the impact of interventions on these outcomes. A large sample of participants was recruited,

living in energy poverty combining qualitative and quantitative methodology, that provides a very complete overview of how people's health, well-being, and coping is holding up in this tough situation. We managed to maintained a large sample over time, with almost 80% participation rate at the final follow-up.

However, we observed lower participant numbers in one of the research conditions in some pilot sites (e.g. Leeds, Obuda) or differences between control and intervention group at baseline (e.g. Valencia). Moreover, unequal distribution or missing data and therewith low cell-counts for some of the outcome variables (e.g. health-related quality of life). With regard the lower numbers and missing data, these were dealt with using statistical models and correction for baseline values of the outcomes. However, the power to detect differences between groups decreased. In the future other study designs, such as cross-over or stepped wedge design, might be considered. This would provide the opportunity to maintain a controlled design. In addition, such a design would create the opportunity to offer the vulnerable participants in the control group with interventions. Pilots expressed their need to provide interventions for control participants, and also felt this would have potentially positively impacted recruitment and therewith participation rates. Indoor Air quality was assessed using home sensors. Although temperature, humidity and CO2 are relevant indicators, more detailed and extensive Indoor Air Quality assessment might be needed to study the impact of interventions. Finally, energy poverty is a complex problem, a longer follow-up may be recommended to capture long-term impact of interventions on health and well-being.

Conclusion

The WELLBASED study provides valuable insights for research into energy poverty and health. The findings show that people living in energy poverty are experiencing health and well-being issues. The energy crisis caused (local) governments to implement support actions that were a lot like the WELLBASED Urban Programs. We see some indications of impact of the WELLBASED Urban Programs on participants health, well-being and energy efficiency. We conclude that interventions for people living in energy poverty are beneficial, however, to make significant impact on these people's lives, more structural and cross-domain action is needed.

6. References

1. Stevens, M., Raat, H., Ferrando, M. *et al.* A comprehensive urban programme to reduce energy poverty and its effects on health and well-being of citizens in six European countries: study protocol of a controlled trial. *BMC Public Health* **22**, 1578 (2022). https://doi.org/10.1186/s12889-022-13968-2

2. Mancia G, Kreutz R, Brunström M, Burnier M, Grassi G, Januszewicz A, et al. 2023 ESH Guidelines for the management of arterial hypertension The Task Force for the management of arterial hypertension of the European Society of Hypertension Endorsed by the European Renal Association (ERA) and the International Society of Hypertension (ISH). Journal of Hypertension. 9900.

3. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989 May;28(2):193-213. doi: 10.1016/0165-1781(89)90047-4. PMID: 2748771.

4. WHO Housing and health guidelines. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

5. Morganti W, Veronese N, Barbagelata M, et al. Validation of a Brief Form of the Self-Administered Multidimensional Prognostic Index: The SELFY-BRIEF-MPI Project. *J Clin Med*. 2023;12(18):6026. Published 2023 Sep 18. doi:10.3390/jcm12186026

6. Veronese N, Custodero C, Cella A, et al. Prevalence of multidimensional frailty and pre-frailty in older people in different settings: A systematic review and meta-analysis. *Ageing Res Rev*. 2021;72:101498. doi:10.1016/j.arr.2021.101498

7. Katz S, Downs TD, Cash HR, Grotz RC. Progress in development of the index of ADL. *Gerontologist*. 1970;10(1):20-30. doi:10.1093/geront/10.1_part_1.20

8. Thema, J., and Vondung, F. (2020) EPOV Indicator Dashboard: Methodology Guidebook. Wuppertal Institut für Klima, Umwelt, Energie GmbH.

9. Pan L, Biru A, Lettu S. Energy poverty and public health: global evidence. Energy Economics 2021;101:105423.

10. Ballesteros-Arjona V, Oliveras L, Bolívar Muñoz J, et al. What are the effects of energy poverty and interventions to ameliorate it on people's health and well-being?: a scoping review with an equity lens. Energy Research & Social Science 2022;87:102456.

11. Jessel S, Sawyer S, Hernández D. Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature. Front Public Health. 2019 Dec 12;7:357. doi: 10.3389/fpubh.2019.00357. PMID: 31921733; PMCID: PMC6920209.

12. Chowdhury SR, Chandra Das D, Sunna TC, Beyene J, Hossain A. Global and regional prevalence of multimorbidity in the adult population in community settings: a systematic review and meta-analysis. EClinicalMedicine. 2023 Feb 16;57:101860. doi: 10.1016/j.eclinm.2023.101860. PMID: 36864977; PMCID: PMC9971315.

13. EUROSTAT Statistics. Available at: https://ec.europa.eu/eurostat/databrowser/view/ILC_MDES01/default/table?lang=en.

14. Carley S, Graff M, Konisky DM, Memmott T. Behavioral and financial coping strategies among energy-insecure households. Proc Natl Acad Sci U S A. 2022 Sep 6;119(36):e2205356119. doi: 10.1073/pnas.2205356119. Epub 2022 Aug 29. PMID: 36037366; PMCID: PMC9457251.

15. González-Eguino M. Energy poverty: an overview. Renewable and Sustainable Energy Reviews 2015;47:377–85.

16. Ana Stojilovska, Hyerim Yoon, Coralie Robert. Out of the margins, into the light: Exploring energy poverty and household coping strategies in Austria, North Macedonia, France, and Spain, Energy Research & Social Science, Volume 82, 2021, 102279.

17. Halkos, G.E.; Gkampoura, E.-C. Coping with Energy Poverty: Measurements, Drivers, Impacts, and Solutions. Energies 2021, 14, 2807. https://doi.org/10.3390/en14102807

18. Ferguson L, Taylor J, Davies M, Shrubsole C, Symonds P, Dimitroulopoulou S. Exposure to indoor air pollution across socio-economic groups in high-income countries: A scoping review of the literature and a modelling methodology. Environ Int. 2020 Oct;143:105748. doi: 10.1016/j.envint.2020.105748. Epub 2020 Jul 3. PMID: 32629198; PMCID: PMC7903144.

19. Lee KK, Bing R, Kiang J, et al. Adverse health effects associated with household air pollution: a systematic review, meta-analysis, and burden estimation study. Lancet Glob Health 2020;8:e1427–34.

Annexes

Annex A – Results Valencia pilot site

Table A 1. Sociodemographic and lifestyle characteristics Valencia sample intervention and control group WELLBASED at baseline (T0) (n=322)

	Intervention group N=145 (45.0%)	Control group N=177 (55.0%)	P-value
Gender[a], n (%)			0.84
Female	102 (70.3%)	122 (69.3%)	
Male	43 (29.7%)	54 (30.7%)	
Age (years)			
Mean (SD)	50.61 (15.35)	47.34 (12.93)	**0.04**
Older people (>65 years)	25 (17.2%)	10 (5.6%)	**<0.001**
Marital status, n (%)			**<0.001**
Married	52 (35.9%)	100 (56.5%)	
Single, separated, divorced or widowed	93 (64.1%)	77 (43.5%)	
Educational level, n (%)			
Post-secondary or lower	65 (44.8%)	154 (87.0%)	**<0.001**
Higher education	80 (55.2%)	23 (13.0%)	
Household income category, n (%) (14 missing)			**<0.001**
1-3	97 (66.9%)	166 (93.8%)	
4-6	35 (24.1%)	11 (6.2%)	
7-9	13 (9.0%)	0	
Paid work, n(%)			0.53
Yes, by respondent only	38 (26.2%)	36 (20.3%)	
Yes, by respondent's partner only	16 (11.0%)	19 (10.7%)	
Yes, by respondent and their partner	21 (14.5%)	23 (13.0%)	
No	70 (48.3%)	99 (55.9%)	
Household composition[b], n (%)			**<0.001**
Single-adult with children	21 (14.8%)	2 (1.2%)	
Single-adult without children	22 (15.5%)	15 (9.1%)	

	Two or more adults with children	53 (37.3%)	59 (35.8%)	
	Two or more adults without children	46 (32.4%)	89 (53.9%)	
Migration background, n (%)				0.17
	Yes	86 (59.3%)	118 (66.7%)	
	No	59 (40.7%)	59 (33.3%)	
Belonging to an ethnic minority[c], n (%)				**0.002**
	Yes	8 (9.5%)	2 (1.3%)	
	No	76 (90.5%)	154 (98.7%)	
Dwelling type[b] , n (%)				0.18
	Detached	1 (0.7%)	1 (0.6%)	
	Semi-detached/terraced	2 (1.4%)	0	
	Apartment or flat	139 (97.9%)	161 (97.6%)	
	Other	0	3 (1.8%)	
Tenure status[b], n (%)				**<0.001**
	Owner	37 (26.1%)	26 (15.8%)	
	Rented at market rate	81 (57.0%)	84 (50.9%)	
	Reduced rent/social housing/free rent	23 (16.2%)	33 (20.0%)	
	Other	1 (0.7%)	22 (13.3%)	
BMI[d], mean (SD)		27.26 (4.85)	26.75 (4.13)	0.32
No. of chronic conditions				**<0.001**
0		17 (11.7%)	38 (21.5%)	
1-2		74 (51.0%)	52 (29.4%)	
3 or more		54 (37.2%)	87 (49.2%)	
Smoker				**0.047**
yes		21 (14.5%)	23 (13.0%)	
no		98 (67.6%)	138 (78.0%)	
ex-smoker		26 (17.9%)	16 (9.0%)	
Average time spent inside the house during daytime [b]				**<0.001**
0-3 hours		23 (15.9%)	2 (1.1%)	
3-6 hours		82 (56.6%)	82 (46.3%)	
6-9 hours		28 (19.3%)	41 (23.2%)	
> 9 hours		12 (8.3%)	52 (29.4%)	

Table A 2. Health and well-being outcomes Valencia sample by intervention and control group WELLBASED at baseline (T0) (n=322)

	Intervention group N=145 (45.0%)	Control group N=177 (55.0%)	P-value
Health-related Quality of Life			0.70
Overall HRQoL, n(%)			
No or slight problems (1-10)	118 (81.4%)	141 (79.7%)	
Moderate, severe or extreme problems (11-25)	27 (18.6%)	36 (20.3%	
Mobility, n(%)			0.92
No or slight problems	121 (83.4%)	147 (83.1%)	
Moderate, severe or extreme problems	24 (16.6%)	30 (16.9%)	
Self-care, n(%)			**0.045**
No or slight problems	141 (97.2%)	163 (92.1%)	
Moderate, severe or extreme problems	4 (2.8%)	14 (7.9%)	
Usual Activities, n(%)			0.53
No or slight problems	131 (90.3%)	156 (88.1%)	
Moderate, severe or extreme problems	14 (9.7%)	21 (11.9%)	
Pain/Discomfort, n(%)			0.51
No or slight problems	104 (71.7%)	121 (68.4%)	
Moderate, severe or extreme problems	41 (28.3%)	56 (31.6%)	
Anxiety/Depression, n(%)			0.14
No or slight problems	110 (75.9%)	146 (82.5%)	
Moderate, severe or extreme problems	35 (24.1%)	31 (17.5%)	
EQ VAS, mean (SD)	77.69 (16.91)	68.98 (15.00)	**<0.001**
Mental health & well-being			
Depression			**0.02**
Normal or mild	122 (84.1%)	130 (73.4%)	
Moderate, severe or extreme	23 (15.9%)	47 (26.6%)	
Anxiety			**0.02**
Normal or mild	100 (69.0%)	100 (56.5%)	
Moderate, severe or extreme	45 (31.0%)	77 (43.5%)	

Stress			0.02
Normal or mild	93 (64.1%)	135 (76.3%)	
Moderate, severe or extreme	52 (35.9%)	42 (23.7%)	

Table A 3. Energy poverty indicators Valencia sample by intervention and control group WELLBASED at baseline (T0) (n=322)

Variable	Intervention group N=145 (45.0%)	Control group N=177 (55.0%)	p-value
Dwelling comfortable warm in winter time			**0.01**
Yes	54 (37.2%)	43 (24.3%)	
No	91 (62.8%)	134 (75.7%)	
Dwelling comfortably cool in summer time			**<0.001**
Yes	56 (38.6%)	33 (18.6%)	
No	89 (61.4%)	144 (81.4%)	
Presence of leak/damp/rot [a]			0.54
Yes	42 (29.6%)	42 (33.1%)	
No	100 (70.4%)	85 (66.9%)	
Arrears on utility bills [b]			**<0.001**
Yes, once	9 (6.3%)	32 (19.4%)	
Yes, twice or more	27 (19.0%)	71 (43.0%)	
No	106 (74.6%)	62 (37.6%)	
Equipped with heating facilities [b]			**<0.001**
Yes, central heating or similar	14 (9.9%)	4 (2.4%)	
Yes, other fixed heating	32 (22.5%)	8 (4.8%)	
Yes, non-fixed	87 (61.3%)	106 (64.2%)	
No	9 (6.3%)	47 (28.5%)	
Equipped with air conditioning (cooling) facilities [c]			**<0.001**
Yes	72 (50.7%)	51 (31.5%)	
No	70 (49.3%)	111 (68.5%)	
Equipped with adequate electrical installations [d]			**<0.001**
Yes	127 (89.4%)	86 (71.7%)	

No	15 (10.6%)	34 (28.3%)	
Home satisfaction			**0.006**
(very) dissatisfied	30 (20.7%)	61 (34.5%)	
(very) satisfied	115 (79.3%)	116 (65.5%)	
[a] 53 missing [b] 15 missing [c] 18 missing [d] 60 missing			

Table A 4. Energy consumption and costs Valencia sample by intervention and control group WELLBASED at baseline (T0) (n=322)

Variable	Intervention group N=145 (45.0%)	Control group N=177 (55.0%)	p-value
Household energy source			
Electricity[a], n (%)	142 (100%)	155 (99.4%)	0.34
Gas[b], n (%)	41 (28.9%)	4 (2.6%)	**<0.001**
Derived heat/ district heating[a], n (%)	0	0	n/a
Other (e.g. oil/petroleum products, renewables or coal products)[c], n (%)	63 (44.4%)	2 (1.2%)	**<0.001**
Monthly energy consumption			
Electricity (kWh), mean (SD)	281.73 (200.47)[e]	751.67 (195.23)[d]	**<0.001**
Gas (m^3), mean (SD)	46.76 (65.02)[g]	n/a[f]	n/a
Derived heat (kWj), mean (SD)	n/a	n/a	n/a
Monthly energy costs,			
Electricity (€), mean (SD)	74.48 (58.65)[h]	104.63 (81.36)[f]	**<0.001**
Gas (€), mean (SD)	77.75 (73.59)[i]	118.50 (93.10)[j]	0.37
Derived heat (€), mean (SD)	n/a	n/a	n/a
Other sources (€), mean (SD)	13.50 (6.01)[k]	40.00 (n/a)[j]	**<0.001**

	Intervention	Control	p-value
Total energy costs[l], mean (SD)	98.39 (79.50)	107.25 (85.04)	0.36
Received support towards energy bills			
Yes, fixed amount of money [c], n (%)	0	4 (2.4%)	0.06
Yes, percentage of costs refunded [c], n (%)	28 (19.7%)	0	**<0.001**
Yes, in kind contribution [c], n (%)	0	0	n/a
Yes, other type of support [c], n (%)	2 (1.4%)	1 (0.6%)	0.48

[a] 24 missing [b] 25 missing [c] 15 missing [d] 151 missing [e] 19 missing [f] 4 missing [g] 16 missing [h] 6 missing [i] 3 missing [j] 1 missing [k] 39 missing [l] 35 missing

Table A 5. Energy-related coping strategies in the past 12 months Valencia sample by intervention and control group WELLBASED at baseline (T0) (n=322)

Variable	Intervention group N=145 (45.0%)	Control group N=177 (55.0%)	p-value
Wearing extra clothes to keep warm			0.82
Never or rarely	16 (11.0%)	21 (11.9%)	
Sometimes, often or always	129 (89.0%)	156 (88.1%)	
Turning heating/cooling off to save money			**<0.001**
Never or rarely	14 (9.7%)	10 (5.6%)	
Sometimes, often or always	75 (51.7%)	59 (33.3%)	
Not an option in my dwelling	56 (38.6%)	108 (61.0%)	
Heating/cooling only one room of the house to save money			**<0.001**
Never or rarely	16 (11.0%)	9 (5.1%)	
Sometimes, often or always	103 (71.0%)	65 (36.7%)	
Not an option in my dwelling	26 (17.9%)	103 (58.2%)	
Going to bed in the daytime to keep warm			**<0.001**
Never or rarely	118 (81.4%)	44 (24.9%)	
Sometimes, often or always	27 (18.6%)	133 (75.1%)	

			<0.001
Going to a public building to keep warm/ cool			<0.001
Never or rarely	123 (84.8%)	104 (58.8%)	
Sometimes, often or always	22 (15.2%)	73 (41.2%)	
Going to a neighbour or friends/relatives house to keep warm/cool			<0.001
Never or rarely	134 (92.4%)	133 (75.1%)	
Sometimes, often or always	11 (7.6%)	44 (24.9%)	
Bathing/showering less to save money			<0.001
Never or rarely	136 (93.8%)	80 (45.2%)	
Sometimes, often or always	9 (6.2%)	97 (54.8%)	
Turning off lights in rooms that are being used to save money			<0.001
Never or rarely	47 (32.4%)	17 (9.6%)	
Sometimes, often or always	98 (67.6%)	160 (90.4%)	
Not cooking/eating cold food to save money			<0.001
Never or rarely	131 (90.3%)	132 (74.6%)	
Sometimes, often or always	14 (9.7%)	45 (25.4%)	
Avoided going to the doctor to save money			<0.001
Never or rarely	1 (0.7%)	154 (87.0%)	
Sometimes, often or always	0	5 (2.8%)	
Health care is for free in my country	144 (99.3%)	18 (10.2%)	

Table A 6. Within-group differences in health and well-being outcomes between baseline and 12-month follow-up in the Valencia pilot

	Intervention group		Control group	
Outcome	**Baseline (n=111)**	**12-month follow-up (n=111)**	**Baseline (n=129)**	**12-month follow-up (n=129)**
	n (%)	*n (%)*	*n (%)*	*n (%)*
Moderate to extremely severe problems in overall HrQoL	23 (20.7%)	34 (30.6%)	29 (22.5%)	5 (3.9%)

Moderate to extremely severe problems in mobility	20 (18.0%)	33 (29.7%)	26 (20.2%)	2 (1.6%)
Moderate to extremely severe problems in self-care	3 (2.7%)	20 (18.0%)	13 (10.1%)	0
Moderate to extremely severe problems in usual activities	12 (10.8%)	26 (23.4%)	19 (14.7%)	1 (0.8%)
Moderate to extremely severe problems in pain/ Discomfort	33 (29.7%)	44 (39.6%)	41 (31.8%)	8 (6.2%)
Moderate to extremely severe problems in anxiety/ depression	28 (25.2%)	36 (32.4%)	23 (17.8%)	1 (0.8%)
	Mean (SD)		*Mean (SD)*	
EQ VAS	77.72 (16.68)	71.09 (20.92)	68.50 (14.87)	69.79 (6.03)
	n (%)		*n (%)*	
Moderate to extreme depression	18 (16.2%)	28 (25.2%)	35 (27.1%)	18 (14.0%)
Moderate to extreme anxiety	32 (28.8%)	33 (29.7%)	61 (47.3%)	18 (14.0%)
Moderate to extreme stress	40 (36.0%)	28 (25.2%)	30 (23.3%)	0

Table A 7. Within-group differences in energy outcomes between baseline and 12-month follow-up in the Valencia pilot

Outcome	Intervention group		Control group	
	Baseline (n=111)	**12-month follow-up (n=111)**	**Baseline (n=129)**	**12-month follow-up (n=129)**
	n (%)	*n (%)*	*n (%)*	*n (%)*
Comfortably warm in winter time	42 (37.8%)	65 (58.6%)	28 (21.7%)	119 (92.2%)
Comfortably cool in summer time	43 (38.7%)	34 (30.6%)	17 (13.2%)	118 (91.5%)
	Mean (SD)		*Mean (SD)*	

Total energy costs*[a]	101.18 (82.98)	78.50 (74.70)	97.98 (79.20)	51.83 (43.66)
Coping behaviours (sum 0-50)	28.60 (4.59)	27.82 (5.23)	31.44 (5.44)	22.72 (4.29)

*Total energy costs include costs for electricity, gas, derived heat and other energy sources

[a] 75 missing

Figure A 1. Daily average indoor and outdoor humidity levels in households in Valencia.
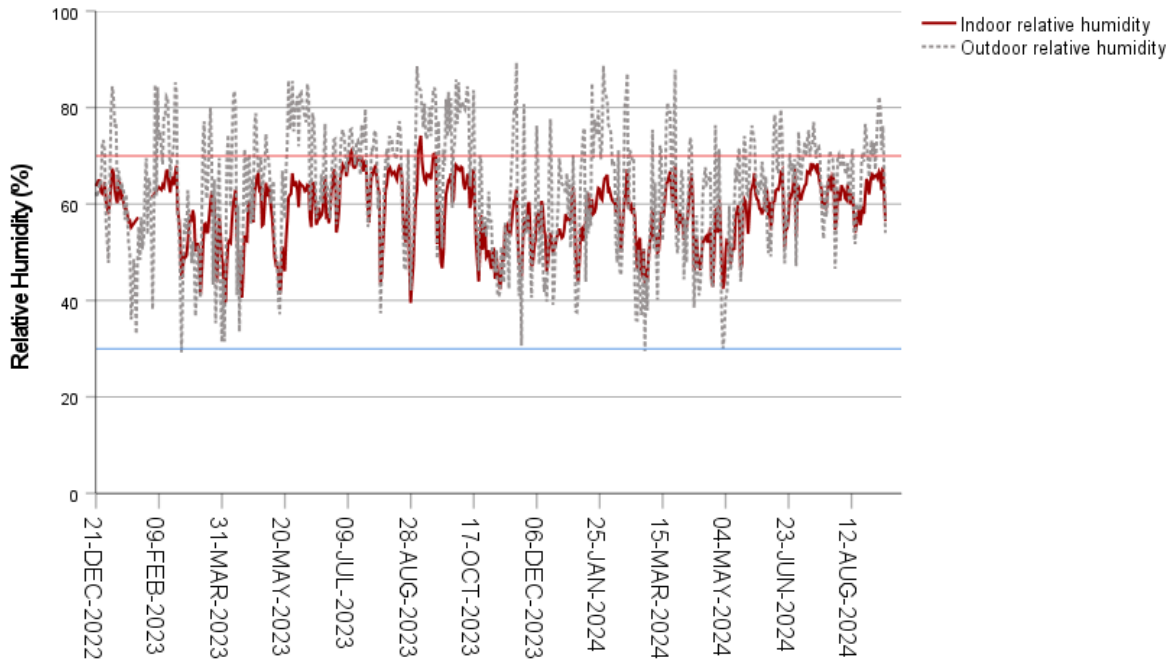
Figure A 2. Daily average indoor and outdoor temperature in households in Valencia.
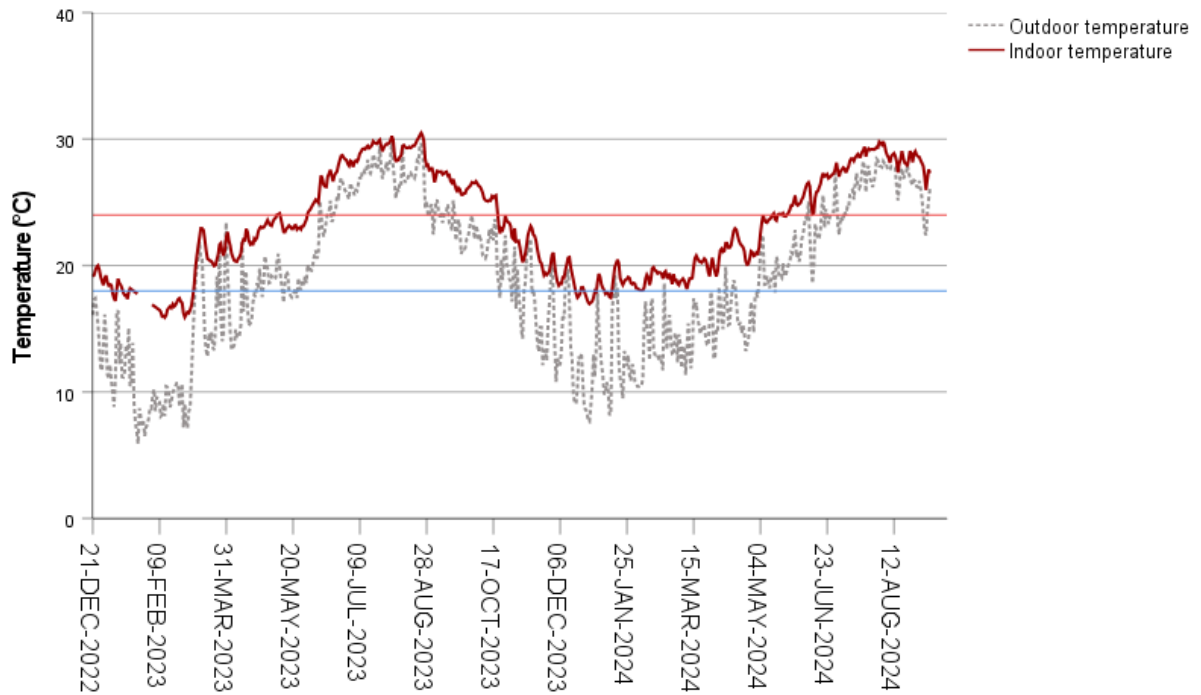
Figure A 3. Daily average indoor CO2 levels in households in Valencia.
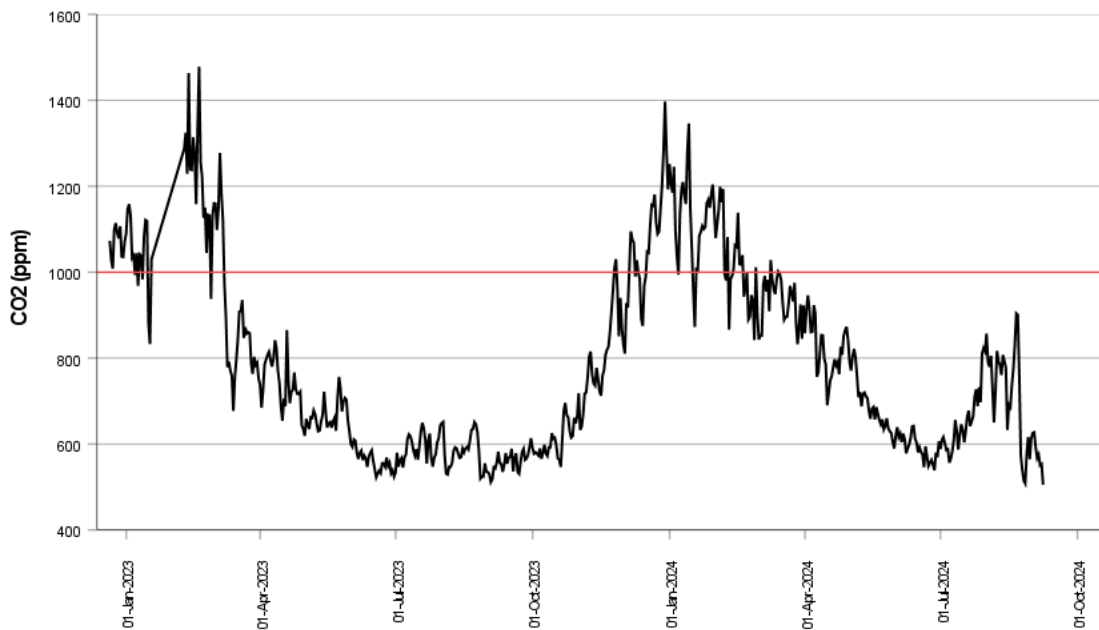
Figure A 4. Daily average percentage above 24 °C or below 18 °C in Valencia households.
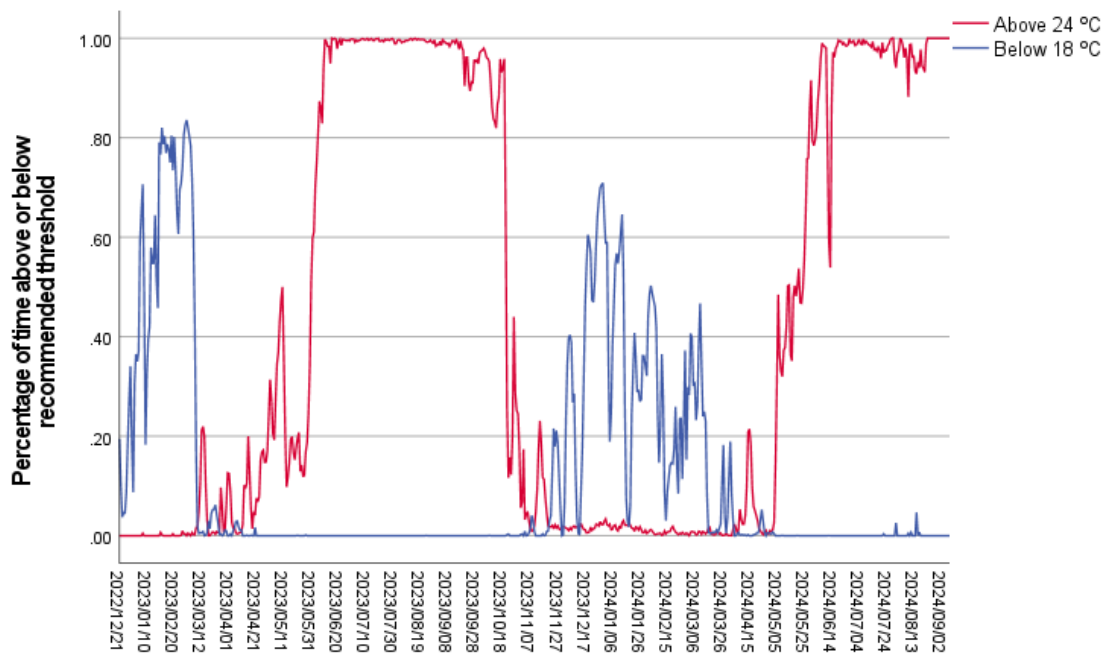
Table A 8. Temperature, Relative humidity, CO2 general descriptives Valencia pilot site.

	Temperature (°C)			Relative Humidity (%)			CO_2 (ppm)		
	Mean	**SD**	**Median**	**Mean**	**SD**	**Median**	**Mean**	**SD**	**Median**
Spring	23.1	2.0	23.2	56.5	6.5	57.2	716	110	695
Summer	28.5	1.1	28.5	62.7	6.9	65.0	585	51	576
Autum	22.5	2.7	22.5	55.5	7.0	54.5	755	718	171
Winter	18.8	1.2	18.8	56.6	5.7	57.4	1057	134	1055
All seasons	23.4	3.9	23.1	58.0	7.1	58.6	767	207	689

Annex B – Results Heerlen pilot site

Table B 1. Sociodemographic and lifestyle characteristics Heerlen sample by intervention and control group WELLBASED at baseline (T0) (n=199)

	Intervention group N=117 (58.8%)	Control group N=82 (41.2%)	P-value
Gender[a], n (%)			0.54
Female	76 (67.3%)	51 (63.0%)	
Male	37 (32.7%)	30 (37.0%)	
Age (years)[b]			
Mean (SD)	53.59 (13.48)	49.02 (15.28)	**0.03**
Older people [b] (>65 years)	16 (13.9%)	12 (14.6%)	0.89
Marital status [b], n (%)			**0.005**
Married	37 (32.2%)	12 (14.6%)	
Single, separated, divorced or widowed	78 (67.8%)	70 (85.4%)	
Educational level [b], n (%)			0.13
Post-secondary or lower	107 (93.0%)	71 (86.6%(	
Higher education	8 (7.0%)	11 (13.4%)	
Household income category [b], n (%) (14 missing)			**0.02**
1-3	52 (45.2%)	41 (50.0%)	
4-6	44 (38.3%)	38 (46.3%)	
7-9	19 (16.5%)	3 (3.7%)	
Paid work [b], n(%)			0.08
Yes, by respondent only	11 (9.6%)	17 (20.7%)	
Yes, by respondent's partner only	6 (5.2%)	2 (2.4%)	
Yes, by respondent and their partner	7 (6.1%)	2 (2.4%)	
No	91 (79.1%)	61 (74.4%)	
Household composition[c], n (%)			**0.01**
Single-adult with children	2 (3.1%)	10 (17.5%)	
Single-adult without children	29 (44.6%)	28 (49.1%)	
Two or more adults with children	13 (20.0%)	4 (7.0%)	

Two or more adults without children	21 (32.3%)	15 (26.3%)	
Migration background [b], n (%)			0.23
Yes	14 (12.2%)	15 (18.3%)	
No	101 (87.8%)	67 (81.7%)	
Belonging to an ethnic minority[d], n (%)			0.58
Yes	9 (10.0%)	5 (7.5%)	
No	81 (90.0%)	62 (92.5%)	
Dwelling type[e] , n (%)			0.28
Detached	2 (3.0%)	1 (1.8%)	
Semi-detached/terraced	45 (68.2%)	31 (54.4%)	
Apartment or flat	17 (25.8%)	24 (42.1%)	
Other	2 (3.0%)	1 (1.8%)	
Tenure status[e], n (%)			0.66
Owner	7 (10.6%)	5 (8.8%)	
Rented at market rate	7 (10.6%)	9 (15.8%)	
Reduced rent/social housing/free rent	51 (77.3%)	43 (75.4%)	
Other	1 (1.5%)	0	
BMI[f], mean (SD)	28.90 (6.08)	28.18 (6.60)	0.43
No. of chronic conditions			**0.02**
0	5 (4.3%)	13 (15.9%)	
1-2	38 (32.5%)	23 (28.0%)	
3 or more	74 (63.2%)	46 (56.1%)	
Smoker			0.30
yes	39 (33.3%)	35 (42.7%)	
no	39 (33.3%)	20 (24.4%)	
ex-smoker	39 (33.3%)	27 (32.9%)	
Average time spent inside the house during daytime [b]			0.58
0-3 hours	7 (6.1%)	6 (7.3%)	
3-6 hours	21 (18.3%)	21 (25.6%)	
6-9 hours	41 (35.7%)	24 (29.3%)	
> 9 hours	46 (40.0%)	31 (37.8%)	
[a] 5 missing [b] 2 missing [c] 77missing [d] 42 missing [e] 76 missing [f] 4 missing			

Table B 2. Health and well-being outcomes Heerlen sample by intervention and control group WELLBASED at baseline (T0) (n=199)

	Intervention group N=117 (58.8%)	Control group N=82 (41.2%)	P-value
Health-related Quality of Life			0.70
Overall HRQoL, n(%)			
No or slight problems (1-10)	71 (60.7%)	52 (63.4%)	
Moderate, severe or extreme problems (11-25)	46 (39.3%)	30 (36.6%)	
Mobility, n(%)			0.15
No or slight problems	82 (70.1%)	65 (79.3%)	
Moderate, severe or extreme problems	35 (29.9%)	17 (20.7%)	
Self-care, n(%)			0.24
No or slight problems	108 (92.3%)	79 (96.3%)	
Moderate, severe or extreme problems	9 (7.7%)	3 (3.7%)	
Usual Activities, n(%)			0.47
No or slight problems	77 (65.8%)	58 (70.7%)	
Moderate, severe or extreme problems	40 (34.2%)	24 (29.3%)	
Pain/Discomfort, n(%)			0.19
No or slight problems	49 (41.9%)	42 (51.2%)	
Moderate, severe or extreme problems	68 (58.1%)	40 (48.8%)	
Anxiety/Depression, n(%)			0.10
No or slight problems	97 (82.9%)	60 (73.2%)	
Moderate, severe or extreme problems	20 (17.1%)	22 (26.8%)	
EQ VAS, mean (SD)	64.09 (20.07)	67.51 (20.67)	0.24
Mental health & well-being			
Depression			0.07
Normal or mild	93 (79.5%)	56 (68.3%)	
Moderate, severe or extreme	24 (20.5%)	26 (31.7%)	
Anxiety			0.08
Normal or mild	81 (69.2%)	47 (57.3%)	
Moderate, severe or extreme	36 (30.8%)	35 (42.7%)	
Stress			0.10
Normal or mild	104 (88.9%)	66 (80.5%)	

		Intervention group	Control group	
	Moderate, severe or extreme	13 (11.1%)	16 (19.5%)	

Table B 3. Energy poverty indicators Heerlen sample by intervention and control group WELLBASED at baseline (T0) (n=199)

Variable		Intervention group N=117 (58.8%)	Control group N=82 (41.2%)	p-value
Dwelling comfortable warm in winter time [a]				0.60
	Yes	56 (48.7%)	43 (52.4%)	
	No	59 (51.3%)	39 (47.6%)	
Dwelling comfortably cool in summer time [a]				0.24
	Yes	43 (37.4%)	24 (29.3%)	
	No	72 (62.6%)	58 (70.7%)	
Presence of leak/damp/rot [b]				0.18
	Yes	26 (48.1%)	16 (34.8%)	
	No	28 (51.9%)	30 (65.2%)	
Arrears on utility bills [c]				0.43
	Yes, once	3 (4.5%)	6 (10.5%)	
	Yes, twice or more	4 (6.1%)	4 (7.0%)	
	No	59 (89.4%)	47 (82.5%)	
Equipped with heating facilities [c]				0.86
	Yes, central heating or similar	61 (92.4%)	54 (94.7%)	
	Yes, other fixed heating	3 (4.5%)	2 (3.5%)	
	Yes, non-fixed	2 (3.0%)	1 (1.8%)	
	No	0	0	
Equipped with air conditioning (cooling) facilities [e]				0.47
	Yes	10 (15.2%)	6 (10.7%)	
	No	56 (84.8%)	50 (89.3%)	
Equipped with adequate electrical installations [f]				0.56
	Yes	54 (90.0%)	53 (93.0%)	
	No	6 (10.0%)	4 (7.0%)	
Home satisfaction [a]				0.09
	(very) dissatisfied	44 (38.3%)	22 (26.8%)	

	71 (61.7%)	60 (73.2%)	

a 2 missing b 99missing c 76 missing d 60 missing d 77 missing d 82 missing

Table B 4. Energy consumption and costs Heerlen sample by intervention and control group WELLBASED at baseline (T0) (n=199)

Variable	Intervention group N=117 (58.8%)	Control group N=82 (41.2%)	p-value
Household energy source			
Electricity[a], n (%)	66 (100%)	55 (100%)	n/a
Gas[a], n (%)	60 (90.9%)	47 (85.5%)	0.35
Derived heat/ district heating[a], n (%)	6 (9.1%)	5 (9.1%)	1.00
Other (e.g. oil/petroleum products, renewables or coal products)[b], n (%)	7 (10.6%)	6 (10.5%)	0.99
Monthly energy consumption			
Electricity (kWh)[c], mean (SD)	162.66 (116.98)	174.19 (122.66)	0.74
Gas (m3)[d], mean (SD)	11.90 (15.37)	14.74 (26.38)	0.63
Derived heat (kWj)[e], mean (SD)	80 (n/a)	0	n/a
Monthly energy costs,			
Electricity (€)[f], mean (SD)	88.68 (80.92)	102.05 (82.51)	0.40
Gas (€)[g], mean (SD)	86.32 (74.50)	102.47 (86.54)	0.35
Derived heat (€)[h], mean (SD)	113.84 (118.34)	82.65 (44.57)	0.60
Other sources (€)[i], mean (SD)	n/a	n/a	n/a
Total energy costs[j], mean (SD)	161.38 (153.41)	186.15 (142.43)	0.38
Received support towards energy bills			
Yes, fixed amount of money [b], n (%)	10 (15.2%)	7 (12.3%)	0.65
Yes, percentage of costs refunded [b], n (%)	3 (4.5%)	5 (8.8%)	0.34

	Yes, in kind contribution [b], n (%)	66 (100%)	57 (100%)	n/a
	Yes, other type of support [b], n (%)	17 (25.8%)	26 (45.6%)	**0.02**

[a] 78 missing [b] 76 missing [c] 71 missing [d] 55 missing [e] 10 missing [f] 12 missing [g] 20 missing [h] 2 missing [i] 87 missing [j] 1 missing

Table B 5. Energy-related coping strategies in the past 12 months Heerlen sample by intervention and control group WELLBASED at baseline (T0) (n=199)

Variable	Intervention group N=117 (58.8%)	Control group N=82 (41.2%)	p-value
Wearing extra clothes to keep warm [a]			0.07
Never or rarely	31 (27.0%)	13 (15.9%)	
Sometimes, often or always	84 (73.0%)	69 (84.1%)	
Turning heating/cooling off to save money [a]			**0.003**
Never or rarely	35 (30.4%)	10 (12.2%)	
Sometimes, often or always	80 (69.6%)	72 (87.8%)	
Not an option in my dwelling	0	0	
Heating/cooling only one room of the house to save money [a]			0.84
Never or rarely	30 (26.1%)	19 (23.2%)	
Sometimes, often or always	82 (71.3%)	60 (73.2%)	
Not an option in my dwelling	3 (2.6%)	3 (3.7%)	
Going to bed in the daytime to keep warm [a]			0.84
Never or rarely	87 (75.7%)	61 (74.4%)	
Sometimes, often or always	28 (24.3%)	21 (25.6%)	
Going to a public building to keep warm/ cool [a]			0.85
Never or rarely	102 (88.7%)	72 (87.8%)	
Sometimes, often or always	13 (11.3%)	10 (12.2%)	
Going to a neighbour or friends/relatives house to keep warm/cool [a]			0.62

	Never or rarely	101 (87.8%)	70 (85.4%)	
	Sometimes, often or always	14 (12.2%)	12 (14.6%)	
Bathing/showering less to save money [a]				**0.01**
	Never or rarely	68 (59.1%)	34 (41.5%)	
	Sometimes, often or always	47 (40.9%)	48 (58.5%)	
Turning off lights in rooms that are being used to save money [a]				0.19
	Never or rarely	38 (33.0%)	20 (24.4%)	
	Sometimes, often or always	77 (67.0%)	62 (75.6%)	
Not cooking/eating cold food to save money [a]				0.14
	Never or rarely	88 (76.5%)	55 (67.1%)	
	Sometimes, often or always	27 (23.5%)	27 (32.9%)	
Avoided going to the doctor to save money [a]				0.09
	Never or rarely	94 (81.7%)	56 (68.3%)	
	Sometimes, often or always	19 (16.5%)	23 (28.0%)	
	Health care is for free in my country	2 (1.7%)	3 (3.7%)	
[a] 2 missing				

Table B 6. Within-group differences in health and well-being outcomes between baseline and 12-month follow-up in the Heerlen pilot

Outcome	Intervention group		Control group	
	Baseline (n=84)	**12-month follow-up (n=84)**	**Baseline (n=60)**	**12-month follow-up (n=60)**
	n (%)	*n (%)*	*n (%)*	*n (%)*
Moderate to extremely severe problems in overall HrQoL	32 (38.1%)	31 (36.9%)	23 (38.3%)	22 (36.7%)
Moderate to extremely severe problems in mobility	24 (26.6%)	28 (33.3%)	13 (21.7%)	14 (23.3%)
Moderate to extremely severe problems in self-care	9 (7.7%)	4 (4.8%)	3 (5.0%)	3 (5.0%)

Moderate to extremely severe problems in usual activities	30 (35.7%)	24 (28.6%)	21 (35.0%)	17 (28.3%)
Moderate to extremely severe problems in pain/ Discomfort	48 (57.1%)	42 (50%)	33 (55.0%)	30 (50%)
Moderate to extremely severe problems in anxiety/ depression	15 (17.9%)	12 (14.3%)	17 (28.3%)	10 (16.7%)
	Mean (SD)		Mean (SD)	
EQ VAS	64.74 (19.79)	62.96 (19.14)	65.50 (20.37)	65.50 (22.88)
	n (%)		n (%)	
Moderate to extreme depression[a]	19 (22.9%)	25 (30.1%)	19 (32.2%)	22 (37.3%)
Moderate to extreme anxiety [a]	26 (31.3%)	26 (31.3%)	27 (45.8%)	19 (32.2%)
Moderate to extreme stress [a]	10 (12.0%)	9 (10.8%)	13 (22.0%)	11 (13.4%)
[a] 2 missing				

Table B 7. Within-group differences in energy outcomes between baseline and 12-month follow-up in the Heerlen pilot

Outcome	Intervention group		Control group	
	Baseline (n=84)	12-month follow-up (n=84)	Baseline (n=60)	12-month follow-up (n=60)
	n (%)	n (%)	n (%)	n (%)
Comfortably warm in winter time [a]	43 (51.8%)	50 (60.2%)	32 (54.2%)	41 (69.5%)
Comfortably cool in summer time [a]	33 (39.8%)	35 (42.2%)	20 (33.9%)	23 (39.0%)
	Mean (SD)		Mean (SD)	
Total energy costs*[b]	130.63 (109.54)	204.48 (186.36)	188.30 (153.45)	163.03 (100.85)
Coping behaviours (sum 0-50)	23.12 (7.56)	22.00 (8.29)	25.75 (7.66)	23.80 (8.57)

*Total energy costs include costs for electricity, gas, derived heat and other energy sources [a] 2 missing [b] 87 missing

Figure B 1. Daily average indoor and outdoor humidity levels in households in Heerlen.
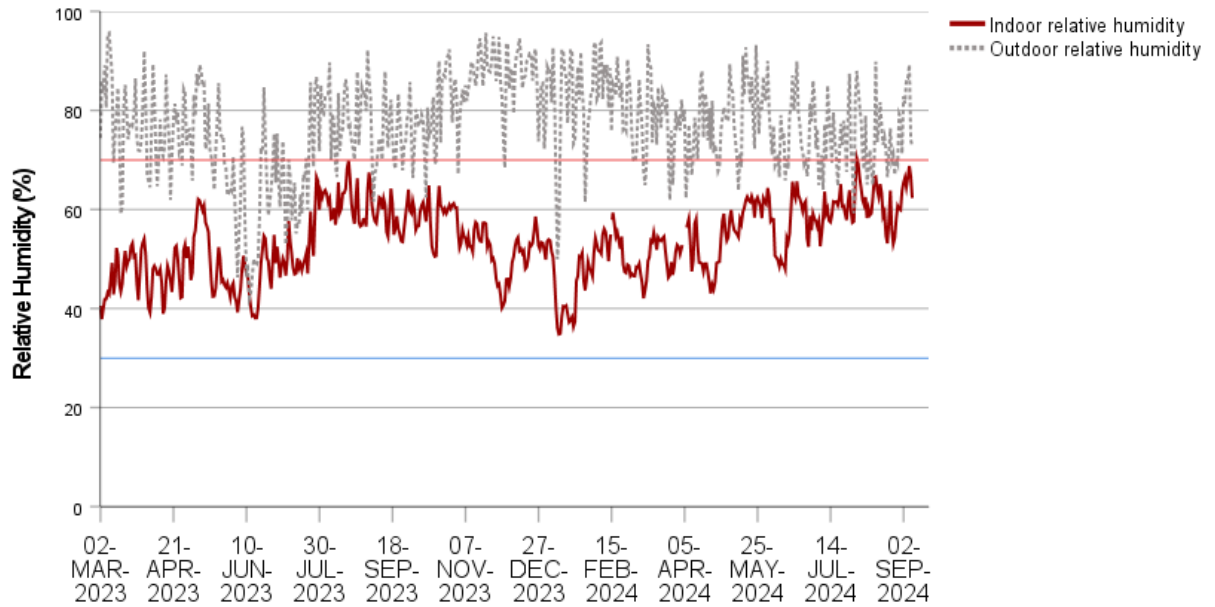
Figure B 2. Daily average indoor and outdoor temperature in households in Heerlen.
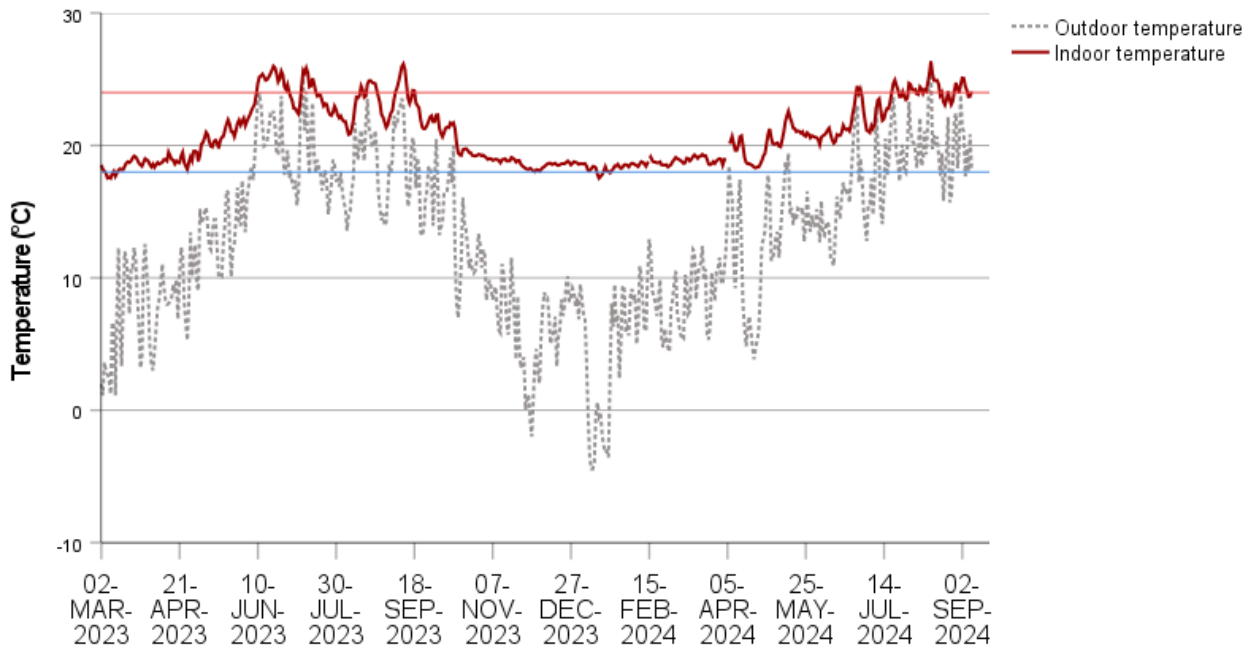
Figure B 3. Daily average indoor CO2 levels in households in Heerlen.
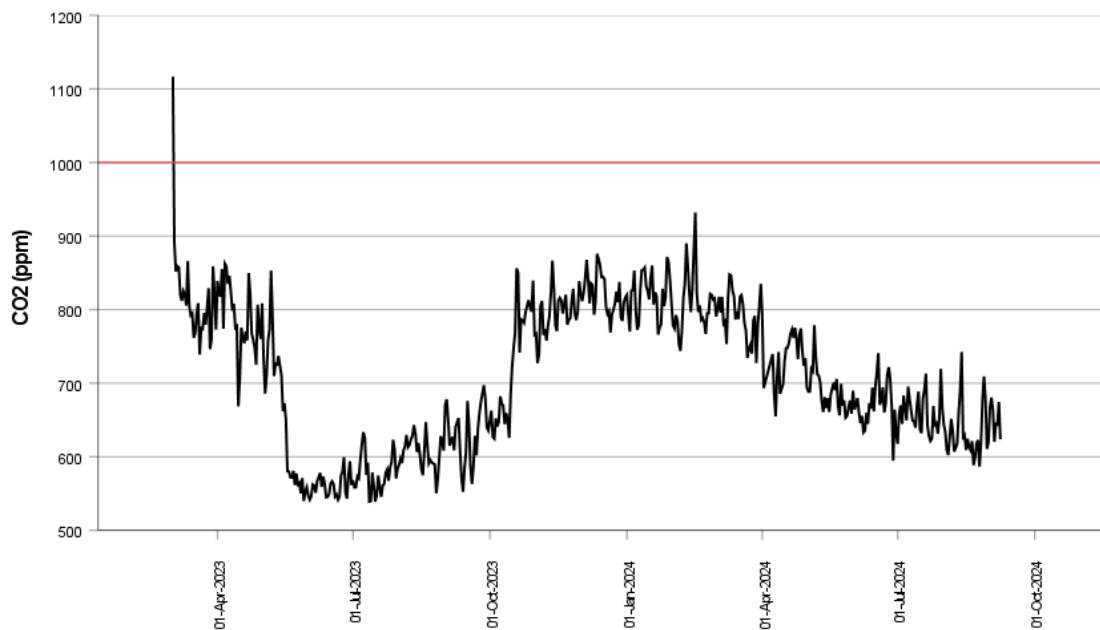
Figure B 4. Daily average percentage above 24 °C or below 18 °C in Heerlen households.
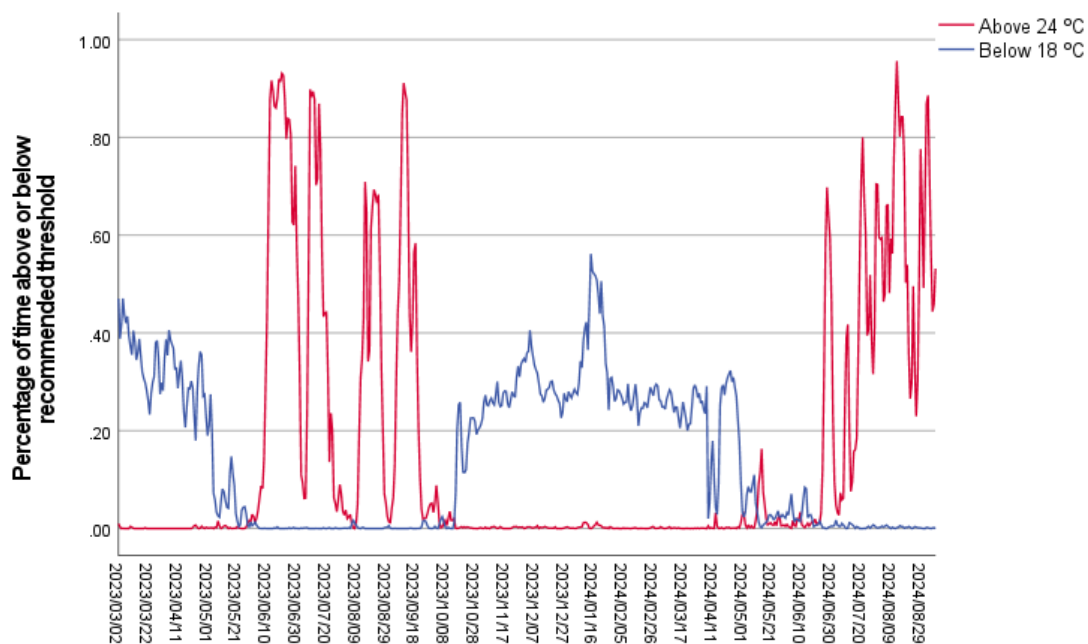
Table B 8. Temperature, Relative humidity, CO2 general descriptives Heerlen pilot site.

	Temperature (°C)			Relative Humidity (%)			CO_2 (ppm)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Spring	20.7	1.8	20.7	51.0	6.7	49.8	681	81	689
Summer	23.7	1.3	23.8	58.4	5.6	58.9	619	43	619
Autum	19.6	1.3	54.2	54.2	5.7	54.2	767	72	792
Winter	18.7	0.4	18.7	48.3	5.8	49.4	811	32.9	810
All seasons	21.2	2.4	20.9	53.6	7.2	53.5	700	96	686

Annex C – Results Edirne pilot site

Table C 1. Sociodemographic and lifestyle characteristics Edirne sample by intervention and control group WELLBASED at baseline (T0) (n=245)

	Intervention group N=122 (49.8%)	Control group N=123(50.2%)	P-value
Gender, n (%)			0.48
Female	58 (47.5%)	64 (52.0%)	
Male	64 (52.5%)	59 (48.0%)	
Age (years)[a]			
Mean (SD)	45.34 (18.04)	43.39 (16.67)	0.39
Older people [b] (>65 years)	16 (13.1%)	12 (10.1%)	0.46
Marital status [a], n (%)			0.78
Married	79 (64.8%)	75 (63.0%)	
Single, separated, divorced or widowed	43 (35.2%)	44 (37.0%)	
Educational level [b], n (%)			0.16
Post-secondary or lower	120 (98.4%)	121 (100%)	
Higher education	2 (1.6%)	0	
Household income category [b], n (%) (14 missing)	121 (100%)	122 (100%)	n/a
1-3	121 (100%)	122 (100%)	n/a
Paid work [c], n(%)			0.54
Yes, by respondent only	13 (10.8%)	11 (9.0%)	
Yes, by respondent's partner only	5 (4.2%)	5 (4.1%)	
Yes, by respondent and their partner	0	2 (1.6%)	
No	102 (85.0%)	104 (85.2%)	
Household composition, n (%)			0.17
Single-adult with children	1 (0.8%)	3 (2.4%)	
Single-adult without children	1 (0.8%)	1 (0.8%)	
Two or more adults with children	51 (41.8%)	66 (53.7%)	
Two or more adults without children	69 (56.6%)	53 (43.1%)	
Migration background [b], n (%)			0.32

Yes	0	1 (0.8%)	
No	121 (100%)	121 (99.2%)	
Belonging to an ethnic minority[d], n (%)			n/a
No	122 (100%)	122 (100%)	
Dwelling type[d] , n (%)			n/a
Detached	121 (100%)	123 (100%	
Tenure status, n (%)			n/a
Owner	122 (100%)	123 (100%)	
BMI[a], mean (SD)	26.52 (4.93)	27.16 (4.98)	0.32
No. of chronic conditions			0.90
0	38 (31.1%)	38 (31.1%)	
1-2	38 (31.1%)	41 (33.6%)	
3 or more	46 (37.7%)	43 (35.2%)	
Smoker			0.47
yes	59 (48.4%)	65 (52.8%)	
no	45 (36.9%)	46 (37.4%)	
ex-smoker	18 (14.8%)	12 (9.8%)	
Average time spent inside the house during daytime [c]			0.60
0-3 hours	5 (4.1%)	5 (4.1%)	
3-6 hours	35 (28.9%)	28 (23.1%)	
6-9 hours	46 (38.0%)	56 (46.3%)	
> 9 hours	35 (28.9%)	32 (26.4%)	
[a] 4 missing			
[b] 2 missing			
[c] 3missing			
[d] 1 missing			

Table C 2. Health and well-being outcomes Edirne sample by intervention and control group WELLBASED at baseline (T0) (n=245)

	Intervention group N=122 (49.8%)	Control group N=123(50.2%)	P-value

Health-related Quality of Life				
Overall HRQoL[a], n(%)				0.97
No or slight problems (1-10)	91 (75.8%)	93 (75.6%)		
Moderate, severe or extreme problems (11-25)	29 (24.2%)	30 (24.4%)		
Mobility [a], n(%)				0.44
No or slight problems	102 (85.0%)	100 (81.3%)		
Moderate, severe or extreme problems	18 (15.0%)	23 (18.7%)		
Self-care [a], n(%)				0.79
No or slight problems	115 (95.8%)	117 (95.1%)		
Moderate, severe or extreme problems	5 (4.2%)	6 (4.9%)		
Usual Activities [a], n(%)				0.96
No or slight problems	111 (92.5%)	114 (92.7%)		
Moderate, severe or extreme problems	9 (7.5%)	9 (7.3%)		
Pain/Discomfort [a], n(%)				0.80
No or slight problems	80 (66.7%)	80 (65.0%)		
Moderate, severe or extreme problems	40 (33.3%)	43 (35.0%)		
Anxiety/Depression [a], n(%)				0.49
No or slight problems	82 (68.3%)	89 (72.4%)		
Moderate, severe or extreme problems	38 (31.7%)	34 (27.6%)		
EQ VAS [b], mean (SD)	61.30 (20.26)	65.09 (20.61)		0.15
Mental health & well-being				
Depression				0.74
Normal or mild	72 (59.0%)	70 (56.9%)		
Moderate, severe or extreme	50 (41.0%)	53 (43.1%)		
Anxiety				0.06
Normal or mild	51 (41.8%)	66 (53.7%)		
Moderate, severe or extreme	71 (58.2%)	57 (46.3%)		
Stress				0.14
Normal or mild	83 (68.6%)	94 (77.0%)		
Moderate, severe or extreme	38 (31.4%)	28 (23.0%)		
[a] 2 missing [b] 6 missing				

Table C 3. Energy poverty indicators Edirne sample by intervention and control group WELLBASED at baseline (T0) (n=245)

Variable		Intervention group N=122 (49.8%)	Control group N=123(50.2%)	p-value
Dwelling comfortable warm in winter time				0.32
	Yes	1 (0.8%)	3 (2.4%)	
	No	121 (99.2%)	120 (97.6%)	
Dwelling comfortably cool in summer time				0.15
	Yes	9 (7.4%)	4 (3.3%)	
	No	113 (92.6%)	119 (96.7%)	
Presence of leak/damp/rot [a]				0.18
	Yes	118 (96.7%)	121 (99.2%)	
	No	4 (3.3%)	1 (0.8%)	
Arrears on utility bills				**0.01**
	Yes, once	13 (10.7%)	20 (16.3%)	
	Yes, twice or more	109 (89.3%)	96 (78.0%)	
	No	0	7 (5.7%)	
Equipped with heating facilities				
	Yes, other fixed heating	122 (100%)	121 (98.4%)	0.16
	Yes, non-fixed	0	2 (1.6%)	
Equipped with air conditioning (cooling) facilities [a]				0.17
	Yes	0	2 (1.6%)	
	No	122 (100%)	120 (98.4%)	
Equipped with adequate electrical installations				0.09
	Yes	11 (9.0%)	20 (16.3%)	
	No	111 (91.0%)	103 (83.7%)	
Home satisfaction [b]				0.44
	(very) dissatisfied	109 (92.4%)	102 (89.5%)	
	(very) satisfied	9 (7.6%)	12 (10.5%)	
[a] 1 missing [b] 13 missing				

Table C 4. Energy consumption and costs Edirne sample by intervention and control group WELLBASED at baseline (T0) (n=245)

Variable	Intervention group N=122 (49.8%)	Control group N=123(50.2%)	p-value
Household energy source			
Electricity[a], n (%)	120 (100%)	120 (100%)	n/a
Gas[a], n (%)	120 (100%)	120 (100%)	n/a
Derived heat/ district heating[a], n (%)	120 (100%)	120 (100%)	n/a
Other (e.g. oil/petroleum products, renewables or coal products)[b], n (%)	111 (95.7%)	111 (93.3%)	0.42
Monthly energy consumption			
Electricity (kWh)[c], mean (SD)	358.85 (142.57)	320.99 (105.77)	0.14
Gas (m3)[d], mean (SD)	n/a	n/a	n/a
Derived heat (kWj)[d], mean (SD)	n/a	n/a	n/a
Monthly energy costs,			
Electricity (€)[a], mean (SD)	22.94 (14.4)	22.46 (12.75)	0.79
Gas (€)[d], mean (SD)	n/a	n/a	n/a
Derived heat (€)[d], mean (SD)	n/a	n/a	n/a
Other sources (€)[i], mean (SD)	n/a	n/a	n/a
Total energy costs[a], mean (SD)	22.94 (14.43)	22.46 (12.75)	0.79
Received support towards energy bills			
Yes, fixed amount of money [e], n (%)	56 (48.7%)	38 (34.9%)	**0.04**
Yes, percentage of costs refunded [f], n (%)	0	2 (1.8%)	0.15
Yes, in kind contribution [f], n (%)	65 (56.0%)	81 (67.5%)	0.07
Yes, other type of support [g], n (%)	5 (4.5%)	8 (7.3%)	0.36

[a] 5 missing [b] 10 missing [c] 147 missing [d] 245 missing [e] 21 missing [f] 9 missing [g] 24 missing [h] 2 missing [i] 87 missing [j] 1 missing [k] 39 missing [l] 35 missing

Table C 5. Energy-related coping strategies in the past 12 months Edirne sample by intervention and control group WELLBASED at baseline (T0) (n=245)

Variable	Intervention group N=122 (49.8%)	Control group N=123(50.2%)	p-value
Wearing extra clothes to keep warm [a]			**0.001**
Never or rarely	2 (1.6%)	15 (12.3%)	
Sometimes, often or always	120 (98.4%)	107 (87.7%)	
Turning heating/cooling off to save money [b]			**0.01**
Never or rarely	23 (19.0%)	40 (32.8%)	
Sometimes, often or always	98 (81.0%)	82 (67.2%)	
Heating/cooling only one room of the house to save money [a]			**0.02**
Never or rarely	14 (11.5%)	30 (24.6%)	
Sometimes, often or always	107 (87.7%)	92 (75.4%)	
Not an option in my dwelling	1 (0.8%)	0	
Going to bed in the daytime to keep warm [c]			0.51
Never or rarely	45 (37.2%)	50 (41.3%)	
Sometimes, often or always	76 (62.8%)	71 (58.7%)	
Going to a public building to keep warm/ cool [c]			**0.03**
Never or rarely	110 (90.9%)	118 (97.5%)	
Sometimes, often or always	11 (9.1%)	3 (2.5%)	
Going to a neighbour or friends/relatives house to keep warm/cool [a]			0.19
Never or rarely	78 (64.5%)	89 (72.4%)	
Sometimes, often or always	43 (35.5%)	34 (27.6%)	
Bathing/showering less to save money [a]			0.39
Never or rarely	117 (95.9%)	114 (93.4%)	
Sometimes, often or always	5 (4.1%)	8 (6.6%)	
Turning off lights in rooms that are being used to save money [c]			0.06
Never or rarely	38 (31.4%)	52 (43.0%)	

Sometimes, often or always	83 (68.6%)	69 (57.0%)	
Not cooking/eating cold food to save money [c]			0.15
Never or rarely	122 (100%)	118 (98.3%)	
Sometimes, often or always	0	2 (1.7%)	
Avoided going to the doctor to save money [a]			0.56
Never or rarely	120 (98.4%)	121 (99.2%)	
Sometimes, often or always	2 (1.6%)	1 (0.8%)	
[a] 1 missing [b] 2 missing [c] 3 missing			

Table C 6. Within-group differences in health and well-being outcomes between baseline and 12-month follow-up in the Edirne pilot

	Intervention group		Control group	
Outcome	Baseline (n=114)	12-month follow-up (n=114)	Baseline (n=121)	12-month follow-up (n=121)
	n (%)	*n (%)*	*n (%)*	*n (%)*
Moderate to extremely severe problems in overall HrQoL [a]	27 (24.3%)	26 (23.4%)	29 (24.4%)	25 (21.0%)
Moderate to extremely severe problems in mobility [a]	17 (15.3%)	23 (20.7%)	23 (19.3%)	24 (20.2%)
Moderate to extremely severe problems in self-care [a]	5 (4.5%)	20 (18.0%)	6 (5.0%)	15 (12.6%)
Moderate to extremely severe problems in usual activities [a]	8 (7.2%)	22 (19.8%)	9 (7.6%)	20 (16.8%)
Moderate to extremely severe problems in pain/ Discomfort [a]	36 (32.4%)	26 (23.4%)	42 (35.3%)	31 (26.1%)
Moderate to extremely severe problems in anxiety/ depression [a]	34 (30.6%)	17 (15.3%)	32 (26.9%)	25 (21.0%)
	Mean (SD)		*Mean (SD)*	
EQ VAS [b]	59.43 (19.88)	68.21 (20.07)	60.21 (21.64)	65.47 (20.39)
	n (%)		*n (%)*	
Moderate to extreme depression	44 (38.6%)	17 (14.9%)	53 (43.8%)	26 (21.5%)
Moderate to extreme anxiety	20 (17.5%)	65 (57.0%)	56 (46.3%)	28 (23.1%)

Moderate to extreme stress	34 (30.1%)	5 (4.4%)	27 (22.5%)	5 (4.2%)

[a] 5 missing [b] 90 missing

Table C 7. Within-group differences in energy outcomes between baseline and 12-month follow-up in the Edirne pilot

Outcome	Intervention group		Control group	
	Baseline (n=114)	12-month follow-up (n=114)	Baseline (n=121)	12-month follow-up (n=121)
	n (%)	*n (%)*	*n (%)*	*n (%)*
Comfortably warm in winter time [a]	1 (0.9%)	32 (28.1%)	3 (2.6%)	12 (10.3%)
Comfortably cool in summer time [a]	8 (7.0%)	24 (21.1%)	4 (3.4%)	13 (11.2%)
	Mean (SD)		*Mean (SD)*	
Total energy costs* [b]	21.89 (12.89)	69.80 (91.57)	23.39 (14.77)	38.94 (53.85)
Coping behaviours (sum 0-50) [c]	24.40 (3.86)	14.11 (5.53)	22.76 (5.47)	16.58 (7.61)

*Total energy costs include costs for electricity, gas, derived heat and other energy sources [a] 5 missing [b] 190 missing [c] 4 missing

Figure C 1. Daily average indoor and outdoor humidity in households in Edirne.
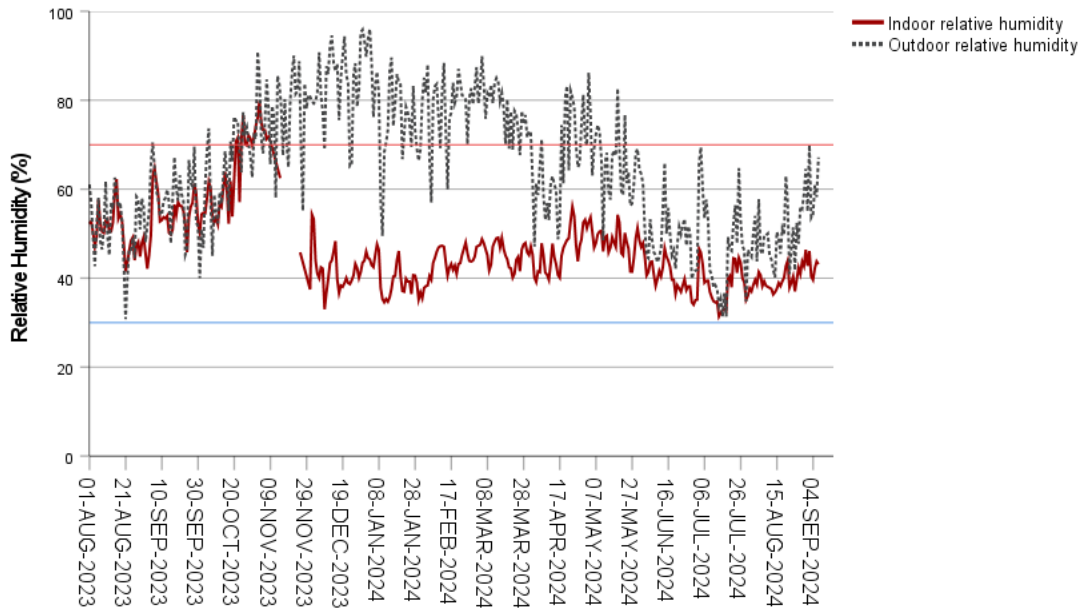
Figure C 2. Daily average indoor and outdoor temperature in households in Edirne.
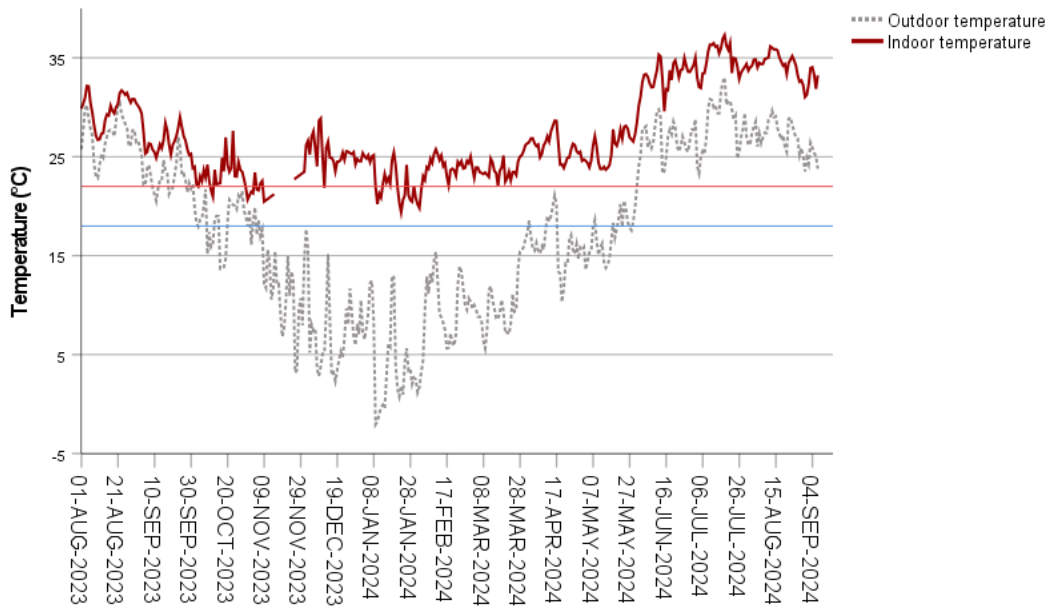
Figure C 3. Daily average indoor CO2 levels in households in Edirne.
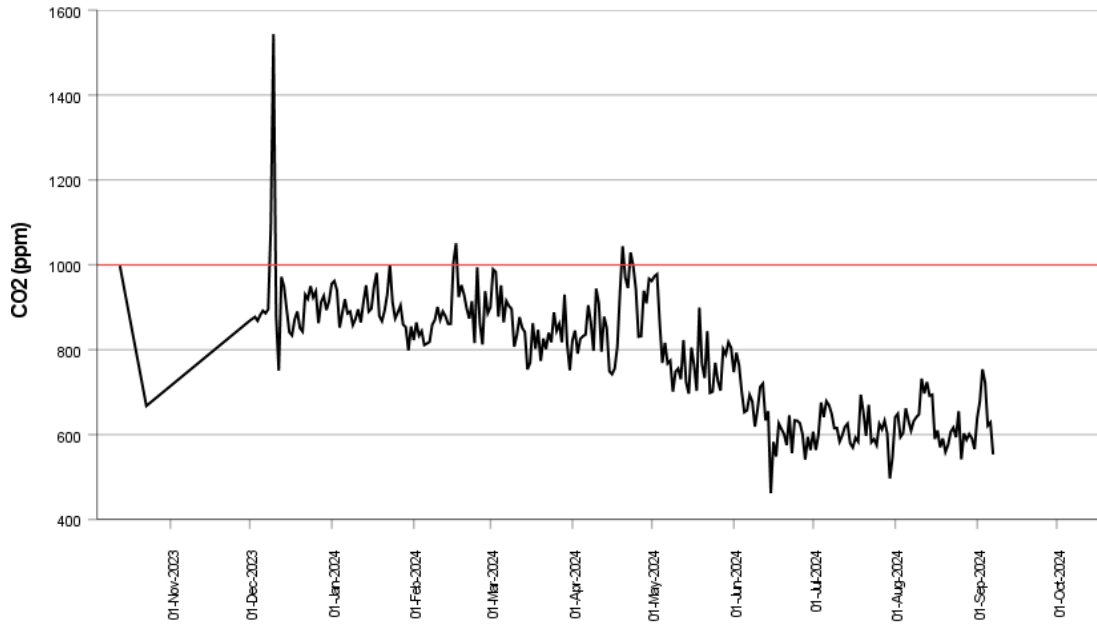
Figure C 4. Daily average percentage above 24 °C or below 18 °C in Edirne households.
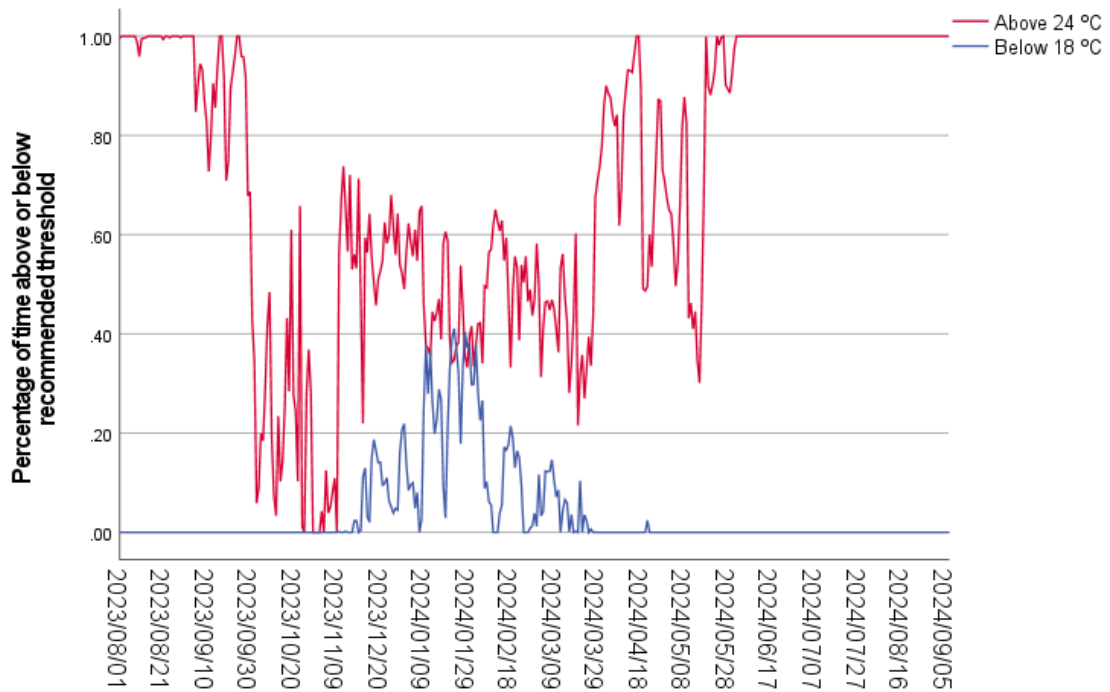
Table C 8. Temperature, Relative humidity, CO2 general descriptives Edirne pilot site.

	Temperature (°C)			Relative Humidity (%)			CO_2 (ppm)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Spring	26.7	2.9	26.2	46.0	4.1	46.0	810	98	813
Summer	30.4	3.0	30.5	48.0	7.3	49.0	617	47	610
Autum	24.4	1.7	24.2	49.7	9.7	48	910	108	890
Winter	23.5	1.6	23.9	42.2	4.0	42.4	892	53	890
All seasons	26.4	3.7	25.4	45.7	6.6	45.2	838	114	862

Annex D – Results Jelgava pilot site

Table D 1. Sociodemographic and lifestyle characteristics Jelgava sample by intervention and control group WELLBASED at baseline (T0) (n=157)

	Intervention group N=124 (79.0%)	Control group N=33 (21.0%)	P-value
Gender, n (%)			0.78
Female	91 (73.4%)	25 (75.8%)	
Male	33 (26.6%)	8 (24.2%)	
Age (years)			
Mean (SD)	53.99 (17.45)	53.48 (14.90)	**0.88**
Older people (>65 years)	39 (31.5%)	8 (24.2%)	0.42
Marital status, n (%)			0.27
Married	77 (62.1%)	17 (51.5%)	
Single, separated, divorced or widowed	47 (37.9%)	16 (48.5%)	
Educational level, n (%)			0.57
Post-secondary or lower	11 (8.9%)	4 (12.1%)	
Higher education	113 (91.1%)	29 (87.9%)	
Household income category, n (%) (14 missing)			0.18
1-3	36 (29.0%)	11 (33.3%)	
4-6	51 (41.1%)	8 (24.2%)	
7-9	37 (29.8%)	14 (42.4%)	
Paid work, n(%)			0.46
Yes, by respondent only	25 (20.2%)	7 (21.2%)	
Yes, by respondent's partner only	5 (4.0%)	0	
Yes, by respondent and their partner	54 (43.5%)	18 (54.5%)	
No	40 (32.3%)	8 (24.2%)	
Household compositiona, n (%)			0.08
Single-adult with children	2 (1.6%)	2 (6.1%)	
Single-adult without children	26 (21.1%)	12 (36.4%)	
Two or more adults with children	43 (35.0%)	11 (33.3%)	
Two or more adults without children	52 (42.3%)	8 (24.2%)	

Migration background, n (%)			0.96
Yes	4 (3.2%)	1 (3.0%)	
No	120 (96.8%)	32 (97.0%)	
Belonging to an ethnic minorityb, n (%)			0.60
Yes	5 (4.1%)	2 (6.3%)	
No	118 (95.9%)	30 (93.8%)	
Dwelling typea , n (%)			0.13
Detached	48 (39.0%)	7 (21.2%)	
Semi-detached/terraced	1 (0.8%)	0	
Apartment or flat	74 (60.2%)	26 (78.8%)	
Tenure statusa, n (%)			0.59
Owner	95 (77.2%)	26 (78.8%)	
Rented at market rate	12 (9.8%)	1 (3.0%)	
Reduced rent/social housing/free rent	13 (10.6%)	5 (15.2%)	
Other	3 (2.4%)	1 (3.0%)	
BMI, mean (SD)	28.15 (5.40%)	26.53 (4.76%)	0.12
No. of chronic conditions			0.21
0	20 (16.1%)	9 (27.3%)	
1-2	42 (33.9%)	7 (21.2%)	
3 or more	62 (50.0%)	17 (51.5%)	
Smoker			0.22
yes	12 (9.7%)	4 (12.1%)	
no	89 (71.8%)	27 (81.8%)	
ex-smoker	23 (18.5%)	2 (6.1%)	
Average time spent inside the house during daytime			0.96
0-3 hours	8 (6.5%)	3 (9.1%)	
3-6 hours	52 (41.9%)	14 (42.4%)	
6-9 hours	43 (34.7%)	11 (33.3%)	
> 9 hours	21 (16.9%)	5 (15.2%)	
a 1 missing b 2 missing			

Table D 2. Health and well-being outcomes Jelgava sample by intervention and control group WELLBASED at baseline (T0) (n=157)

	Intervention group N=124 (79.0%)	Control group N=33 (21.0%)	P-value
Health-related Quality of Life			
Overall HRQoL, n(%)			0.31
No or slight problems (1-10)	114 (91.9%)	32 (97.0%)	
Moderate, severe or extreme problems (11-25)	10 (8.1%)	1 (3.0%)	
Mobility, n(%)			0.23
No or slight problems	107 (86.3%)	31 (93.9%)	
Moderate, severe or extreme problems	17 (13.7%)	2 (6.1%)	
Self-care, n(%)			0.37
No or slight problems	121 (97.6%)	33 (100%)	
Moderate, severe or extreme problems	3 (2.4%)	0	
Usual Activities, n(%)			0.26
No or slight problems	113 (91.1%)	32 (97.0%)	
Moderate, severe or extreme problems	11 (8.9%)	1 (3.0%)	
Pain/Discomfort, n(%)			0.36
No or slight problems	105 (84.7%)	30 (90.9%)	
Moderate, severe or extreme problems	19 (15.3%)	3 (9.1%)	
Anxiety/Depression, n(%)			0.55
No or slight problems	110 (88.7%)	28 (84.8%)	
Moderate, severe or extreme problems	14 (11.3%)	5 (15.2%)	
EQ VAS, mean (SD)	72.45 (14.56)	76.91 (13.33)	0.11
Mental health & well-being			
Depression			0.47
Normal or mild	117 (94.4%)	30 (90.9%)	
Moderate, severe or extreme	7 (5.6%)	3 (9.1%)	
Anxiety			0.44
Normal or mild	108 (87.1%)	27 (81.8%)	
Moderate, severe or extreme	16 (12.9%)	6 (18.2%)	
Stress			0.45
Normal or mild	120 (96.8%)	31 (93.9%)	

| Moderate, severe or extreme | 4 (3.2%) | 2 (6.1%) | |

Table D 3. Energy poverty indicators Jelgava sample by intervention and control group WELLBASED at baseline (T0) (n=157)

Variable	Intervention group N=124 (79.0%)	Control group N=33 (21.0%)	p-value
Dwelling comfortable warm in winter time			0.19
Yes	96 (77.4%)	29 (87.9%)	
No	28 (22.6%)	4 (12.1%)	
Dwelling comfortably cool in summer time			0.29
Yes	51 (41.1%)	17 (51.5%)	
No	73 (58.9%)	16 (48.5%)	
Presence of leak/damp/rot [a]			0.12
Yes	48 (39.0%)	8 (24.2%)	
No	75 (61.0%)	25 (75.8%)	
Arrears on utility bills [a]			0.61
Yes, once	9 (7.3%)	1 (3.0%)	
Yes, twice or more	8 (6.5%)	3 (9.1%)	
No	106 (86.2%)	29 (87.9%)	
Equipped with heating facilities [a]			0.80
Yes, central heating or similar	114 (92.7%)	31 (93.9%)	
Yes, other fixed heating	9 (7.3%)	2 (6.1%)	
Equipped with air conditioning (cooling) facilities [a]			0.62
Yes	5 (4.1%)	2 (6.1%)	
No	118 (95.9%)	31 (93.9%)	
Equipped with adequate electrical installations[a]			0.36
Yes	117 (95.1%)	30 (90.9%)	
No	6 (4.9%)	3 (9.1%)	
Home satisfaction			0.22
(very) dissatisfied	10 (8.1%)	5 (15.2%)	
(very) satisfied	114 (91.9%)	28 (84.8%)	
[a] 1 missing			

Table D 4. Energy consumption and costs Jelgava sample by intervention and control group WELLBASED at baseline (T0) (n=157)

Variable	Intervention group N=124 (79.0%)	Control group N=33 (21.0%)	p-value
Household energy source			
Electricitya, n (%)	119 (100%)	31 (100%)	n/a
Gasa, n (%)	71 (59.7%)	19 (61.3%)	0.87
Derived heat/ district heatinga, n (%)	67 (56.3%)	21 (67.7%)	0.25
Other (e.g. oil/petroleum products, renewables or coal products)b, n (%)	29 (24.0%)	4 (12.5%)	0.16
Monthly energy consumption			
Electricity (kWh)c, mean (SD)	187.67 (158.25)	170.44 (211.78)	0.68
Gas (m3)d, mean (SD)	40.72 (66.29)	8.83 (14.31)	**0.001**
Derived heat (kWj)e, mean (SD)	73.62 (41.33)	n/a	n/a
Monthly energy costs,			
Electricity (€)f, mean (SD)	49.62 (47.62)	38.83 (44.04)	0.26
Gas (€)a, mean (SD)	58.54 (89.54)	35.68 (50.97)	0.33
Derived heat (€)g, mean (SD)	89.08 (61.35)	56.34 (36.83)	**0.02**
Other sources (€)h, mean (SD)	n/a	n/a	n/a
Total energy costsa, mean (SD)	130.82 (95.86)	95.41 (60.30)	**0.01**
Received support towards energy bills			
Yes, fixed amount of money b, n (%)	16 (13.2%)	2 (6.3%)	0.28
Yes, percentage of costs refunded b, n (%)	29 (24.0%)	3 (9.4%)	0.07
Yes, in kind contribution b, n (%)	0	0	n/a
Yes, other type of support b, n (%)	4 (3.3%)	1 (3.1%)	0.96

a 7 missing b 4 missing c 44 missing d 20 missing e 81 missing f 1 missing g 2 missing h 33 missing i 87 missing j 1 missing

Table D 5. Energy-related coping strategies in the past 12 months Jelgava sample by intervention and control group WELLBASED at baseline (T0) (n=157)

Variable	Intervention group N=124 (79.0%)	Control group N=33 (21.0%)	p-value
Wearing extra clothes to keep warm			0.29
Never or rarely	66 (53.2%)	21 (63.6%)	
Sometimes, often or always	12 (36.4%)	58 (46.8%)	
Turning heating/cooling off to save money			0.89
Never or rarely	77 (62.1%)	22 (66.7%)	
Sometimes, often or always	13 (10.5%)	3 (9.1%)	
Not an option in my dwelling	34 (27.4%)	8 (24.2%)	
Heating/cooling only one room of the house to save money			0.19
Never or rarely	78 (62.9%)	25 (75.8%)	
Sometimes, often or always	9 (7.3%)	0	
Not an option in my dwelling	37 (29.8%)	8 (24.2%)	
Going to bed in the daytime to keep warm			0.93
Never or rarely	117 (94.4%)	31 (93.9%)	
Sometimes, often or always	7 (5.6%)	2 (6.1%)	
Going to a public building to keep warm/ cool			0.30
Never or rarely	120 (96.8%)	33 (100%)	
Sometimes, often or always	4 (3.2%)	0	
Going to a neighbour or friends/relatives house to keep warm/cool			0.46
Never or rarely	122 (98.4%)	33 (100%)	
Sometimes, often or always	2 (1.6%)	0	
Bathing/showering less to save money			0.81

	Never or rarely	115 (92.7%)	31 (93.9%)	
	Sometimes, often or always	9 (7.3%)	2 (6.1%)	
Turning off lights in rooms that are being used to save money				0.16
	Never or rarely	40 (32.3%)	15 (45.5%)	
	Sometimes, often or always	84 (67.7%)	18 (54.5%)	
Not cooking/eating cold food to save money				0.96
	Never or rarely	120 (96.8%)	32 (97.0%)	
	Sometimes, often or always	4 (3.2%)	1 (3.0%)	
Avoided going to the doctor to save money				0.96
	Never or rarely	120 (96.8%)	32 (97.0%)	
	Sometimes, often or always	4 (3.2%)	1 (3.0%)	

Table D 6. Within-group differences in health and well-being outcomes between baseline and 12-month follow-up in the Jelgava pilot

Outcome	Intervention group		Control group	
	Baseline (n=117)	12-month follow-up (n=117)	Baseline (n=31)	12-month follow-up (n=31)
	n (%)	*n (%)*	*n (%)*	*n (%)*
Moderate to extremely severe problems in overall HrQoL	10 (8.6%)	10 (8.6%)	0	0
Moderate to extremely severe problems in mobility	16 (13.7%)	12 (10.3%)	1 (3.2%)	0
Moderate to extremely severe problems in self-care	3 (2.6%)	5 (4.3%)	0	0
Moderate to extremely severe problems in usual activities	11 (9.4%)	5 (4.3%)	0	0
Moderate to extremely severe problems in pain/ Discomfort	18 (15.4%)	17 (14.5%)	2 (6.5%)	1 (3.2%)
Moderate to extremely severe problems in anxiety/ depression	13 (11.1%)	11 (9.4%)	4 (12.9%)	1 (3.2%)
	Mean (SD)		*Mean (SD)*	

EQ VAS	71.91 (14.51)	74.57 (17.06)	77.77 (12.68)	78.87 (12.48)
	n (%)		*n (%)*	
Moderate to extreme depression	6 (5.1%)	8 (6.8%)	1 (3.2%)	1 (3.2%)
Moderate to extreme anxiety	16 (13.7%)	11 (9.4%)	4 (12.9%)	2 (6.5%)
Moderate to extreme stress	4 (3.4%)	6 (5.1%)	1 (3.2%)	2 (6.5%)

Table D 7. Within-group differences in energy outcomes between baseline and 12-month follow-up in the Jelgava pilot

Outcome	**Intervention group**		**Control group**	
	Baseline (n=117)	12-month follow-up (n=117)	Baseline (n=31)	12-month follow-up (n=31)
	n (%)	*n (%)*	*n (%)*	*n (%)*
Comfortably warm in winter time	89 (76.1%)	100 (85.5%)	28 (90.3%)	30 (96.8%)
Comfortably cool in summer time	50 (42.7%)	54 (46.2%)	15 (48.4%)	13 (41.9%)
	Mean (SD)		*Mean (SD)*	
Total energy costs*a	136.94 (101.79)	112.89 (86.45)	92.63 (66.24)	80.33 (48.70)
Coping behaviours (sum 0-50)	17.78 (6.39)	16.21 (5.99)	16.00 (5.80)	15.55 (5.93)
*Total energy costs include costs for electricity, gas, derived heat and other energy sources [a] 41 missing				

Figure D 1. Daily average indoor and outdoor humidity levels in households in Jelgava.
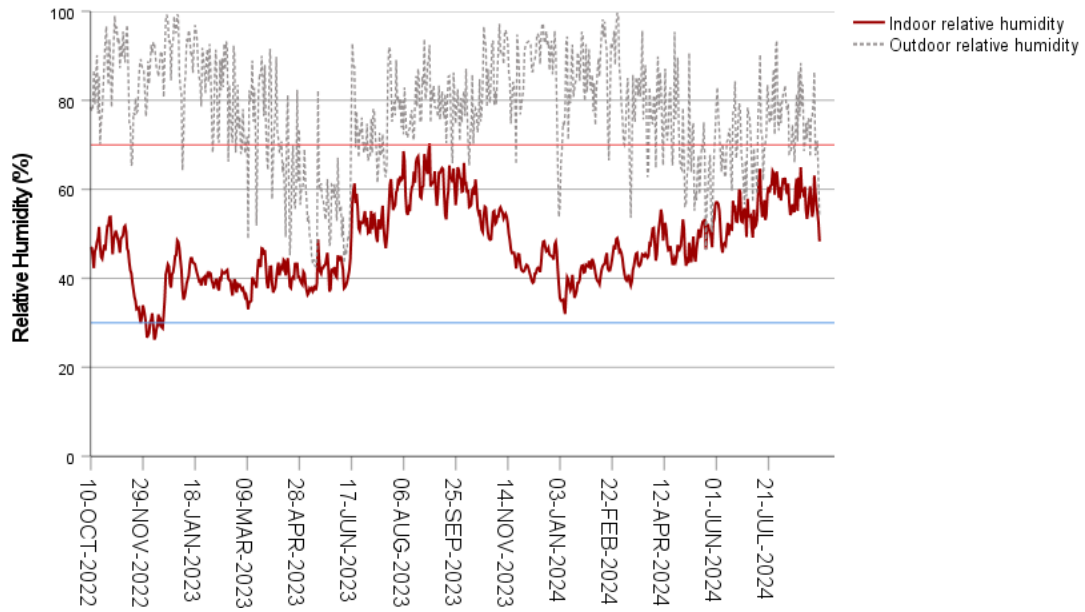
Figure D 2. Daily average indoor and outdoor temperature in households in Jelgava.
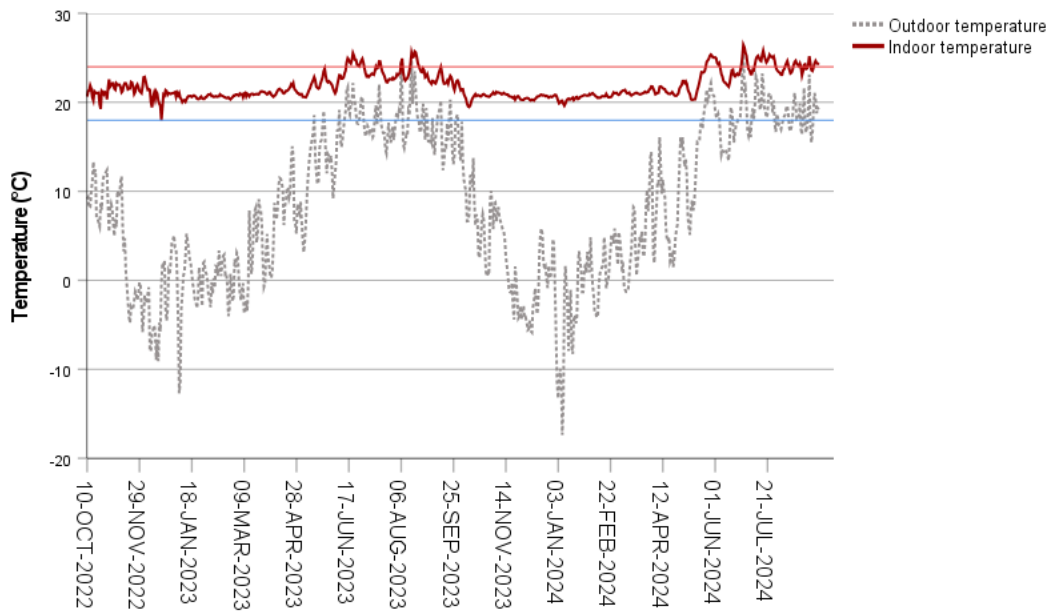
Figure D 3. Daily average indoor CO2 levels in households in Jelgava.
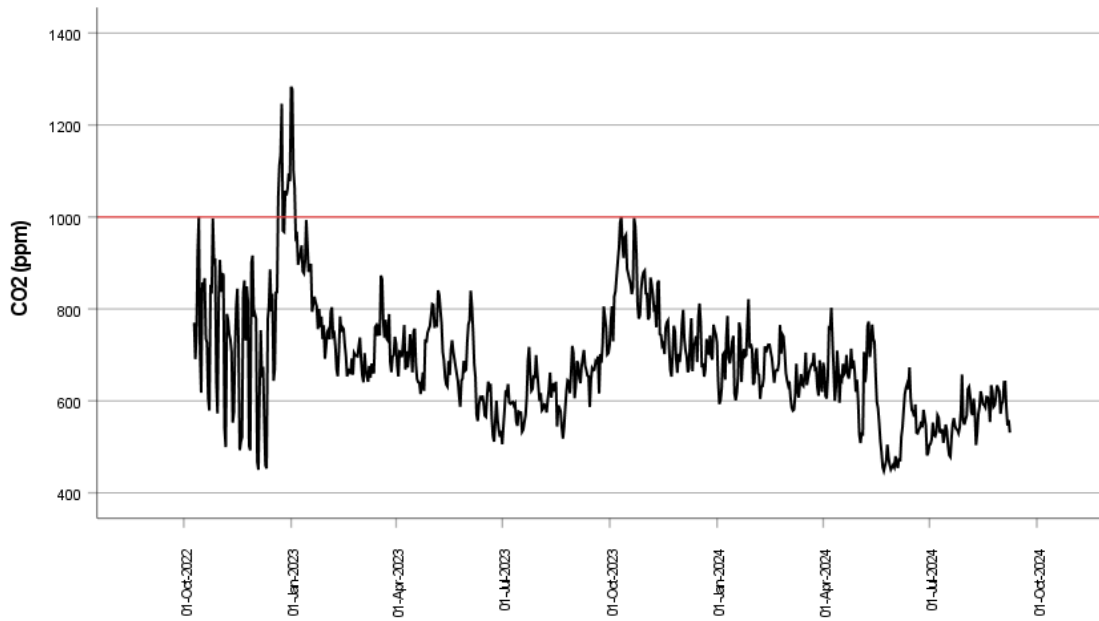
Figure D 4. Daily average percentage above 24 °C or below 18 °C in Jelgava households.
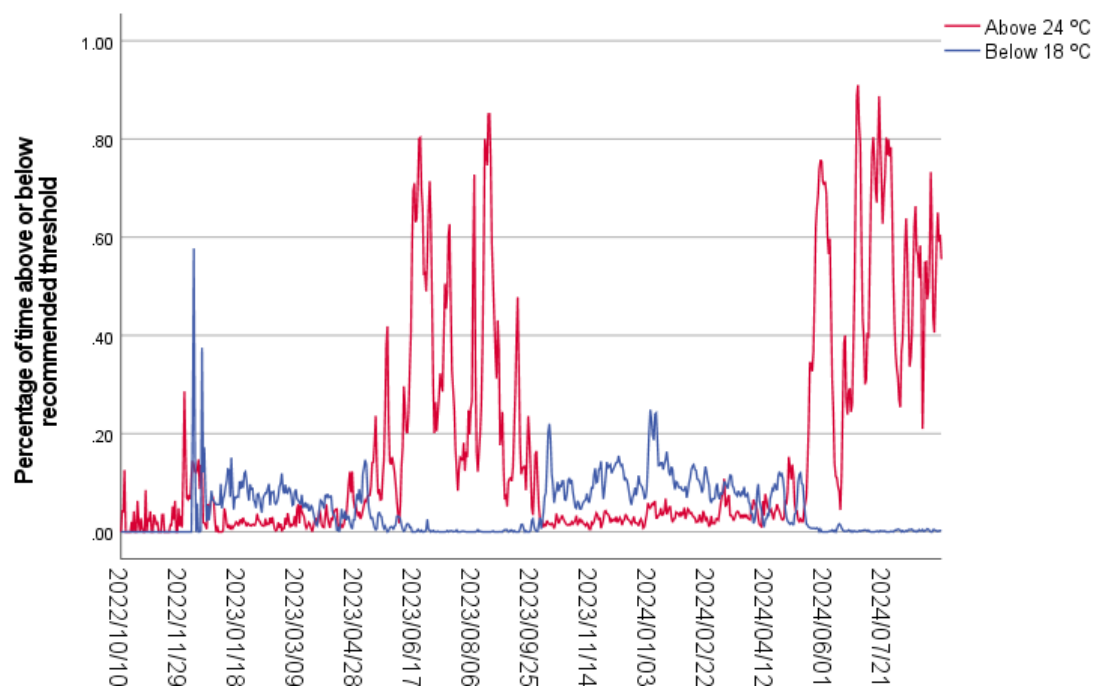
Table D 8. Temperature, Relative humidity, CO2 general descriptives Jelgava pilot site.

	Temperature (°C)			Relative Humidity (%)			CO_2 (ppm)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Spring	22.1	1.3	21.8	46.3	5.4	45.7	642	92	652
Summer	23.8	1.0	23.7	57.9	4.9	58	591	54	587
Autum	20.8	0.6	20.7	50.8	7.8	52.2	788	91	777
Winter	20.7	0.3	20.7	41.3	3.6	42.5	704	88	697
All seasons	22.1	1.6	21.5	49.7	8.4	49.1	665	107	657

Annex E – Results Obuda pilot site

Table E 1. Sociodemographic and lifestyle characteristics Obuda sample by intervention and control group WELLBASED at baseline (T0) (n=112)

	Intervention group N=82 (73.2%)	Control group N=30 (26.8%)	P-value
Gender[a], n (%)			0.86
Female	58 (70.7%)	20 (69.0%)	
Male	24 (29.3%)	9 (31.0%)	
Age (years)[a]			
Mean (SD)	55.66 (18.20)	59.76 (18.42)	0.30
Older people [b] (>65 years)	32 (39.0%)	16 (55.2%)	0.13
Marital status [a], n (%)			0.63
Married	19 (23.2%)	8 (27.6%)	
Single, separated, divorced or widowed	63 (76.8%)	21 (72.4%)	
Educational level [a], n (%)			**0.04**
Post-secondary or lower	41 (50.0%)	8 (27.6%)	
Higher education	41 (50.0%)	21 (72.4%)	
Household income category [a], n (%) (14 missing)			0.92
1-3	65 (79.3%)	24 (82.8%)	
4-6	14 (17.1%)	4 (13.8%)	
7-9	3 (3.7%)	1 (3.4%)	
Paid work [a], n(%)			0.61
Yes, by respondent only	23 (28.0%)	5 (17.2%)	
Yes, by respondent's partner only	5 (6.1%)	1 (3.4%)	
Yes, by respondent and their partner	16 (19.5%)	7 (24.1%)	
No	38 (46.3%)	16 (55.2%)	
Household composition[b], n (%)			0.66
Single-adult with children	1 (1.7%)	0	
Single-adult without children	37 (61.7%)	18 (75.0%)	
Two or more adults with children	10 (16.7%)	3 (12.5%)	

Two or more adults without children	12 (20.0%)	3 (12.5%)	
Migration background [a], n (%)			0.17
Yes	5 (6.1%)	0	
No	77 (93.9%)	29 (100%)	
Belonging to an ethnic minority[c], n (%)			0.54
Yes	1 (1.3%)	0	
No	75 (98.7%)	29 (100%)	
Dwelling type[d] , n (%)			**0.02**
Detached	1 (1.6%)	3 (12.5%)	
Semi-detached/terraced	1 (1.6%)	3 (12.5%)	
Apartment or flat	50 (80.6%)	16 (66.7%)	
Other	10 (16.1%)	2 (8.3%)	
Tenure status[d], n (%)			**<0.001**
Owner	20 (32.3%)	20 (83.3%)	
Rented at market rate	15 (24.2%)	2 (8.3%)	
Reduced rent/social housing/free rent	22 (35.5%)	1 (4.2%)	
Other	5 (8.1%)	1 (4.2%)	
BMI, mean (SD)	27.41 (5.48)	25.68 (5.36)	0.14
No. of chronic conditions			0.43
0	9 (11.0%)	5 (16.7%)	
1-2	35 (42.7%)	9 (30.0%)	
3 or more	38 (46.3%)	16 (53.3%)	
Smoker			0.38
yes	22 (26.8%)	7 (23.3%)	
no	43 (52.4%)	13 (43.3%)	
ex-smoker	17 (20.7%)	10 (33.3%)	
Average time spent inside the house during daytime [a]			0.27
0-3 hours	1 (1.2%)	0	
3-6 hours	29 (35.4%)	7 (24.1%)	
6-9 hours	26 (31.7%)	15 (51.7%)	
> 9 hours	26 (31.7%)	7 (24.1%)	
[a] 1 missing [b] 28 missing [c] 7 missing [d] 26 missing			

Table E 2. Health and well-being outcomes Obuda sample by intervention and control group WELLBASED at baseline (T0) (n=112)

	Intervention group N=82 (73.2%)	Control group N=30 (26.8%)	P-value
Health-related Quality of Life			
Overall HRQoL, n(%)			0.99
No or slight problems (1-10)	71 (86.6%)	26 (86.7%)	
Moderate, severe or extreme problems (11-25)	11 (13.4%)	4 (13.3%)	
Mobility, n(%)			0.87
No or slight problems	72 (87.8%)	26 (86.7%)	
Moderate, severe or extreme problems	10 (12.2%)	4 (13.3%)	
Self-care, n(%)			0.94
No or slight problems	79 (96.3%)	29 (96.7%)	
Moderate, severe or extreme problems	3 (3.7%)	1 (3.3%)	
Usual Activities, n(%)			0.32
No or slight problems	71 (86.6%)	28 (93.3%)	
Moderate, severe or extreme problems	11 (13.4%)	2 (6.7%)	
Pain/Discomfort, n(%)			0.99
No or slight problems	71 (86.6%)	26 (86.7%)	
Moderate, severe or extreme problems	11 (13.4%)	4 (13.3%)	
Anxiety/Depression, n(%)			0.63
No or slight problems	71 (86.6%)	27 (90.0%)	
Moderate, severe or extreme problems	11 (13.4%)	3 (10.0%)	
EQ VAS, mean (SD)	76.39 (18.78)	79.90 (17.61)	0.38
Mental health & well-being			
Depression [a]			0.18
Normal or mild	54 (65.9%)	23 (79.3%)	
Moderate, severe or extreme	28 (34.1%)	6 (20.7%)	
Anxiety [a]			0.45
Normal or mild	53 (64.6%)	21 (72.4%)	
Moderate, severe or extreme	29 (35.4%)	8 (27.6%)	
Stress [a]			0.51

	Normal or mild	60 (73.2%)	23 (79.3%)	
	Moderate, severe or extreme	22 (26.8%)	6 (20.7%)	
[a] 1 missing				

Table E 3. Energy poverty indicators Obuda sample by intervention and control group WELLBASED at baseline (T0) (n=112)

Variable	Intervention group N=82 (73.2%)	Control group N=30 (26.8%)	p-value
Dwelling comfortable warm in winter time [a]			0.79
Yes	72 (87.8%)	26 (89.7%)	
No	10 (12.2%)	3 (10.3%)	
Dwelling comfortably cool in summer time [a]			0.41
Yes	27 (32.9%)	12 (41.4%)	
No	55 (67.1%)	17 (58.6%)	
Presence of leak/damp/rot [b]			0.49
Yes	5 (8.5%)	1 (4.2%)	
No	54 (91.5%)	23 (95.8%)	
Arrears on utility bills [c]			0.11
Yes, once	6 (9.7%)	0	
Yes, twice or more	4 (6.5%)	0	
No	52 (83.9%)	24 (100%)	
Equipped with heating facilities [c]			0.81
Yes, central heating or similar	59 (95.2%)	23 (95.8%)	
Yes, other fixed heating	2 (3.2%)	1 (4.2%)	
Yes, non-fixed	1 (1.6%)	0	
Equipped with air conditioning (cooling) facilities [b]			0.41
Yes	20 (32.3%)	10 (41.7%)	
No	42 (67.7%)	14 (58.3%)	
Equipped with adequate electrical installations [c]			0.52
Yes	58 (98.3%)	24 (100%)	
No	1 (1.7%)	0	
Home satisfaction [a]			0.12

	12 (14.6%)	8 (27.6%)	
(very) dissatisfied	12 (14.6%)	8 (27.6%)	
(very) satisfied	70 (85.4%)	21 (72.4%)	
[a] 1 missing [b] 29 missing [c] 32 missing			

Table E 4. Energy consumption and costs Obuda sample by intervention and control group WELLBASED at baseline (T0) (n=112)

Variable	Intervention group N=82 (73.2%)	Control group N=30 (26.8%)	p-value
Household energy source			
Electricity[a], n (%)	58 (100%)	22 (100%)	n/a
Gas[b], n (%)	13 (22.8%)	12 (54.5%)	**0.007**
Derived heat/ district heating[a], n (%)	29 (50.0%)	7 (31.8%)	0.14
Other (e.g. oil/petroleum products, renewables or coal products)[c], n (%)	2 (3.2%)	3 (12.5%)	0.10
Monthly energy consumption			
Electricity (kWh)[d], mean (SD)	171.34 (178.20)	245.09 (155.02)	0.22
Gas (m^{3})[e], mean (SD)	114.00 (n/a)	149.74 (19.54)	n/a
Derived heat (kWj)[f], mean (SD)	74.83 (59.56)	0	n/a
Monthly energy costs,			
Electricity (€)[g], mean (SD)	31.85 (34.85)	31.36 (26.49)	0.96
Gas (€), mean (SD)	25.31 (10.81)	65.80 (87.26)	0.14
Derived heat (€)[h], mean (SD)	28.15 (26.49)	31.31 (35.24)	0.81
Other sources (€)[i], mean (SD)	31.38 (n/a)	2.70 (3.82)	n/a
Total energy costs[j], mean (SD)	52.01 (48.62)	78.93 (93.14)	0.23
Received support towards energy bills			
Yes, fixed amount of money [c], n (%)	7 (11.3%)	2 (8.3%)	0.69
Yes, percentage of costs refunded [c], n (%)	4 (6.5%)	1 (4.2%)	0.69
Yes, in kind contribution [c], n (%)	0	0	n/a

Yes, other type of support [c], n (%)	2 (3.2%)	2 (8.3%)	0.31

[a] 32 missing [b] 33 missing [c] 26 missing [d] 37 missing [e] 20 missing [f] 31 missing [g] 8 missing [h] 3 missing [i] 2 missing [j] 38 missing

Table E 5. Energy-related coping strategies in the past 12 months Obuda sample by intervention and control group WELLBASED at baseline (T0) (n=112)

Variable	Intervention group N=82 (73.2%)	Control group N=30 (26.8%)	p-value
Wearing extra clothes to keep warm [a]			0.62
Never or rarely	44 (53.7%)	14 (48.3%)	
Sometimes, often or always	38 (46.3%)	15 (51.7%)	
Turning heating/cooling off to save money [a]			0.82
Never or rarely	31 (37.8%)	10 (34.5%)	
Sometimes, often or always	43 (52.4%)	17 (58.6%)	
Not an option in my dwelling	8 (9.8%)	2 (6.9%)	
Heating/cooling only one room of the house to save money [a]			0.34
Never or rarely	43 (52.4%)	17 (58.6%)	
Sometimes, often or always	24 (29.3%)	10 (34.5%)	
Not an option in my dwelling	15 (18.3%)	2 (6.9%)	
Going to bed in the daytime to keep warm [a]			0.31
Never or rarely	54 (65.9%)	16 (55.2%)	
Sometimes, often or always	28 (34.1%)	13 (44.8%)	
Going to a public building to keep warm/ cool [a]			0.96
Never or rarely	79 (96.3%)	28 (96.6%)	
Sometimes, often or always	3 (3.7%)	1 (3.4%)	
Going to a neighbour or friends/relatives house to keep warm/cool [a]			0.30
Never or rarely	79 (96.3%)	29 (100%)	
Sometimes, often or always	3 (3.7%)	0	

				0.05
Bathing/showering less to save money [a]				
	Never or rarely	63 (76.8%)	27 (93.1%)	
	Sometimes, often or always	19 (23.2%)	2 (6.9%)	
Turning off lights in rooms that are being used to save money [a]				0.57
	Never or rarely	43 (52.4%)	17 (58.6%)	
	Sometimes, often or always	39 (47.6%)	12 (41.4%)	
Not cooking/eating cold food to save money [a]				0.23
	Never or rarely	69 (84.1%)	27 (93.1%)	
	Sometimes, often or always	13 (15.9%)	2 (6.9%)	
Avoided going to the doctor to save money [a]				0.16
	Never or rarely	56 (68.3%)	25 (86.2%)	
	Sometimes, often or always	10 (12.2%)	1 (3.4%)	
	Health care is for free in my country	16 (19.5%)	3 (10.3%)	
[a] 1 missing				

Table E 6. Within-group differences in health and well-being outcomes between baseline and 12-month follow-up in the Obuda pilot

Outcome	Intervention group		Control group	
	Baseline (n=75)	12-month follow-up (n=75)	Baseline (n=25)	12-month follow-up (n=25)
	n (%)	*n (%)*	*n (%)*	*n (%)*
Moderate to extremely severe problems in overall HrQoL	11 (14.7%)	12 (16.0%)	4 (16.0%)	3 (12.0%)
Moderate to extremely severe problems in mobility	10 (13.3%)	10 (13.3%)	4 (16.0%)	2 (8.0%)
Moderate to extremely severe problems in self-care	3 (4.0%)	3 (4.0%)	1 (4.0%)	3 (12.0%)
Moderate to extremely severe problems in usual activities	10 (13.3%)	8 (10.7%)	2 (8.0%)	2 (8.0%)
Moderate to extremely severe problems in pain/ Discomfort	11 (14.7%)	13 (17.3%)	3 (12.0%)	3 (12.0%)

Moderate to extremely severe problems in anxiety/ depression	10 (13.3%)	11 (14.7%)	3 (12.0%)	4 (16.0%)
	Mean (SD)		*Mean (SD)*	
EQ VAS	76.01 (19.32)	77.67 (18.24)	79.64 (17.33)	73.84 (19.28)
	n (%)		*n (%)*	
Moderate to extreme depression	28 (37.3%)	22 (29.3%)	6 (24.0%)	7 (28.0%)
Moderate to extreme anxiety	29 (38.7%)	20 (26.7%)	7 (28.0%)	5 (20.0%)
Moderate to extreme stress	22 (29.3%)	24 (32.0%)	6 (24.0%)	4 (16.0%)

Table E 7. Within-group differences in energy outcomes between baseline and 12-month follow-up in the Obuda pilot

Outcome	Intervention group		Control group	
	Baseline (n=75)	**12-month follow-up (n=75)**	**Baseline (n=25)**	**12-month follow-up (n=25)**
	n (%)	*n (%)*	*n (%)*	*n (%)*
Comfortably warm in winter time	66 (88.0%)	65 (86.7%)	22 (88.0%)	18 (72.0%)
Comfortably cool in summer time	26 (34.7%)	34 (45.3%)	10 (40.0%)	14 (56.0%)
	Mean (SD)		*Mean (SD)*	
Total energy costs*a	53.44 (52.90)	47.29 (43.42)	74.16 (72.89)	67.36 (68.48)
Coping behaviours (sum 0-50)	21.48 (6.28)	20.27 (6.12)	19.88 (6.00)	18.72 (8.03)

*Total energy costs include costs for electricity, gas, derived heat and other energy sources [a] 41 missing

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Figure E 1. Daily average indoor and outdoor humidity levels in households in Obuda.
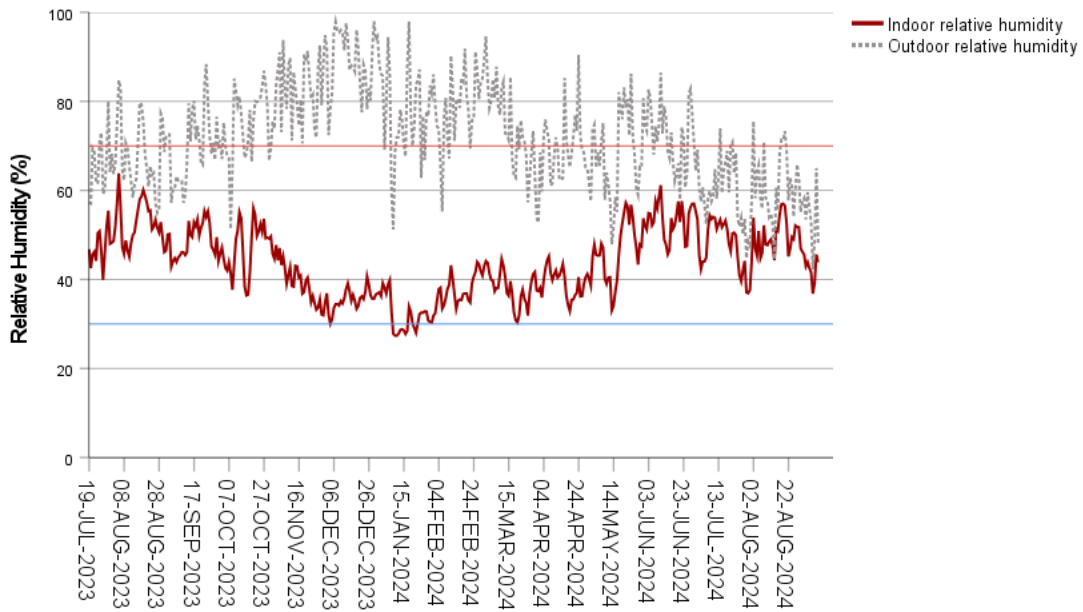
Figure E 2. Daily average indoor and outdoor temperature in households in Obuda.
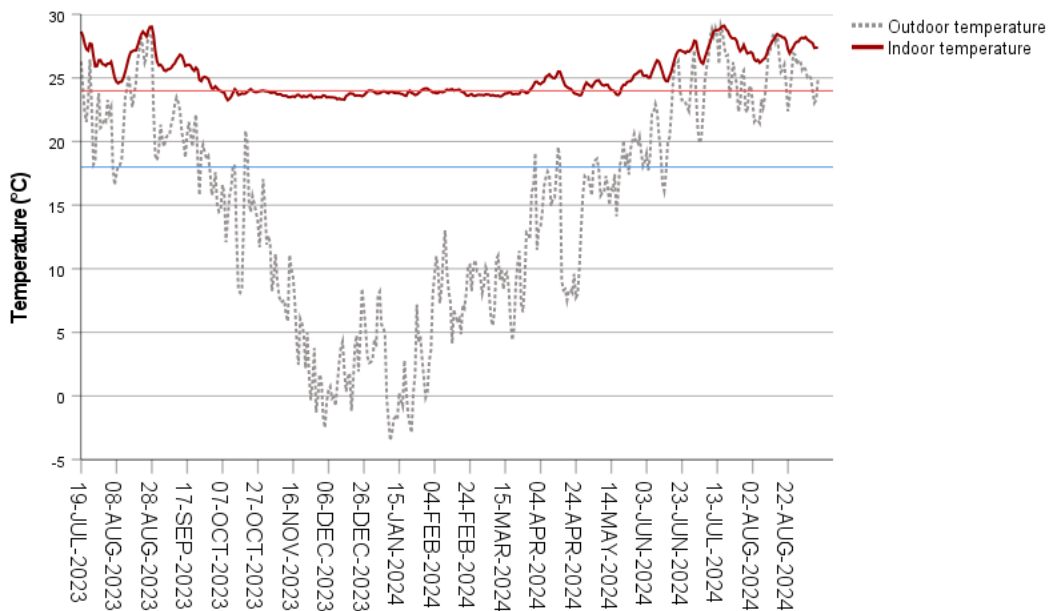
Figure E 3. Daily average indoor CO2 levels in households in Obuda.
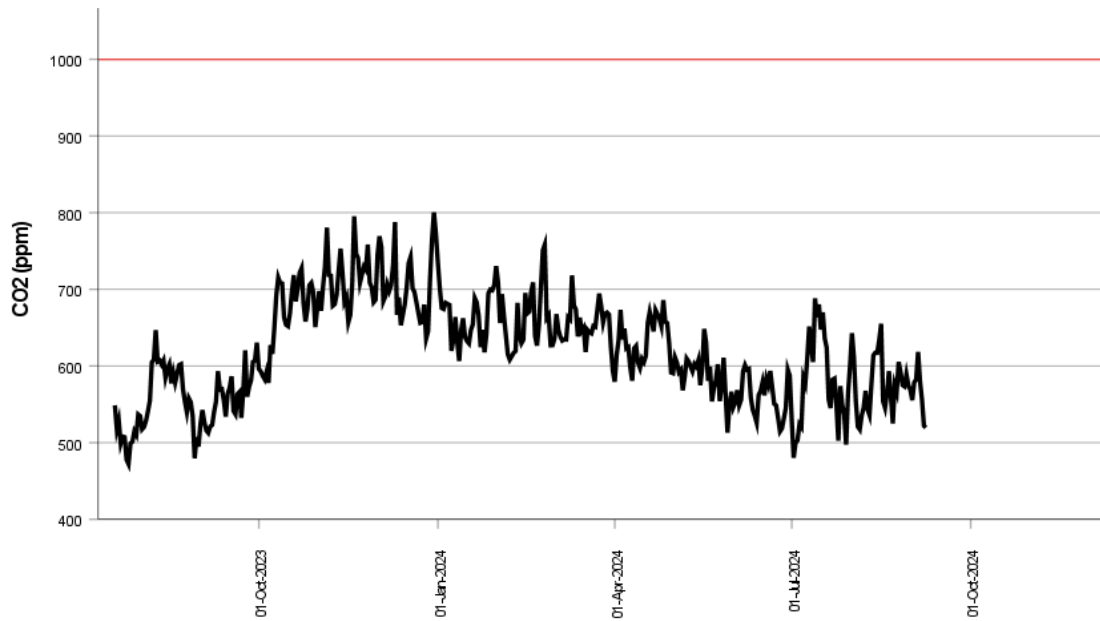
Figure E 4. Daily average percentage above 24 °C or below 18 °C in Obuda households.
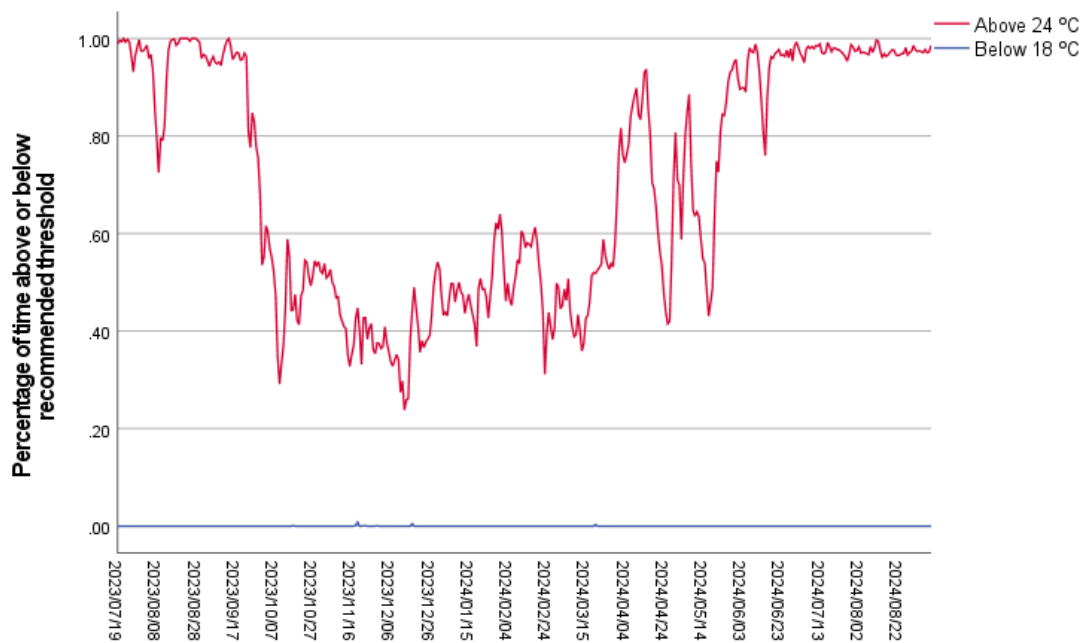
Table E 8. Temperature, Relative humidity, CO2 general descriptives Obuda pilot site.

	Temperature (°C)			Relative Humidity (%)			CO_2 (ppm)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Spring	24.7	0.7	24.6	44.3	7.5	42.2	607	41	600
Summer	27.1	1.1	27.1	49.3	5.1	49.6	562	44	556
Autum	23.8	0.4	23.6	42.1	7.0	41.6	684	52	693
Winter	23.8	0.2	23.8	35.7	4.6	36.3	665	39	657
All seasons	25.2	1.7	24.4	43.7	7.9	44.0	620	67	617

Annex F – Results Leeds pilot site

Table F 1. Sociodemographic and lifestyle characteristics Leeds sample by intervention and control group WELLBASED at baseline (T0) (n=200)

	Intervention group N=10 (5%)	Control group N=190 (95%)	P-value*
Gendera, n (%)			n/a
Female	5 (55.6%)	130 (69.9%)	
Male	4 (44.4%)	56 (30.1%)	
Age (years)a			
Mean (SD)	45.44 (14.53)	47.01 (13.43)	n/a
Older people a (>65 years)	1 (11.1%)	16 (8.6%)	
Marital status b , n (%)			n/a
Married	1 (12.5%)	34 (18.5%)	
Single, separated, divorced or widowed	7 (87.5%)	150 (81.5%)	
Educational level a, n (%)			n/a
Post-secondary or lower	7 (77.8%)	125 (67.2%)	
Higher education	2 (22.2%)	61 (32.8%)	
Household income category c, n (%) (14 missing)			n/a
1-3	5 (62.5%)	97 (53.0%)	
4-6	3 (37.5%)	63 (34.4%)	
7-9	0	23 (12.6%)	
Paid work a, n(%)			n/a
Yes, by respondent only	3 (37.5%)	59 (32.1%)	
Yes, by respondent's partner only	0	7 (3.8%)	
Yes, by respondent and their partner	1 (12.5%)	15 (8.2%)	
No	4 (50.0%)	103 (56.0%)	
Household compositiond, n (%)			n/a
Single-adult with children	0	34 (21.8%)	
Single-adult without children	4 (100%)	56 (35.9%)	
Two or more adults with children	0	32 (20.5%)	

Two or more adults without children	0	34 (21.8%)	
Migration background a, n (%)			n/a
Yes	4 (44.4%)	13 (7.0%)	
No	5 (55.6%)	173 (93.0%)	
Belonging to an ethnic minoritye, n (%)			n/a
Yes	3 (37.5%)	19 (11.2%)	
No	5 (62.5%)	150 (88.8%)	
Dwelling typef , n (%)			n/a
Detached	0	3 (1.9%)	
Semi-detached/terraced	0	90 (57.3%)	
Apartment or flat	4 (100%)	54 (34.4%)	
Other	0	10 (6.4%)	
Tenure statusf, n (%)			n/a
Owner	0	3 (1.9%)	
Rented at market rate	0	66 (42.0%)	
Reduced rent/social housing/free rent	4 (100%)	86 (54.8%)	
Other	0	2 (1.3%)	
BMI g, mean (SD)	25.36 (4.05)	30.15 (8.22)	n/a
No. of chronic conditionsh			n/a
0	0	23 (12.3%)	
1-2	5 (55.6%)	61 (32.6%)	
3 or more	4 (44.4%)	103 (55.1%)	
Smoker h			n/a
yes	1 (11.1%)	56 (29.9%)	
no	5 (55.6%)	55 (29.4%)	
ex-smoker	3 (33.3%)	76 (40.6%)	
Average time spent inside the house during daytime b			n/a
0-3 hours	2 (25.0%)	11 (6.0%)	
3-6 hours	2 (25.0%)	36 (19.6%)	
6-9 hours	1 (12.5%)	45 (24.5%)	
> 9 hours	3 (37.5%)	92 (50.0%)	

*no p-value calculated due to low sample size in the intervention group (n=10) a 5 missing b 8 missing c 9 missing d 40 missing e 23 missing f 39 missing g 16 missing h 4 missing

Table F 2. Health and well-being outcomes Leeds sample by intervention and control group WELLBASED at baseline (T0) (n=200)

	Intervention group N=10 (5%)	Control group N=190 (95%)	P-value*
Health-related Quality of Life			
Overall HRQoL[a], n(%)			n/a
No or slight problems (1-10)	6 (60.0%)	99 (52.7%)	
Moderate, severe or extreme problems (11-25)	4 (40.0%)	89 (47.3%)	
Mobility, n(%)			n/a
No or slight problems	8 (80.0%)	133 (70.0%)	
Moderate, severe or extreme problems	2 (20.0%)	57 (30.0%)	
Self-care[b], n(%)			n/a
No or slight problems	8 (80.0%)	150 (79.4%)	
Moderate, severe or extreme problems	2 (20.0%)	39 (20.6%)	
Usual Activities[b], n(%)			n/a
No or slight problems	7 (70.0%)	122 (64.6%)	
Moderate, severe or extreme problems	3 (30.0%)	67 (35.4%)	
Pain/Discomfort[b], n(%)			n/a
No or slight problems	5 (50.0%)	105 (55.6%)	
Moderate, severe or extreme problems	5 (50.0%)	84 (44.4%)	
Anxiety/Depression[a], n(%)			n/a
No or slight problems	7 (70.0%)	100 (53.2%)	
Moderate, severe or extreme problems	3 (30.0%)	88 (46.8%)	
EQ VAS[a], mean (SD)	53.70 (28.96)	61.47 (24.74)	n/a
Mental health & well-being			
Depression [c]			n/a
Normal or mild	6 (66.7%)	95 (50.8%)	
Moderate, severe or extreme	3 (33.3%)	92 (49.2%)	

	Intervention	Control	
Anxiety [c]			n/a
Normal or mild	7 (77.8%)	99 (52.9%)	
Moderate, severe or extreme	2 (22.2%)	88 (47.1%)	
Stress [c]			n/a
Normal or mild	6 (66.7%)	125 (66.8%)	
Moderate, severe or extreme	3 (33.3%)	62 (33.2%)	

[*] no p-value calculated due to low sample size in the intervention group (n=10) [a] 2 missing [b] 1 missing [c] 4 missing

Table F 3. Energy poverty indicators Leeds sample by intervention and control group WELLBASED at baseline (T0) (n=200)

Variable	Intervention group N=10 (5%)	Control group N=190 (95%)	p-value*
Dwelling comfortable warm in winter time [a]			n/a
Yes	2 (22.2%)	89 (48.1%)	
No	7 (77.8%)	96 (51.9%)	
Dwelling comfortably cool in summer time [a]			n/a
Yes	4 (44.4%)	99 (53.5%)	
No	5 (55.6%)	86 (46.5%)	
Presence of leak/damp/rot [b]			n/a
Yes	1 (25.0%)	56 (38.6%)	
No	3 (75.0%)	89 (61.4%)	
Arrears on utility bills [c]			n/a
Yes, once	0	18 (11.5%)	
Yes, twice or more	1 (25.0%)	47 (29.9%)	
No	3 (75.0%)	92 (58.6%)	
Equipped with heating facilities [c]			n/a
Yes, central heating or similar	3 (75.0%)	154 (98.1%)	
Yes, other fixed heating	1 (25.0%)	2 (1.3%)	
Yes, non-fixed	0	1 (0.6%)	
Equipped with air conditioning (cooling) facilities [d]			n/a

	Yes	0	1 (0.6%)	
	No	4 (100%)	155 (99.4%)	
Equipped with adequate electrical installations [e]				n/a
	Yes	4 (100%)	140 (92.7%)	
	No	0	11 (7.3%)	
Home satisfaction [a]				n/a
	(very) dissatisfied	4 (44.4%)	71 (38.4%)	
	(very) satisfied	5 (55.6%)	114 (61.6%)	

*no p-value calculated due to low sample size in the intervention group (n=10) [a] 6 missing [b] 51 missing [c] 39 missing [d] 40 missing [e] 45 missing

Table F 4. Energy consumption and costs Leeds sample by intervention and control group WELLBASED at baseline (T0) (n=200)

Variable	Intervention group N=10 (5%)	Control group N=190 (95%)	p-value*
Household energy source			
Electricity[a], n (%)	4 (100%)	155 (100%)	n/a
Gas[a], n (%)	0	135 (87.1%)	n/a
Derived heat/ district heating[a], n (%)	0	3 (1.9%)	n/a
Other (e.g. oil/petroleum products, renewables or coal products)[b], n (%)	1 (25.0%)	2 (1.3%)	n/a
Monthly energy consumption			
Electricity (kWh)[c], mean (SD)	77.47 (n/a)	276.84 (241.93)	n/a
Gas (m3)[d], mean (SD)	n/a	93.75 (91.22)	n/a
Derived heat (kWj)[e], mean (SD)	n/a	n/a	n/a
Monthly energy costs,			
Electricity (€)[f], mean (SD)	141.37 (169.22)	120.05 (82.87)	n/a
Gas (€)[g], mean (SD)	n/a	113.62 (81.29)	n/a
Derived heat (€)[h], mean (SD)	n/a	57.9 (50.25)	n/a
Other sources (€)[i], mean (SD)	n/a	n/a	n/a

	Total energy costs[j], mean (SD)	141.37 (169.22)	201.06 (141.95)	n/a
Received support towards energy bills				n/a
	Yes, fixed amount of money [b], n (%)	2 (50.0%)	26 (16.6%)	
	Yes, percentage of costs refunded [c], n (%)	0	1 (0.6%)	
	Yes, in kind contribution [c], n (%)	0	2 (1.3%)	
	Yes, other type of support [c], n (%)	1 (25.0%)	17 (10.8%)	
[*] no p-value calculated due to low sample size in the intervention group (n=10) [a] 41 missing [b] 39 missing [c] 132 missing [d] 125 missing [e] 3 missing [f] 44 missing [g] 42 missing [h] 1 missing [i] 3 missing [j] 77 missing				

Table F 5. Energy-related coping strategies in the past 12 months Leeds sample by intervention and control group WELLBASED at baseline (T0) (n=200)

Variable	Intervention group N=10 (5%)	Control group N=190 (95%)	p-value*
Wearing extra clothes to keep warm [a]			n/a
	Never or rarely	1 (11.1%)	25 (13.5%)	
	Sometimes, often or always	8 (88.9%)	160 (86.5%)	
Turning heating/cooling off to save money [a]			n/a
	Never or rarely	2 (22.2%)	21 (11.4%)	
	Sometimes, often or always	7 (77.8%)	163 (88.1%)	
	Not an option in my dwelling	0	1 (0.5%)	
Heating/cooling only one room of the house to save money [a]			n/a
	Never or rarely	1 (11.1%)	61 (33.0%)	
	Sometimes, often or always	8 (88.9%)	117 (63.2%)	
	Not an option in my dwelling	0	7 (3.8%)	
Going to bed in the daytime to keep warm [a]			n/a
	Never or rarely	3 (33.3%)	97 (52.4%)	
	Sometimes, often or always	6 (66.7%)	88 (47.6%)	

				n/a
Going to a public building to keep warm/ cool [a]				n/a
Never or rarely	5 (55.6%)	144 (77.8%)		
Sometimes, often or always	4 (44.4%)	41 (22.2%)		
Going to a neighbour or friends/relatives house to keep warm/cool [a]				n/a
Never or rarely	5 (55.6%)	146 (78.9%)		
Sometimes, often or always	4 (44.4%)	39 (21.1%)		
Bathing/showering less to save money [a]				n/a
Never or rarely	4 (44.4%)	77 (41.6%)		
Sometimes, often or always	5 (55.6%)	108 (58.4%)		
Turning off lights in rooms that are being used to save money [a]				n/a
Never or rarely	2 (22.2%)	32 (17.3%)		
Sometimes, often or always	7 (77.8%)	153 (82.7%)		
Not cooking/eating cold food to save money [a]				n/a
Never or rarely	5 (55.6%)	87 (47.0%)		
Sometimes, often or always	4 (44.4%)	98 (53.0%)		
Avoided going to the doctor to save money [a]				n/a
Never or rarely	6 (66.7%)	103 (55.7%)		
Sometimes, often or always	0	36 (19.5%)		
Health care is for free in my country	3 (33.3%)	46 (24.9%)		
*no p-value calculated due to low sample size in the intervention group (n=10) [a] 6 missing				

Table F 6. Within-group differences in health and well-being outcomes between baseline and 12-month follow-up in the Leeds pilot

	Intervention group		Control group	
Outcome	**Baseline (n=5)**	**12-month follow-up (n=5)**	**Baseline (n=101)**	**12-month follow-up (n=101)**
	n (%)	*n (%)*	*n (%)*	*n (%)*

Moderate to extremely severe problems in overall HrQoL[a]	2 (40.0%)	2 (40.0%)	43 (43.0%)	43 (43.0%)
Moderate to extremely severe problems in mobility	0	2 (40.0%)	27 (26.7%)	34 (33.7%)
Moderate to extremely severe problems in self-care[a]	0	0	20 (20.0%)	24 (24.0%)
Moderate to extremely severe problems in usual activities[a]	1 (20.0%)	2 (40.0%)	32 (32.0%)	33 (33.0%)
Moderate to extremely severe problems in pain/ Discomfort[a]	2 (40.0%)	2 (40.0%)	42 (42.0%)	45 (45.0%)
Moderate to extremely severe problems in anxiety/ depression[a]	0	0	43 (43.0%)	45 (45.0%)
	Mean (SD)		*Mean (SD)*	
EQ VAS[a]	63.40 (31.33)	61.20 (21.05)	63.09 (24.95)	64.30 (24.36)
	n (%)		*n (%)*	
Moderate to extreme depression[a]	0	0	36 (36.0%)	42 (42.0%)
Moderate to extreme anxiety [a]	0	1 (20.0%)	38 (38.0%)	45 (45.0%)
Moderate to extreme stress [a]	0	0	27 (27.0%)	31 (31.0%)
[a] 1 missing				

Table F 7. Within-group differences in energy outcomes between baseline and 12-month follow-up in the Leeds pilot

Outcome	Intervention group			
	Baseline (n=5)	12-month follow-up (n=5)	Baseline (n=101)	12-month follow-up (n=101)
	n (%)	*n (%)*	*n (%)*	*n (%)*
Comfortably warm in winter time [a]	2 (40.0%)	4 (80.0%)	50 (50.5%)	52 (52.5%)

Comfortably cool in summer time [a]	2 (40.0%)	3 (60.0%)	54 (54.5%)	64 (64.6%)
	Mean (SD)		*Mean (SD)*	
Total energy costs*[b]	43.85 (14.55)	154.61 (138.27)	163.60 (113.98)	166.88 (91.67)
Coping behaviours (sum 0-50)[a]	22.40 (4.34)	17.20 (3.96)	27.12 (8.30)	25.63 (9.16)
*Total energy costs include costs for electricity, gas, derived heat and other energy sources [a] 2 missing [b] 52 missing				

Figure F 1 . Daily average indoor and outdoor humidity levels in households in Leeds.
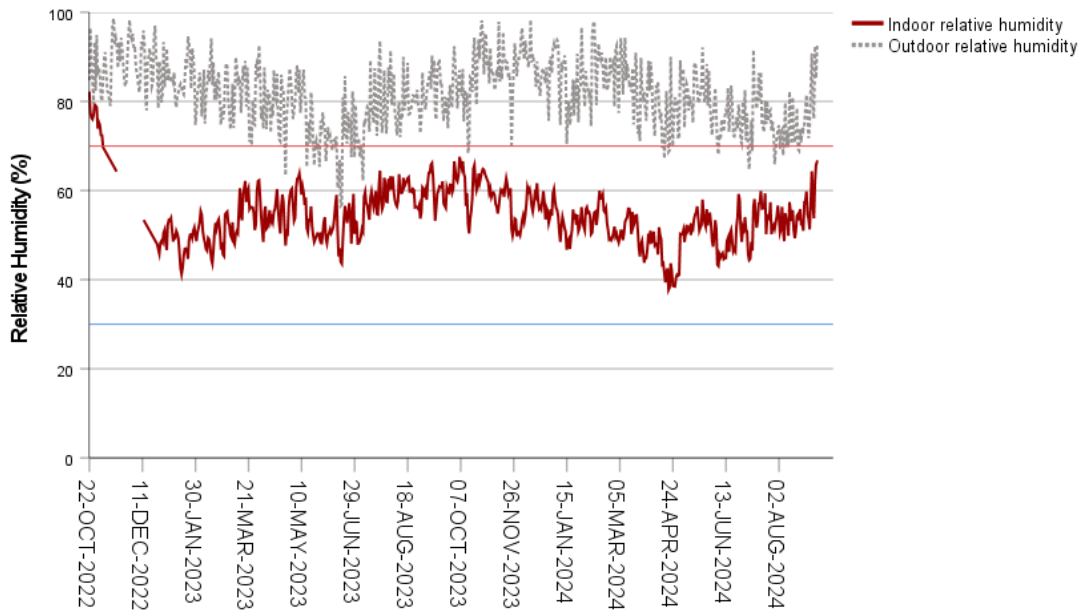
Figure F 2. Daily average indoor and outdoor temperature in households in Leeds.
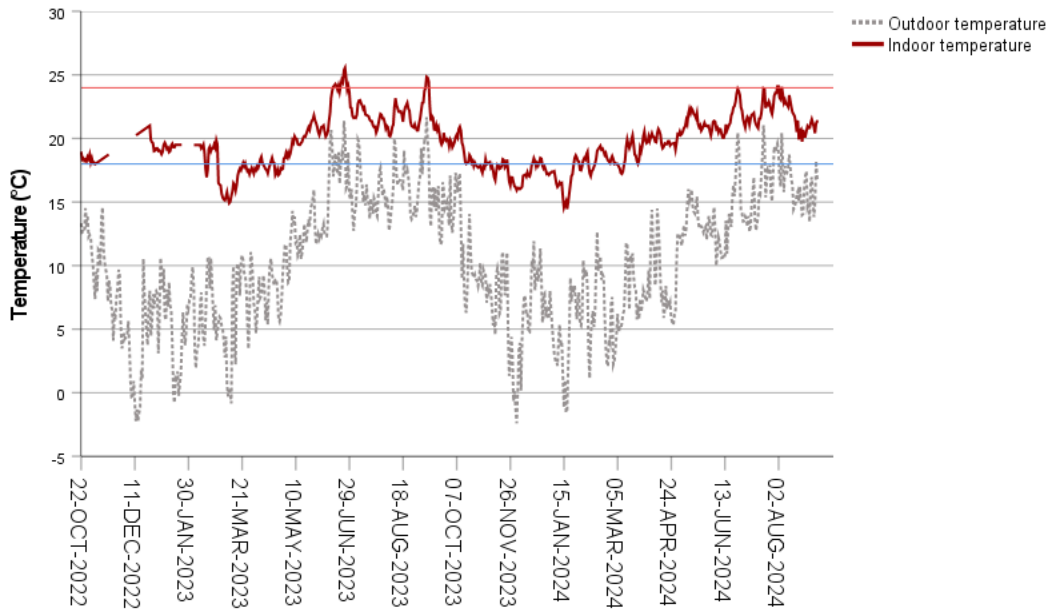
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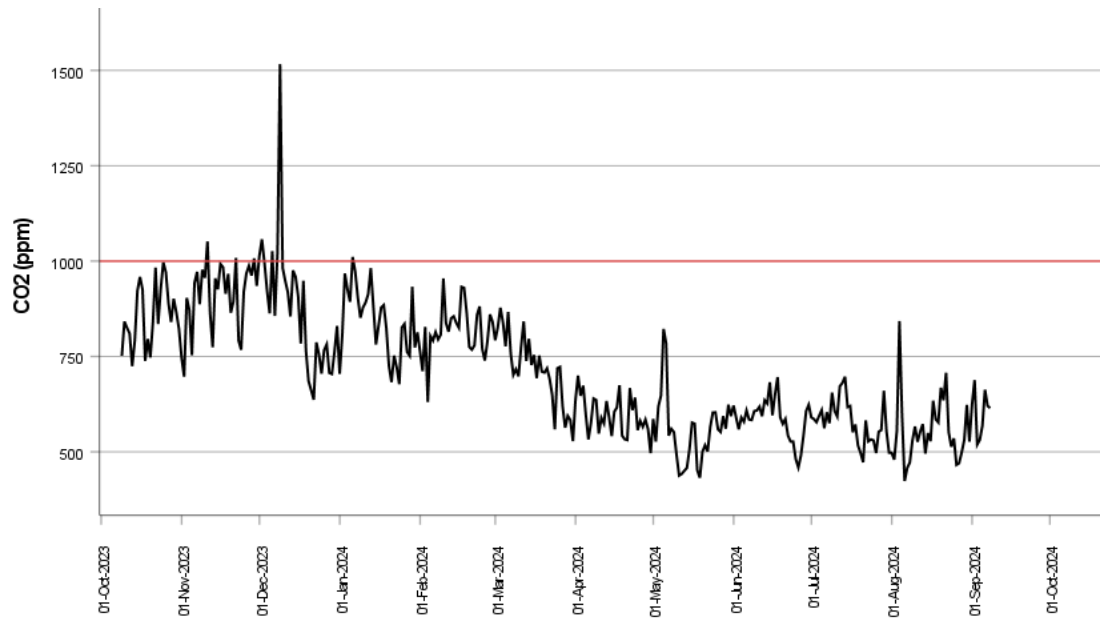
Figure F 4. Daily average percentage above 24 °C or below 18 °C in Leeds households.
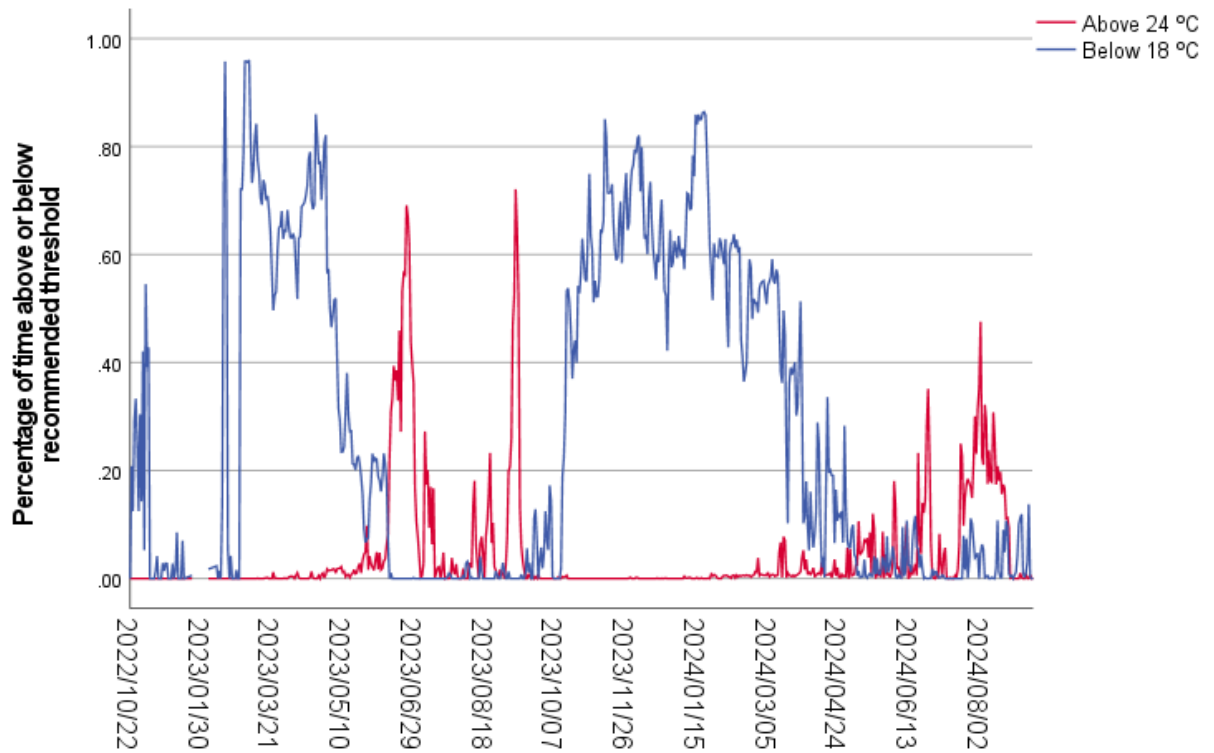
Table F 8. Temperature, Relative humidity, CO2 general descriptives Leeds pilot site.

	Temperature (°C)			Relative Humidity (%)			CO_2 (ppm)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Spring	19.6	2.0	19.9	52.9	5.8	52.8	590	71	589
Summer	22.1	1.0	22.0	56.5	4.7	56.4	567	70	557
Autum	17.2	1.8	17.1	62.5	4.2	63.3	904	116	919
Winter	16.4	1.7	16.7	57.6	4.6	57.9	805	81	797
All seasons	19.1	2.7	19.4	56.7	6.0	56.6	724	164	712

Annex G - Results for follow-up at 15/18-month follow-up

Changes in the main health, well-being and energy outcomes between the control and intervention group at 18-month follow-up (15-month follow-up in practice) (corrected for age, gender, education and baseline status of the outcome measure) were calculated. Analyses were performed for all pilots together (Table G1).

At 15/18-month follow-up there were no significant differences in overall health-related quality of life, depression, anxiety, and stress, comparing the intervention and the control group for the overall sample. Likewise, there were no significant differences regarding the energy poverty indicators 'comfortably warm in wintertime' and 'comfortably cool in summertime', and in total energy costs and coping behaviours adopted by participants.

Although not significant, some outcomes were improved at 15/18-month follow-up when looking at the Odds Ratios. For example, the odds ratio for overall HrQoL was 2.41 at 12-months and 0.80 at 15/18-months, and the odds ratio for the energy poverty indicator 'comfortably warm in wintertime-yes' was 1.39 for the intervention group at 15/18-month follow-up.

Table G 1 Main outcomes at 15/18-month follow-up, differences between intervention and control group

	All pilots(n=948)	
	Intervention group	
	OR* (95% CI)	p value
Overall HrQoL[c]		
Moderate to severe problems	0.80 (0.44 - 1.45)	0.46
Depression[a]		
Moderate to severe	0.72 (0.37 - 1.40)	0.33
Anxiety[a]		
Moderate to severe	0.96 (0.49 - 1.88)	0.90
Stress[b]		
Moderate to severe	1.15 (0.45 - 2.95)	0.77

Comfortably warm in winter time[d]		
Yes	1.39 (0.32 - 6.08)	0.66
Comfortably cool in summer time[d]		
Yes	0.89 (0.18 - 4.45)	0.89
	B* (SE)	**p value**
Total energy costs in Euro's**[e]	-20.26 (9.60)	0.86
Coping behaviours (sum 0-50)[a]	-2.14 (0.63)	0.91

*Values are random-intercept linear mixed model regression coefficients adjusted for age, gender, income and baseline value of the outcome of interest. Results are presented as Odds Ratios (OR) for categorical variables and Beta's for continuous variables including a 95% Confidence Interval (CI).

** Total energy costs include costs for electricity, gas, derived heat and other energy sources

[a] 82 missing [b] 84 missing [c] 95 missing [d] 83 missing [e] 327 missing

Annex H - Gender stratified analyses

Regarding gender, changes in the main health, well-being and energy outcomes between the control and intervention group at 12-month follow-up (corrected for age, education and baseline status of the outcome measure) were calculated for women and men separately (table H1). Analyses were performed for all pilots together. Table H1 shows no significant differences for men or women.

Table H 1 Main outcomes at 12-month follow-up, differences between intervention and control group by gender

	Men (n=326)		Women (n=605)		Total sample (n=988)	
	OR* (95% CI)	p value	OR* (95% CI)	p value	OR* (95% CI)	p value
Overall HrQoL[c]						
Moderate to severe problems	1.04 (0.36 - 2.99)	0.94	2.60 (0.59 - 11.50)	0.21	2.41 (0.68 - 8.51)	0.17
Depression[a]						
Moderate to severe problems	0.70 (0.21 - 2.33)	0.56	0.81 (0.35 - 1.88)	0.62	0.81 (0.38 - 1.75)	0.59
Anxiety[a]						
Moderate to severe problems	0.97 (0.27 - 3.49)	0.96	0.88 (0.36 - 2.14)	0.77	0.86 (0.34 - 2.20)	0.76
Stress[b]						
Moderate to severe problems	2.21 (0.19 - 26.05)	0.53	1.65 (0.27 - 10.08)	0.59	1.58 (0.29 - 8.68)	0.60
Comfortably warm in winter time[d]						
Yes	0.62 (0.12 - 3.25)	0.58	0.90 (0.26 - 3.05)	0.86	0.87 (0.24 - 3.11)	0.83
Comfortably cool in summer time[d]						

	B* (SE)	p value	B* (SE)	p value	B* (SE)	p value
Yes	0.59 (0.15 - 2.22)	0.43	0.49 (0.12 - 1.92)	0.30	0.51 (0.14 - 1.86)	0.31
	B* (SE)	**p value**	**B* (SE)**	**p value**	**B* (SE)**	**p value**
*Total energy costs in Euro's**[e]*	6.46 (13.92)	0.36	21.00 (11.13)	0.16	16.70 (8.13)	0.14
Coping behaviours (sum 0-50)[f]	-0.12 (1.56)	0.52	-0.46 (2.00)	0.57	-0.39 (1.79)	0.57

*Values are random-intercept linear mixed model regression coefficients adjusted for age, gender, income and baseline value of the outcome of interest. Results are presented as Odds Ratios (OR) for categorical variables and Beta's for continuous variables including a 95% Confidence Interval (CI).

** Total energy costs include costs for electricity, gas, derived heat and other energy sources

[a] 84 missing [b] 86 missing [c] 88 missing [d] 90 missing [e] 520 missing [f] 89 missing

Annex I - Cost results overall and per pilot site

I-1 Health care costs

The healthcare costs were determined by multiplying the resource use (number of appointments with health care professional and hospitalized nights) with the corresponding unit prices for 2024. Resource use was collected using 2 items of the SMRC Health Care utilization questionnaire regarding the number of doctor appointments, Accident & Emergency (A&E) visits as well as the number of days hospitalized in the last 6 months.

Table I1 shows the resource use at baseline (T0) and at 12-month follow-up (T2) for the intervention group and the results of the paired t-test. Table I2 shows the resource use at baseline and 12-month follow-up for the control group and the results of the paired t-test. In the intervention group, the number of doctor appointments, A&E visits and days hospitalised decreased, but only significantly for A&E visits. In the control group, use of all three resources decreased significantly.

Table I 1. Resource use of intervention participants at baseline (T0) and at follow-up (T2)

	n (paired)	T0	T2	p-value[+]
Number of doctor appointments	504	3.4 (5.2)	2.9 (5.6)	0.13
Number of Accident & Emergency visits	504	0.7 (2.3)	0.3 (0.8)	0.002
Number of days hospitalised	500	0.4 (2.0)	0.5 (3.8)	0.57

Data are mean (SD)
[+] P-value based on paired t-test

Table I 2. Resource use of control participants at baseline (T0) and at follow-up (T2)

	n (paired)	T0	T2	p-value[+]
Number of doctor appointments	463	3.1 (8.0)	1.9 (3.6)	0.001
Number of Accident & Emergency visits	462	0.7 (1.6)	0.4 (1.1)	<0.001
Number of days hospitalised	458	0.7 (3.3)	0.2 (1.6)	0.003

Data are mean (SD)
[+] P-value based on paired t-test

To estimate health care costs, the unit prices of the two resources are needed. The unit prices are based on the 2024 Dutch unit prices that are provided by the Dutch Guidelines for carrying out economic evaluations. The Dutch unit prices of 2024 were then adjusted using the Organisation for Economic Co-operation and Development (OECD) Purchasing Power Parities (PPPs) for the actual individual consumption to reflect the 2024 unit prices in the countries of the other pilot sites. Exchange rates to convert the Pound, Lira and Forint to euros were applied as described in the methods section. As the Dutch unit prices are already from 2024, no adjustment needed to be done for inflation.

Table I3 shows the calculated unit prices used for the valuation of the resource use in the six pilot sites. The calculated unit prices are rounded off by 2 decimals in the table, however, calculations are done with the entire number.

Table I 3. Unit prices used for the valuation of resource use of each country (for 2024; in euros)

	Heerlen (The Netherlands)	Valencia (Spain)	Edirne (Turkey)	Jelgava (Latvia)	Obuda (Hungary)	Leeds (United Kingdom)
OECD PPP's 2022	reference	0.586	6.087	0.513	164.856	0.716
Doctor appointments	120	70.32	28.49	61.56	53.41	99.67
Accident & Emergency visits	258	151.19	61.25	132.35	114.84	214.28
Number of days hospitalised	644	377.38	152.88	330.37	286.65	534.88

*reference for the Dutch unit prices 2024: https://www.zorginstituutnederland.nl/over-ons/publicaties/publicatie/2024/01/16/richtlijn-voor-het-uitvoeren-van-economische-evaluaties-in-de-gezondheidszorg

**Using OECD PPPs 2022 for actual individual consumption: https://stats.oecd.org/Index.aspx?DataSetCode=CPL#

The following tables demonstrate the mean use of the three resources per participant at baseline (T0) and follow-up (T2), for each pilot site there are two tables; one for intervention group and one for control group. With the mean resource use, the health care costs per participant at baseline and follow-up were calculated

as well as the change in health care costs between baseline and follow-up. Calculation was performed by multiplying the mean resource use with the unit price.

For example, intervention group participants in Valencia pilot site reported a mean number of 4.29 doctor appointments at baseline. When multiplied with the unit price (70.32 euros), the mean costs are 301.67 euros. At follow-up the mean costs are 256.67 euros, resulting in a decrease of 45.01 euro. In terms of the hospitalised nights, the mean number also decreased leading to a decrease of 98.27 euros between baseline and follow-up. Combining the three resources for the Valencia pilot site intervention group, the total decrease is 218.75 euros per participant. In Valencia pilot site control group, there is also a decrease of 382.30 euros per participant when combining the three resources. Similarly in Edirne, Jelgava and Obuda, in both intervention and control group there were health care costs savings. Heerlen has increased costs in both groups, but a larger increase in the intervention group. Leeds had a slight increase in costs in the intervention group, and a decrease in the control group. Please note all numbers in below tables are rounded off for practical reasons, but calculations are performed with the entire number.

Table I 4. Valencia Intervention group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	To			T2			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	111	4.29	70.32	301.67	3.65	70.32	256.67	-45.01
Accident & Emergency visit	111	1.11	151.19	167.82	0.46	151.19	69.55	-98.27
Number of days hospitalised	111	0.33	377.38	124.54	0.13	377.38	49.06	-75.48
				594.03			375.27	-218.75

Table I 5. Valencia control group – healthcare costs per participant at baseline (T0) and at follow-up (T1)

	n (paired)	T0			T2			Δ Health care costs (euro)
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	
Number of doctor appointments	129	2.64	70.32	185.64	1.73	70.32	121.65	-63.99
Accident & Emergency visit	129	0.91	151.19	137.58	0.31	151.19	46.87	-90.71
Number of days hospitalised	129	0.47	377.38	177.37	0.01	377.38	3.77	-173.60
				500.60			172.30	-328.30

Table I 6. Heerlen Intervention group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	T0			T2			Δ Health care costs (euro)
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	
Number of doctor appointments	83	2.98	120	357.60	4.39	120	526.80	169.20
Accident & Emergency visit	84	0.31	258	79.98	0.33	258	85.14	5.16
Number of days hospitalised	84	0.27	644	173.88	1.87	644	1204.28	1030.40
				611.46			1816.22	1204.76

Table I 7. Heerlen control group – healthcare costs per participant at baseline (T0) and at follow-up (T1)

	n (paired)	To			T2			Δ Health care costs (euro)
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	
Number of doctor appointments	59	4.19	120	502.80	2.78	120	333.60	-169.20
Accident & Emergency visit	59	0.24	258	61.92	0.27	258	69.66	7.74
Number of days hospitalised	59	0.25	644	161	0.78	644	502.32	341.32
				725.72			905.58	179.86

Table I 8. Edirne Intervention group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	To			T2			Δ Health care costs (euro)
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	
Number of doctor appointments	113	2.05	28.48	58.40	1.07	28.49	30.48	-27.92
Accident & Emergency visit	112	0.99	61.25	60.65	0.58	61.25	35.52	-25.11
Number of days hospitalised	109	0.4	152.88	61.15	0.31	152.88	47.39	-13.76
				180.19			113.40	-66.79

Table I 9. Edirne Control group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	To			T2			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	119	2.33	28.49	66.38	1.07	28.49	30.48	-35.89
Accident & Emergency visit	119	0.97	61.25	59.41	0.64	61.25	39.20	-20.21
Number of days hospitalised	116	0.91	152.88	139.12	0.19	152.88	29.05	-110.07
				264.91			98.73	-166.18

Table I 10. Jelgava Intervention group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	To			T2			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	117	3.8	61.56	233.93	3.01	61.56	185.30	-48.63
Accident & Emergency visit	117	0.15	132.35	19.85	0.08	132.35	10.59	-9.27
Number of days hospitalised	117	0.62	330.37	204.83	0.37	330.37	122.24	-82.59
				458.61			318.12	-140.49

Table I 11. Jelgava Control group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	To			T2			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	31	2.23	61.56	137.2788	1.52	61.56	93.57	-43.71
Accident & Emergency visit	31	0.19	132.35	25.15	0.10	132.35	13.24	-11.92
Number of days hospitalised	31	0.52	330.37	171.79	0	330.37	0	-171.79
				334.22			106.81	-227.41

Table I 12. Obuda Intervention group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	To			T2			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	75	3.99	53.41	213.12	2.84	53.41	151.69	-61.43
Accident & Emergency visit	75	0.65	114.84	74.65	0.12	114.84	13.78	-60.87
Number of days hospitalised	74	0.53	286.65	151.93	0.27	286.65	77.40	-74.53
				439.69			242.87	-196.82

Table I 13. Obuda Control group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	T0			T2			Δ Health care costs (euro)
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	
Number of doctor appointments	25	3.12	53.41	166.65	3.76	53.41	200.83	34.18
Accident & Emergency visit	25	0.12	114.84	13.78	0.2	114.84	22.97	9.19
Number of days hospitalised	25	1.12	286.65	321.05	0.28	286.65	80.26	-240.79
				501.48			304.06	-197.42

Table I 14. Leeds Intervention group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	T0			T2			Δ Health care costs (euro)
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	
Number of doctor appointments	5	0.80	99.67	79.73	1.40	99.67	139.53	59.80
Accident & Emergency visit	5	0.20	214.28	42.86	0.20	214.28	42.86	0
Number of days hospitalised	5	0	534.88	0	0	534.88	0	0
				122.60			182.39	59.80

Table I 15. Leeds Control group – healthcare costs per participant at baseline (T0) and at follow-up (T2)

	n (paired)	To			T2			
		Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Mean resource use (number of units)	Unit price (euro)	Mean health care costs (euro)	Δ Health care costs (euro)
Number of doctor appointments	100	4.18	99.67	416.61	2.26	99.67	225.25	-191.36
Accident & Emergency visit	99	0.65	214.28	139.29	0.34	214.28	72.86	-66.43
Number of days hospitalised	98	1.1	534.88	588.37	0.30	534.88	160.46	-427.90
				1144.26			458.57	-685.69

I-2. Health utility

Health utility values obtained by the EQ-5D-5L instrument at baseline and 12-month follow-up are presented. The formula used to calculate the health utility values are based on the Dutch tariff for the Five-Level Version of EQ-5D (Versteegh et al., 2016). Healthy utility values are between 1 and 0; 1 represents full health and 0 is a state as bad as being dead (EuroQoL, 2024). Values below 0 are considered as worse than being dead (EuroQol, 2024).

In the intervention group, the change in health utility score was relatively small in all pilot sites, with a small decrease in Valencia, Obuda and leeds and a small increase in Heerlen, Edirne and Jelgava. **Overall, for the intervention group of all six pilot sites together, there was a small increase in utility score of 0.004.**

Table I 16. Utility scores (EQ-5D-5L) of intervention group participants at baseline (T0) and the first follow-up (T2) per pilot site and total sample (n=503)

	n	T0	T2	Δ Utility score
Heerlen (The Netherlands)	84	0.66	0.66	0.0008
Valencia (Spain)	111	0.74	0.68	-0.06
Edirne (Turkey)	111	0.71	0.80	0.09
Jelgava (Latvia)	117	0.84	0.84	0.002
Obuda (Hungary)	75	0.80	0.80	-0.005
Leeds (UK)	5	0.72	0.63	-0.09
Total	503	0.75	0.76	0.004

In the control group, the change in health utility score was largest in Valencia (increase of 0.13). In Heerlen and Edirne, utility score slightly increased as well. In Jelgava, Obuda and Leeds, utility score slightly decreased. **Overall, for the control group of all six pilot sites together, there was a small increase in utility score of 0.04.**

Table I 17. Utility scores (EQ-5D-5L) of control group participants at baseline (T0) and the first follow-up (T2) per pilot site and total sample (n=464)

	n	T0	T2	Δ Utility score
Heerlen (The Netherlands)	60	0.64	0.66	0.02
Valencia (Spain)	129	0.73	0.86	0.13
Edirne (Turkey)	119	0.73	0.77	0.03
Jelgava (Latvia)	31	0.89	0.89	-0.002
Obuda (Hungary)	25	0.84	0.83	-0.01
Leeds (UK)	100	0.58	0.56	-0.02
Total	464	0.70	0.75	0.04

I-3 Health care perspective cost-effectiveness

With the change in health care costs and the change in utility score, the incremental cost effectiveness-ratio (ICER) can be calculated. ICER is defined as the ratio of the change in costs of an intervention to the change in effects of the intervention. In this case, the ICER is calculated by dividing the delta of healthcare costs (Annex I-1) by the delta of health utility (Annex I-2). The cost-effectiveness analyses from the healthcare perspective for the **intervention group** and for the **control group** is presented.

Table I-18. shows that there is a **mean increase in health care costs of 76.75 euros per participant for the intervention group**. The ratio ranges from a saving of 87806.36 euros per 1 unit increase in utility score for Jelgava to a cost of 105950 euros for Heerlen. **The weighted average of the intervention group of the six pilot sites combined is an additional cost of 18708 euros per 1-unit increase in utility score.**

Table I19. shows that there is a **mean decrease in health care costs of 284.24 euros per participant for the control group**. The ratio ranges from a saving of 5160.86 euros per 1 unit increase in utility score for Edirne to a cost of 142133.06 euros for Jelgava. **The weighted average of the control group of the six pilot sites combined is a saving of 6593 euros per 1-unit increase in utility score.**

Table I 18. cost-effectiveness analysis for each pilot site and the weighted average of the total sample for intervention group (n=503)

	n	n_{weight}	Δ Health care costs (euro)	Δ Utility score	ICER (Δ Health care costs / Δ Utility score)
Heerlen (The Netherlands)	84	0.17	1204.76	0.0008	1505950
Valencia (Spain)	111	0.22	-218.75	-0.06	3428.74
Edirne (Turkey)	111	0.22	-66.79	0.09	-763.29
Jelgava (Latvia)	117	0.23	-140.49	0.002	-87806.36
Obuda (Hungary)	75	0.15	-196.82	-0.005	41876.44
Leeds (UK)	5	0.01	59.80	-0.09	-637.53
Total*	503	1	76.75	0.004	18707.54

Abbreviations: ICER=Incremental cost-effectiveness ratio

*Weighted n-average

Table I 19. cost-effectiveness analysis for each pilot site and the weighted average of the total sample for control group (n=464)

	n	n_{weight}	Δ Health care costs (euro)	Δ Utility score	ICER (Δ Health care costs / Δ Utility score)
Heerlen (The Netherlands)	60	0.13	179.86	0.02	7589.03
Valencia (Spain)	129	0.28	-328.30	0.13	-2496.58
Edirne (Turkey)	119	0.26	-166.18	0.03	-5160.86
Jelgava (Latvia)	31	0.07	-227.41	-0.002	142133.06
Obuda (Hungary)	25	0.06	-197.42	-0.01	16315.35
Leeds (UK)	100	0.22	-685.69	-0.02	36865.25
Total	464	1	-284.24	0.04	-6592.74

Abbreviations: ICER=Incremental cost-effectiveness ratio

*Weighted n-average

Annex J - Overview direction of results

Table J 1 **Intervention and control group: overview of health and energy outcomes and their direction**

	Baseline to follow-up absolute numbers		12-month	18 month
	Intervention group	Control group	Intervention vs control group	Intervention vs control group
Problems in overall HrQoL[c]	-	+	-	+
Mobility [d]	-	+	-	n/a
self-care[c]	-	-	-	n/a
Usual activities[c]	-	+	-	n/a
Pain/ Discomfort[c]	+	+	-	n/a
Anxiety/ depression[c]	+	+	-	n/a
EQ VAS[e]	+	+	+	n/a
Depression	+	+	+	+
Anxiety	+	+	+	+
Stress	+	+	-	n/a
Comfortably warm in wintertime	+	+	-	+
Comfortably cool in summertime	+	+	-	-
Energy costs	+	+	-	+
Energy coping behavior	+	+	+	+
Note: a + indicates that the direction of the association was in favor of the intervention group, a – indicates that the direction of the association was in favor of the control group. Equal indicates the results were around 1.00 and thus equal between both groups. Significance levels are *not* taken into account. n/a- not analyzed.				

Table J 2 Intervention and control group: overview of health and energy outcomes and their direction per pilot sites

	12-month- Intervention vs control group					
	Valencia	Heerlen	Edirne	Jelgava	Obuda	Leeds
Problems in overall HrQoL[c]	-	-	-	-	-	+
Mobility [d]	-	-	-	-	-	Equal
self-care[c]	-	-	-	-	+	+
Usual activities[c]	-	Equal	-	-	-	+
Pain/ Discomfort[c]	-	-	+	-	-	+
Anxiety/ depression[c]	-	+	+	-	Equal	+
EQ VAS[e]	-	-	+	+	+	-
Depression	-	+	+	+	+	+
Anxiety	-	+	+	+	-	+
Stress	-	+	-	-	-	+
Comfortably warm in wintertime	-	-	+	-	+	+
Comfortably cool in summertime	-	-	+	+	-	-
Energy costs	-	-	-	-	-	-
Energy coping behavior	-	+	+	+	-	+
Note: a + indicates that the direction of the association was in favor of the intervention group, a – indicates that the direction of the association was in favor of the control group. Equal indicates the results were around 1.00 and thus equal between both groups. Significance levels are *not* taken into account.						