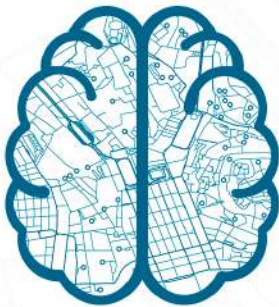


# eMOTIONAL Cities

Mapping the cities through the  
senses of **those who make them**

**POLICY BRIEFS**



# eMOTIONAL Cities

## CONTACT




### • ADDRESS

Edifício IGOT R. Branca Edmee Marques  
1600-276 Lisboa, Portugal.



### • WEB

[emotionalcities-h2020.eu/](http://emotionalcities-h2020.eu/)

 Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.







# INTRODUCTION

eMOTIONAL Cities is a HORIZON 2020 project that investigates, with evidence-based insights, how urban environments influence mental health and well-being.

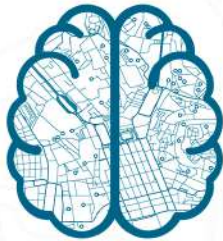


Using an innovative interdisciplinary approach, the project combined neuroscience, urban planning, computer science, and urban analytics to assess the impact of cities on health. This led to the development of pioneering tools to map cities by integrating geospatial data - including physical infrastructure, mobility, environmental comfort, and social determinants of health—with people's emotional and cognitive responses as they navigate these spaces.



To ensure the findings were applicable across different contexts, the study included a diverse range of cities, such as Copenhagen, Lisbon, London, and Lansing/Detroit (USA), covering a variety of urban forms, policy environments, and planning histories. Additionally, a clinical study involving older adults at risk of dementia provided real-world evidence of how urban design can support vulnerable populations in moving through city spaces with greater confidence and autonomy.

This policy brief presents key findings from eMOTIONAL Cities and offers practical recommendations to foster healthier, more inclusive, and emotionally responsive urban environments.



# eMOTIONAL Cities

## TABLE OF CONTENTS

<b>POLICY BRIEF 1:</b> STRATEGIES FOR ACCESSIBLE AND REUSABLE DATA	<b>05</b>
<b>POLICY BRIEF 2:</b> KEY LINKAGES BETWEEN URBAN ENVIRONMENTS AND PUBLIC HEALTH	<b>09</b>
<b>POLICY BRIEF 3:</b> POLICY SHOWCASE ON SUSTAINABLE URBAN HEALTH	<b>14</b>
<b>POLICY BRIEF 4:</b> UNDERSTANDING URBAN WELL-BEING THROUGH BRAIN RESEARCH	<b>18</b>
<b>POLICY BRIEF 5:</b> RESULTS OF NEUROSCIENCE EXPERIMENTS	<b>22</b>
<b>POLICY BRIEF 6:</b> LEVERAGING SPATIAL ANALYSIS FOR IMPROVED URBAN HEALTH AND WELL-BEING	<b>23</b>





POLICY BRIEF 1:

# STRATEGIES FOR ACCESSIBLE AND REUSABLE DATA

**POLICY BRIEF 1:****STRATEGIES FOR  
ACCESSIBLE AND  
REUSABLE DATA**

 The FAIR (Findable, Accessible, Interoperable, Reusable) data principles provide a strong foundation for efficient data management, sharing, and integration across different sectors. By ensuring data discoverability, usability, and reliability, these principles maximise data value and foster better decision-making in areas such as urban planning and public health.

By adopting FAIR principles, organisations can overcome these challenges, improving data governance and accessibility. The following section details how the eMOTIONAL Cities project implemented FAIR principles in its Spatial Data Infrastructure.

**FINDABLE**

- Data should be easily discoverable using standardised identifiers and rich metadata.
- In eMOTIONAL Cities, data was described using detailed metadata in a geospatial catalogue, indexed in the Zenodo data repository.

**ACCESSIBLE**

- Data should be retrievable through open standards, with clear access conditions.
- In eMOTIONAL Cities, each dataset includes a public metadata record with direct access links in various standard formats.





## INTEROPERABLE

- Data must use standardised formats and vocabularies to facilitate integration.
- The project adopted industry standards (e.g., OGC, W3C) to enhance data interoperability.



## REUSABLE

- Data should have clear licensing and provenance information, ensuring proper attribution.

Effective data management is essential for informed decision-making, yet many organisations struggle with:

### DATA SILOS

Isolated datasets limit collaboration and prevent comprehensive analysis.



### LIMITED ACCESSIBILITY

Proprietary formats make data difficult to retrieve and use.



### LACK OF INTEROPERABILITY

Poorly standardised data hinders integration across platforms.



### MISSED OPPORTUNITIES FOR DATA REUSE

Incomplete metadata and unclear licensing reduce long-term usability.



## POLICY RECOMMENDATIONS

### • ADOPT GLOBAL STANDARDS

Encourage the use of internationally recognised geospatial standards (e.g., OGC, ISO) to enhance data consistency and usability.

### • DEVELOP NATIONAL FRAMEWORKS

Establish or update national geospatial data policies to align with global best practices.


### • RAISE AWARENESS

Conduct training programmes and awareness campaigns to educate stakeholders on FAIR principles and equip them with the necessary skills.

### • SUPPORT OPEN DATA INITIATIVES

Promote open data policies that provide standardised geospatial data to the public, fostering transparency, innovation, and compliance with standards.

### • PRIORITISE FREE AND OPEN-SOURCE SOFTWARE (FOSS) ENCOURAGE THE USE OF FOSS SOLUTIONS

 Adopting robust geospatial standards and maintaining well-documented metadata is essential to fully leverage Spatial Data Infrastructures. By aligning with international frameworks (e.g., OGC, ISO) and investing in comprehensive metadata creation, organisations can significantly enhance data discoverability, interoperability, and reuse. Strengthening capacity-building initiatives and policy alignment will help establish a more interconnected and FAIR-compliant geospatial data ecosystem.

POLICY BRIEF 2:

# KEY LINKAGES BETWEEN URBAN ENVIRONMENTS AND PUBLIC HEALTH



**POLICY BRIEF 2:**

# KEY LINKAGES BETWEEN URBAN ENVIRONMENTS AND PUBLIC HEALTH

The link between emotional health and the built environment is increasingly studied from a neurological perspective, revealing how physical spaces impact brain function, mood, and well-being. Urban design can significantly affect the independence and safety of individuals with cognitive impairments, reinforcing the need for inclusive and intuitive environments that support mental resilience and social integration.

## ENVIRONMENTAL STRESSORS AND THE BRAIN

- The built environment can reduce or intensify stress, a major factor in emotional health.
- Crowded spaces, noise, poor air quality, and lack of greenery increase cortisol levels, affecting brain regions responsible for emotional regulation.
- Calming environments with lower noise pollution and access to nature promote relaxation and emotional balance.



## NEUROPLASTICITY AND ENVIRONMENTAL DESIGN

- The brain adapts and rewires in response to its surroundings.
- Natural light, biophilic design, textured materials, and open spaces enhance emotional resilience and cognitive function.

## NATURE AND EMOTIONAL REGULATION

- Green spaces and parks contribute to better mental health.
- Exposure to nature activates brain areas linked to emotional regulation and reduces rumination and anxiety.



## SPATIAL PERCEPTION AND SOCIAL CONNECTIVITY

- The way cities are designed influences social interaction and self-perception.
- Spaces that promote natural gathering points (e.g., plazas, shared workspaces, and public transport hubs) activate brain areas linked to social bonding and emotional well-being.



## NEUROLOGICAL RESPONSES TO COLOUR AND AESTHETICS

- Colours, patterns, and architectural elements evoke distinct emotional responses.
- Warm tones can increase energy or anxiety, while cooler tones foster relaxation.
- Well-designed proportions, symmetry, and acoustics support emotional stability.







# IMPLICATIONS FOR PEOPLE WITH MILD COGNITIVE DISORDERS



## • COGNITIVE AND NAVIGATIONAL CHALLENGES

**Wayfinding difficulties:** People with dementia often struggle with navigation due to memory loss and spatial disorientation. Poor signage or complex layouts can increase confusion.

**Familiarity:** Recognisable landmarks and consistent layouts improve wayfinding and reduce stress.



## • IMPACT ON SAFETY

**Trip hazards:** Uneven surfaces, poor lighting, and clutter increase fall risks.

**Accessibility:** Narrow doorways, steep stairs, and inadequate facilities limit mobility and independence.



## • PSYCHOLOGICAL EFFECTS

**Sense of control:** Well-designed spaces support autonomy, reducing dependence on caregivers.

**Overstimulation:** Excessive noise, clutter, or visual stimuli can trigger agitation, while calming environments aid relaxation.

**Social isolation:** Poor urban design discourages social interaction, while well-planned gathering spaces foster community engagement.




The built environment significantly influences quality of life, independence, and safety, especially for individuals with mild cognitive disorders or dementia. By applying these principles, urban planners can create healthier, more accessible, and emotionally supportive environments for all.

POLICY BRIEF 3:

**POLICY SHOWCASE  
ON SUSTAINABLE  
URBAN HEALTH**

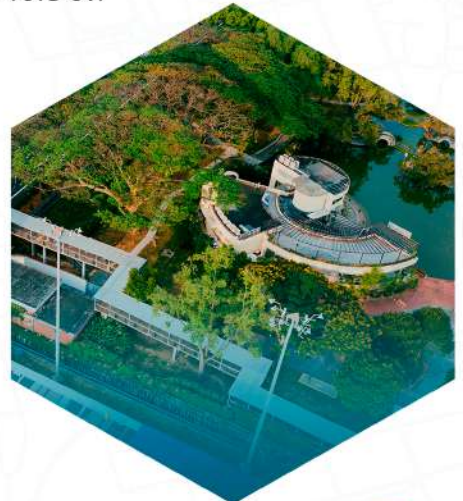
## POLICY BRIEF 3:

# POLICY SHOWCASE ON SUSTAINABLE URBAN HEALTH

 Urban environments significantly influence well-being, with stress being a major factor in quality of life. Policymakers need robust tools to identify and address stress-inducing factors.

The eMOTIONAL Cities research demonstrates the potential of Scenario Discovery in urban planning, highlighting the role of:

- **GREENERY AND VEGETATION**
- **BUILDING DENSITY**
- **PERSONALITY TRAITS**
- **AI-DRIVEN POLICY OPTIMISATION**





# GENERAL RECOMMENDATIONS

## SCENARIO DISCOVERY FOR POLICY INSIGHTS

- Traditional “what-if” analyses often fail to account for uncertainties and complexities in urban planning.
- Scenario Discovery shifts the focus to identifying key policy outcomes and their variability under different conditions.
- This method allows policymakers to detect high-risk scenarios and implement precise, proactive interventions.

## VEGETATION AND STRESS REDUCTION

- Green spaces have well-documented stress-reducing effects.
- However, our research shows that the required percentage of vegetation varies across urban areas.
- A one-size-fits-all greening policy is ineffective—planners must implement location-specific strategies that optimise vegetation coverage based on local conditions.

## IMPACT OF BUILDING DENSITY AND PERSONALITY TRAITS

- Higher building density and increased social interactions do not necessarily lower stress levels.
- This highlights the need for multi-dimensional urban policies rather than focusing only on density.
- Social interactions may enhance well-being, but they cannot replace other stress-reducing strategies.

## POLICY DESIGN WITH AI-BASED SAMPLING

- AI-enhanced sampling increases the efficiency of Scenario Discovery.
- By selecting relevant data points, policymakers can analyse more scenarios with fewer resources.
- AI-driven insights help identify key vulnerabilities and enable more effective urban policy design.

## URBAN POLICIES FOR STRESS REDUCTION



Policymakers should develop adaptive policies that consider local environmental and social dynamics.



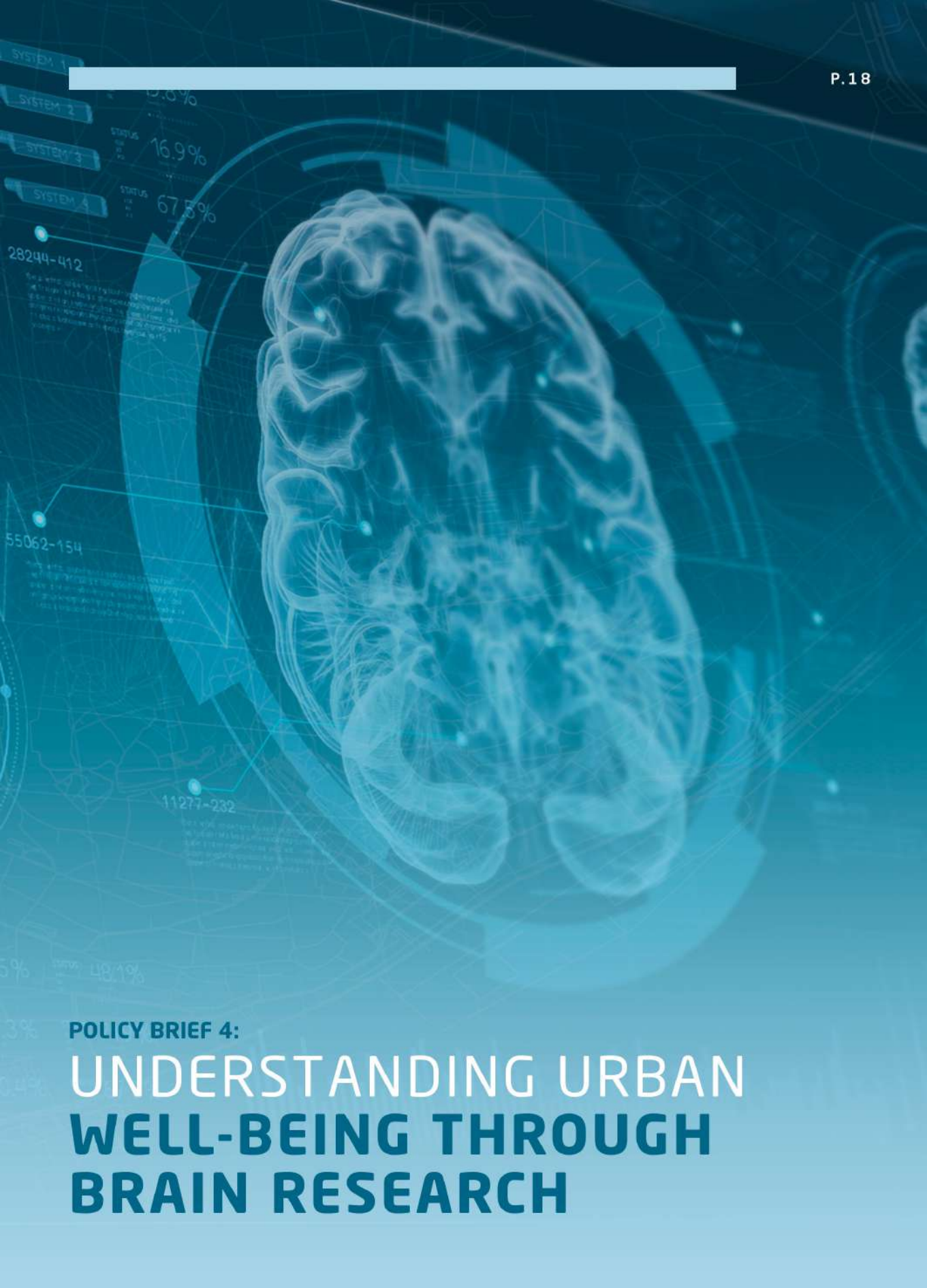
Cities should be not only functional but also psychologically supportive, ensuring a better quality of life for all residents.



Stress-reducing urban policies should focus on:

- Customised greening strategies
- AI-enhanced data analysis
- People-centred urban planning

This research highlights the need for a shift in urban policymaking, moving beyond traditional approaches towards innovative, data-driven strategies. The integration of: Scenario Discovery, AI-based policy optimisation and Context-specific green infrastructure provides a new frontier for stress reducing urban development. Policymakers must embrace these tools to create resilient, sustainable, and healthier cities for future generations.



**POLICY BRIEF 4:**

# UNDERSTANDING URBAN WELL-BEING THROUGH BRAIN RESEARCH



**POLICY BRIEF 4:**

# UNDERSTANDING URBAN WELL-BEING THROUGH BRAIN RESEARCH

Cities shape human experiences, influencing emotions, cognition, and overall well-being.

- 01** Neuroscience research provides a unique perspective on how different urban environments—both indoor and outdoor—affect brain activity and emotional states.
- 02** EEG and physiological sensors enable objective measurement of stress, relaxation, cognitive load, and emotional responses in urban spaces.
- 03** Understanding these neural reactions helps create cities that promote mental health and well-being.



## HOW NEUROSCIENCE CAN INFORM URBAN DESIGN?

The research examined how the built environment influences brain activity, focusing on two studies:

- **STUDY 1: THE IMPACT OF NATURALNESS AND CROWDEDNESS ON COGNITIVE LOAD**

Natural environments were associated with lower cognitive load and reduced stress responses.

- **STUDY 2: URBAN DESIGN AND SPATIAL ORIENTATION IN INDIVIDUALS WITH MILD COGNITIVE IMPAIRMENT (MCI)**

Well-designed urban spaces with clear landmarks and open areas improve navigation and reduce anxiety for individuals with cognitive impairments.

Using neuroscience-based methodologies, urban planners can assess how people respond neurologically and physiologically to different environments, leading to data-driven design decisions.



☀️ Natural spaces lower stress and cognitive load, highlighting the importance of green urban environments. Thoughtful urban design can support navigation and well-being, particularly for vulnerable populations.

## POLICY IMPLICATIONS

### INCORPORATING GREEN SPACES:

- Urban policies should prioritise accessible parks and green areas to reduce stress and improve quality of life.

### LEVERAGING AI AND TECHNOLOGY:

- Smart city initiatives can integrate real-time physiological monitoring to dynamically adapt urban design.

**BY BRIDGING NEUROSCIENCE AND URBAN PLANNING, POLICYMAKERS CAN CREATE EMOTIONALLY SUPPORTIVE CITIES THAT FOSTER HEALTHIER AND HAPPIER COMMUNITIES**

### DESIGNING EMOTIONALLY SUPPORTIVE SPACES:

- Architects and urban planners should use neuroscientific findings to create environments that enhance well-being.





POLICY BRIEF 5:

# RESULTS OF NEUROSCIENCE EXPERIMENTS



## POLICY BRIEF 5:

# RESULTS OF NEUROSCIENCE EXPERIMENTS



Cities have a fundamental role in shaping physical and mental health by influencing environmental exposure, mobility, and community well-being. The eMOTIONAL Cities project provides scientific insights into how urban spaces affect cognitive and emotional well-being.

## KEY FINDINGS FROM THE EMOTIONAL CITIES NEUROSCIENCE EXPERIMENTS



### NEUROIMAGING EVIDENCE FOR URBAN PLANNING

- Brain imaging studies reveal that urban environments activate reward circuits, influencing how people interact with city spaces.



### EMOTIONAL EVALUATION OF CITY WALKS

- Green spaces elicit positive emotional responses, while high-density crowded areas trigger stress-related neural activity.



## AGE AND EMOTIONAL RESILIENCE

- Older adults (50+) exhibit higher emotional stability in daily activities. Urban infrastructure should actively support their psychological and emotional well



## TRANSPORT MODE AND EMOTIONAL STRESS

- Driving is linked to lower stress levels than travelling by bus, suggesting the need for stress-reducing public transport designs.



## DAILY ACTIVITIES AND STRESS RECOVERY

- Social interactions help reduce stress and promote emotional balance.



## GREEN SPACES AND COGNITIVE BENEFITS

- Urban greenery (parks, community gardens, tree-lined streets) significantly reduces stress and improves cognitive function.



## NOISE POLLUTION AND STRESS RESPONSE

- High vehicle density increases physiological stress responses, including higher heart rates. Cities must adopt noise-reduction and pedestrian-friendly policies in high-traffic areas.



## DEMENTIA-FRIENDLY URBAN DESIGN FOR WAYFINDING

- Elderly patients with mild cognitive impairment perform better in urban environments with clear landmarks, pedestrian-friendly pathways, and minimal sensory overload.



## POLICY RECOMMENDATIONS

### • DATA-DRIVEN AND PEOPLE-ORIENTED URBAN PLANNING:

01

Integrating urban analytics with health data enables human-centred city designs that prioritise cognitive and emotional well-being.

### • NEUROSCIENTIFIC EVIDENCE FOR CITY DESIGN:

02

Brain imaging research offers an innovative approach to predict and enhance urban engagement, making city spaces more attractive and accessible.

### • GREEN SPACES AND STRESS MITIGATION:

03

Exposure to natural elements significantly reduces stress and enhances emotional well being.

### • AIR POLLUTION AND NOISE CONTROL:

04

Policies should focus on reducing emissions, investing in clean energy, and expanding green spaces to mitigate environmental stressors.



By using individual health data, wearable sensor technology, and neuroimaging tools, policymakers can develop healthier, more inclusive, and emotionally supportive city environments.

POLICY BRIEF 6:

# LEVERAGING SPATIAL ANALYSIS FOR IMPROVED URBAN HEALTH AND WELL-BEING





**POLICY BRIEF 6:**

# LEVERAGING SPATIAL ANALYSIS FOR IMPROVED URBAN HEALTH AND WELL-BEING

Urban health is a growing concern as cities face rising population density and environmental challenges.

- Data-driven approaches are essential to identify health disparities and develop effective interventions.
- The spatial analysis toolbox integrates health, environmental, and socio-economic data to map and analyse urban health patterns.
- By using spatial techniques such as hotspots analysis and spatial modelling, urban planners can pinpoint high-risk areas and design healthier urban environments.

## • PHYSICAL ENVIRONMENT

Access to green spaces, air pollution levels, noise pollution, and urban heat islands directly impact stress, anxiety, and cardiovascular health.



## • SOCIOECONOMIC FACTORS

Income disparities, housing conditions, employment status, and education access contribute to health inequalities.



## • BUILT ENVIRONMENT AND INFRASTRUCTURE

Walkability, public transport access, and healthcare facility distribution influence physical activity and healthcare accessibility.



## PHYSICAL HEALTH

- Low-income populations are more susceptible to respiratory diseases, diabetes, and obesity.
- Poor air quality, lack of green spaces, and high noise pollution worsen health risks.



## MENTAL HEALTH

- Noise pollution and limited green spaces contribute to depression, anxiety, and stress.
- Social support systems and recreational spaces play a crucial role in mental well-being.



## VULNERABLE GROUPS

- Children and older adults are at higher risk due to mobility limitations and environmental hazards.
- Women in low-income settings face heightened mental distress and anxiety.





## POLICY RECOMMENDATIONS

- **ENHANCE DATA-DRIVEN POLICYMAKING WITH SPATIAL ANALYSIS**

Spatial analysis improves regional health pattern detection, enabling precise interventions.

- **OPEN DATA TO SUPPORT MORE LOCALISED APPROACHES**

Making localised health data publicly available allows for better identification of high-risk areas.

- **STRENGTHEN SOCIOECONOMIC POLICIES TO ADDRESS HEALTH INEQUITIES**

Tailored policies can reduce age- and gender-based health disparities and improve healthcare access for vulnerable groups.

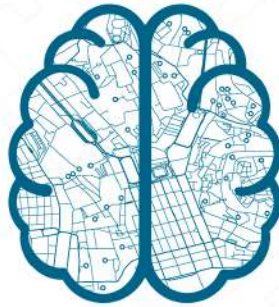


Spatial analysis is a key tool in improving urban health by identifying high-risk populations and areas. By integrating health, environmental, and socio-economic data, policymakers can design more effective, targeted interventions. Aligning urban health policies with spatial modelling and data-driven approaches will create more equitable and healthier cities.






[www.emotionalcities-h2020.eu](http://www.emotionalcities-h2020.eu)



# eMOTIONAL Cities

 Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.





**eMOTIONAL**  
Cities