MUSINGS ON NEUROURBANISM, PUBLIC SPACE AND URBAN HEALTH

Ana Bonifácio[1] (iD)
Paulo Morgado[1] (iD)
Angeliki Peponi[1,2] (iD)
Leonardo Ancora[3] (iD)
Diego Andrés Blanco-Mora[3,4] (iD)
Marta Conceição[3] (iD)
Bruno Miranda[3] (iD)

ABSTRACT – The recent pandemic outbreak warned of the urgent need for closer interaction between health and spatial planning. Although the relationship between urban space and health has been widely proven and led to the emergence and or reinforcement of new concepts and new interdisciplinary areas such as neurourbanism, neuroarchitecture, environmental psychology, psychogeography, and liveability, that try to cope with the new urban issues and epidemics, as urban stress and mental illness, covid-19, social isolation, health iniquities and public health. However, there has not been much discussion nor has a theoretical and methodological framework been addressed. The embryonic state of such cross-disciplinary fields of knowledge requires more thinking contributions towards its consolidation and guidelines for professionals and policymakers. This paper's main goal is to contribute to the discussion, by musings around the triangulation of public spaces, urban health and urban health determinants. Starting with a large collection of scientific literature, mainly published between 2019 and 2022, focusing on the discussion of public space, urban health and determinants of (urban) health, critically an analysis was conducted to understand how they interrelate. More precisely, the main objectives are: 1) to underline the importance of public space in its social, place-making and quality of life promotor; 2) to highlight and strengthen awareness that the urban environment affects people's mental health and well-being; 3) to propose a set of determinants of urban health to work as a tool for professionals for a more objective evaluation and monitoring of health in cities and; 4) to strengthen the work that has been done on the importance of neurourbanism as an interdisciplinary science that brings together neuroscience and urban planning to foster healthier cities and communities, and overall people's general well-being.

Despite the empirical association between health, both physical and mental, and the surrounding environment where people spend their time, and despite the necessity and opportunity shown by the recent covid-19 pandemic, few evidence-based research and policies, and recommendations, towards healthier cities and communities were produced, especially regarding mental health/illness.

Keywords: Neurourbanism; Urban space; City; Urban health; Mental health.

RESUMO – REFLEXÕES SOBRE NEUROURBANISMO, ESPAÇO PÚBLICO E SAÚDE URBANA. A recente pandemia alertou para a necessidade urgente de uma interação mais estreita entre a saúde e o planeamento espacial. Embora a relação entre espaço urbano e saúde tenha sido amplamente comprovada e tenha levado ao aparecimento e/ou reforço de novos conceitos e novas áreas interdisciplinares como o neurourbanismo, neuroarquitectura, psicologia ambiental, psicogeografia e 'liveability', que tentam lidar com as novas questões urbanas e epidemias, como o stress urbano e doenças mentais, covid-19, isolamento social, iniquidades de saúde e saúde pública. No entanto, tanto quanto se sabe, não houve muita discussão nem foi abordado um quadro teórico e metodológico. O estado embrionário de tais campos interdisciplinares do conhecimento requer um maior contributo de reflexão para a sua consolidação e orientações para profissionais e decisores políticos. Este documento tem como principal objetivo contribuir para a discussão, através de reflexões em torno da triangulação dos espaços públicos, da saúde urbana e dos determinantes da saúde urbana.

Começando com uma grande coleção de literatura científica, publicada principalmente entre 2019 e 2022, centrada na discussão do espaço público, saúde urbana e determinantes da saúde (urbana), foi realizada uma análise crítica para compreender como se inter-relacionam. Mais precisamente, os seus principais objetivos são: 1) sublinhar a importância do espaço público no seu fator social, de ordenamento e de qualidade de vida; 2) realçar e reforçar a consciência de que o ambiente urbano afeta a saúde mental e o bem-estar das pessoas; 3) propor um conjunto de determinantes da saúde urbana para trabalhar como instrumento para os profissionais para uma avaliação e monitorização mais objetiva da saúde nas cidades e; 4) reforçar o trabalho que tem sido feito sobre a importância do neurourbanismo como ciência interdisciplinar que reúne as neurociências e o planeamento urbano para promover cidades e comunidades mais saudáveis, e o bem-estar geral das pessoas em geral.

Apesar da associação empírica entre a saúde, tanto física como mental, e o ambiente circundante onde as pessoas passam o seu tempo, e apesar da necessidade e oportunidade demonstrada pela recente pandemia covid-19, foram produzidas poucas pesquisas e políticas baseadas em evidências, e recomendações, no sentido de cidades e comunidades mais saudáveis, especialmente no que diz respeito à saúde mental/doença.

Palavras-chave: Neourbanismo; Espaço urbano; Cidade; Saúde urbana; Saúde mental.

RÉSUMÉ – RÉFLEXIONS SUR LE NEUROURBANISME, L'ESPACE PUBLIC ET LA SANTÉ URBAINE. La récente pandémie a mis en évidence le besoin urgent d'une interaction plus étroite entre la santé et l'aménagement du territoire. Bien que la relation entre l'espace urbain et la santé ait été largement prouvée et ait conduit à l'émergence et/ou au renforcement de nouveaux concepts et de nouveaux domaines interdisciplinaires tels que le neurourbanisme, la neuroarchitecture, la psychologie environnementale, la psychogéographie et l'habitabilité, qui tentent de faire face aux nouvelles questions et épidémies urbaines, telles que le stress urbain et les maladies mentales, le covid-19, l'isolement social, les iniquités sanitaires et la santé publique, il n'y a pas eu beaucoup de discussions ni de cadres théoriques et méthodologiques. Cependant, il n'y a pas eu beaucoup de discussions et aucun cadre théorique et méthodologique n'a été abordé. L'état embryonnaire de ces champs de connaissances interdisciplinaires nécessite une réflexion plus poussée en vue de leur consolidation et de l'élaboration de lignes directrices à l'intention des professionnels et des décideurs. L'objectif principal de cet article est de contribuer à la discussion, en réfléchissant à la triangulation des espaces publics, de la santé urbaine et des déterminants de la santé urbaine. À partir d'une large collection de littérature scientifique, principalement publiée entre 2019 et 2022, axée sur la discussion de l'espace public, de la santé urbaine et des déterminants de la santé (urbaine), une analyse critique a été menée pour comprendre comment ils sont liés. Plus précisément, les objectifs principaux sont les suivants 1) souligner l'importance de l'espace public dans son rôle social, d'aménagement du territoire et de promoteur de la qualité de vie ; 2) souligner et renforcer la prise de conscience que l'environnement urbain affecte la santé mentale et le bien-être des personnes ; 3) proposer un ensemble de déterminants de la santé urbaine qui serviront d'outils aux professionnels pour une évaluation et un suivi plus objectifs de la santé dans les villes ; et 4) renforcer le travail effectué sur l'importance du neurourbanisme en tant que science interdisciplinaire qui réunit les neurosciences et la planification urbaine pour favoriser des villes et des communautés plus saines, et le bien-être général des personnes.

Malgré l'association empirique entre la santé, tant physique que mentale, et l'environnement dans lequel les gens passent leur temps, et malgré la nécessité et l'opportunité démontrées par la récente pandémie de covid-19, peu de recherches, de politiques et de recommandations fondées sur des données probantes ont été produites en faveur de villes et de communautés plus saines, en particulier en ce qui concerne la santé et la maladie mentales.

Mots clés: Neourbanisme ; Espace urbain ; Ville ; Santé urbaine ; Santé mentale.

RESUMEN – REFLEXIONES SOBRE NEUROURBANISMO, ESPACIO PÚBLICO Y SALUD URBANA. La reciente pandemia alertó sobre la urgente necesidad de una interacción más estrecha entre la salud y la ordenación del territorio. Aunque la relación entre el espacio urbano y la salud ha sido ampliamente comprobada y ha llevado al surgimiento y/o refuerzo de nuevos conceptos y nuevas áreas interdisciplinares como el neurourbanismo, la neuroarquitectura, la psicología ambiental, la psicogeografía, y la habitabilidad, que intentan hacer frente a los nuevos problemas y epidemias urbanas, como el estrés urbano y las enfermedades mentales, el covid-19, el aislamiento social, las iniquidades sanitarias y la salud pública. Sin embargo, no se ha debatido mucho ni se ha abordado un marco teórico y metodológico. El estado embrionario de estos campos de conocimiento interdisciplinares requiere una mayor contribución reflexiva para su consolidación y la elaboración de directrices para profesionales y responsables políticos. El objetivo principal de este artículo es contribuir al debate, reflexionando en torno a la triangulación de los espacios públicos, la salud urbana y los determinantes de la salud urbana. A partir de una amplia colección de literatura científica, principalmente publicada entre 2019 y 2022, centrada en la discusión del espacio público, la salud urbana y los determinantes de la salud (urbana), se realizó un análisis crítico para entender cómo se interrelacionan. Más concretamente, los objetivos principales son: 1) subrayar la importancia del espacio público como promotor social, de la creación de lugares y de la calidad de vida; 2) destacar y reforzar la concienciación de que el entorno urbano afecta a la salud mental y al bienestar de las personas; 3) proponer un conjunto de determinantes de la salud urbana que sirva de herramienta a los profesionales para una evaluación y un seguimiento más objetivos de la salud en las ciudades y; 4) reforzar el trabajo que se ha realizado sobre la importancia del neurourbanismo como ciencia interdisciplinar que aúna la neurociencia y el urbanismo para fomentar ciudades y comunidades más sanas, así como el bienestar general de las personas.

A pesar de la asociación empírica entre la salud, tanto física como mental, y el entorno en el que las personas pasan su tiempo, y a pesar de la necesidad y la oportunidad mostradas por la reciente pandemia de covid-19, se produjeron pocas investigaciones y políticas basadas en pruebas, y recomendaciones, hacia ciudades y comunidades más sanas, especialmente en lo que respecta a la salud/enfermedad mental.

Palavras clave: Neourbanismo; Espacio urbano; Ciudad; Salud urbana; Salud mental.

I. INTRODUCTION

The link between urban development and well-being, happiness, and quality of life, between physical space and health, between city and public space and the advantages and disadvantages of

their use, is an old discussion that has gained a new momentum in the last three decades, by the exponential increase of urban problems and the need to with them. Urban planners and policymakers, show haste to implement a myriad of actions for requalification and environmental valorisation, urban rehabilitation, revitalization and regenerative public spaces, integrated strategies and processes for the reconciliation between people and places, increase places connectivity, promote compactness, fight sprawl, increase urban green areas and integrate nature in cities, upgrade waterfronts and soft transport modes (cycling and walking) to fight car use and private transport, among other initiatives.

While this urban development aimed to cope with urban problems and meet the needs of its citizens, leverage the quality of life and promote health and well-being, there's "grey" literature highlighting the pros and cons of the urban environment and urban living style. Indeed, urban development outcomes have proven to be positive, fostering people's general well-being and quality of life, but also negative by affecting people's health and well-being (EC *et al*., 2019), therefore resulting in a significant burden on states' finances and impacting the public economy. Then, to reduce the level of uncertainty within urban development outcomes there is an urgent need to build evidence on how, and how much the urban environment people live in, work, and spend time, in affects their health and well-being. Although the challenge has been stressed through the years, there isn't enough research work capable of providing evidence-based knowledge upon the topic.

Moreover, accordingly to the United Nations (UN) population prospects, not only world population is increasing at astonishing rate as the urban population in particular is projected to increase at an even higher rate. Indeed, the number of urban dwellers has been progressively increasing and, already in 2022, the UN reiterates that «six out of every ten people in the world are expected to reside in urban areas by 2030, rising to 83% by 2050.» (United Nations Human Settlements Programme [UN-Habitat], 2022, p. 9 from UNDESA, 2019).

Therefore, it is impossible to dissociate the dynamics of world population growth from emerging phenomena and challenges such as climate change and climate action, the continued use and consumption of fossil fuels, the necessary decarbonization of the planet, geopolitical issues and their impacts on human life, people's health, and its socio-cultural dimension.

Taking mental health as a component of health that was (especially before the pandemic) often less considered, the knowledge that exists is mainly empirical through a few studies that correlate urban design and health issues and/or health benefits. However, still there is no evidence that mental health concerns are taken into account in the way current urban planning processes/methodologies. It's worth saying that one of the positive side effects of the pandemic, is that it drew people's attention to important issues, such as mental health effects of the built environment, that until now were not properly recognized. Another relevant issue raised through the pandemic, was the importance of scientific knowledge for policymakers to support decisions. The 'scientification' of public policies during pandemic outbreaks was highly reported and had an impact on collective awareness of the importance of science with societal impact. In the scope of this scientific chain value, the need to have metrics for evaluation and benchmarking was stressed in different forums involving academics and politicians. In this realm, urban health determinants to measure, evaluate and classify the impact of urban space on the mental health of citizens were at the core of the discussion all over the world.

In this context, geography plays a key role, as many parameters mentioned in the literature are geographical-based, e.g. landscape (land use and land cover; topography; accessibility; connectivity; diversity; buildings; houses; etc.), the socio-economic structure of the population (age; gender; purchase power per capita; education; etc.), the configuration of urban space, the cultural heritage, the climate and environmental factors (air quality, noise, temperature, relative humidity, wind, etc.), the health indicators (people diagnosed with a certain type of diseases; a daily dose of medication; access to health care facilities), and lifestyle indicators (drugs and alcohol consumption indicators, sports activity, etc,); the territory overall organization (facilities, infrastructures, mobility, etc.), among others, that have an either direct and or indirect influence on people's health and mental well-being.

The analysis of physical space and its relationship with health has a long history in architecture, interiors, work, and residence spaces (Higuera-Trujillo, 2021). However, research on the study of the relationship between human health and the urban built environment is still at an early stage. In 'Neurourbanism: towards a new discipline' (Adli *et al*., 2017) the lack of close and effective interaction between urban planners and health professionals is evident, considering several studies that point to the increase in mental disorders such as anxiety, stress, depression, and other emotional disorders in urban environments (Peen *et al*., 2010). Thus, it is considered that neurourbanism is a new field that

explores neuroscience, the biological underpinnings of mental states and disorders to ensure a better quality of life in urban areas. (Ancora *et al.*, 2022; McCay *et al.*, 2017; Pykett *et al.*, 2020).

Even before the pandemic, several global institutions identified the need to study the urban context and the quality of life (also from the perspective of individual health), of which the UN and the European Union (EU) stand out. The UN, through the World Health Organization (WHO) and the UN-Habitat, for example, has demonstrated that mental health has been at the heart of its policy research and work for several decades (UN/WHO/HPR/HEP, 1998; UN/WHO, 2001; UN/WHO, 2010). Moreover, more recently, the EU, in its strategic investment fighting against imbalances and inequities, launched programmes and funding lines dedicated to the promotion of health in cities.

As an example of such funding policies to foster research on the topic, we can highlight eMOTIONAL Cities project. A research & innovation actions (RIA) project supported by the EU Horizon 2020 programme. Under this call, European Commission (EC) supports five more projects worth 30 million euros total, which together constitute the Urban Health Cluster (UHC) – The first European cluster to improve and safeguard the health and well-being of citizens, leaving none behind.

To promote and maintain mental health and well-being, and to reduce the risk factors of mental illness, stands as pivotal to achieve urban sustainability and to build healthier, resilient, and human-centred cities and communities.

This article attempts to contribute to raise awareness on the importance of urban planning and urban design as a technical and political tool for preparedness for the emergent challenges cities and humanity are facing and to guarantee people's mental health and well-being. The article is organized in four parts. The first part discusses on public spaces realm of public health and summarizes its conceptual evolution; drawing on the findings on the relations between the built environment and health, and more specifically mental health, the second part of this article dedicates to discuss on the concept of urban health, mental health and urban stressors to shed light on the impact of urbanite in people's health and well-being; the third part divide on the discussion of the determinants of urban health based on the extensive narrative on the topic, and ends with a summarize table of the built environments determinants and its negative impacts on mental health; the fourth and last part it's dedicated to final remarks.

II.   PUBLIC SPACE AS THE COLLECTIVE LIVING ROOM

The history of the city is the history of its public space (Borja & Muxi, 2003, p. 15) because it is the place where all social and political activities are printed, and the place of all discussions and decisions that affect the collective. In this regard, public spaces demand thinking and design, e.g, the outline, the matter, the form, as well as the banal urban features citizens daily use for interaction with the environment, to enjoy, or to express themselves through social and artistic manifestations or simply the most careless use of crossing and permanence.

The understanding of the 'public space' concept varies. There are who understand it as a set of voids, as a space that mediates volumes, as small 'leftovers' that must be filled up; and others who do not understand them and therefore do not place them at the forefront of the act of planning and making cities. However, public space is the place that promotes socialisation and, as such, is a fundamental space to combat social isolation and the mental problems that often result from it. «Public spaces are all places publicly owned or of public use, accessible and enjoyable by all for free and without a profit motive.» (UN-HABITAT, 2016, p. 127).

In the scope of this paper, we considered public places as the most visible, collective, accessible, and ordinary of citiy spaces. This is the vision of public space which has gained importance in recent decades, and it is also the one that contributes to the satisfaction of different quality of life criteria, even when the "death" of public space has been announced. Despite this, municipalities persist in investing in a public space that area constantly expanding through new areas resulting from changes in mobility and transportation infrastructures. The design and maintenance of streets have become a major challenge for local authorities who must find ways to harness the symbolic power of public spaces, as they have always done. (Remesar, 2007, p. 5)

In the late 1960s of the 20th century, Jan Gehl 'transformed' Copenhagen into the 'laboratory city' for several studies on the interaction between public space and public life, intending to understand this interaction, testing different methods and analyzing the resulting patterns. More recently, the Gehl Institute and the Robert Wood Johnson Foundation have developed an 'Inclusive

Healthy Places (IHP) Framework' (fig. 1) as a data-driven tool dedicated to people in the assumption of bridging health equity gaps in public space. Understanding Community Context; Support Inclusion in Process; Design and Program Public Space for Health Equity; and Foster Social Resilience are the four principles for creating healthy and inclusive places.
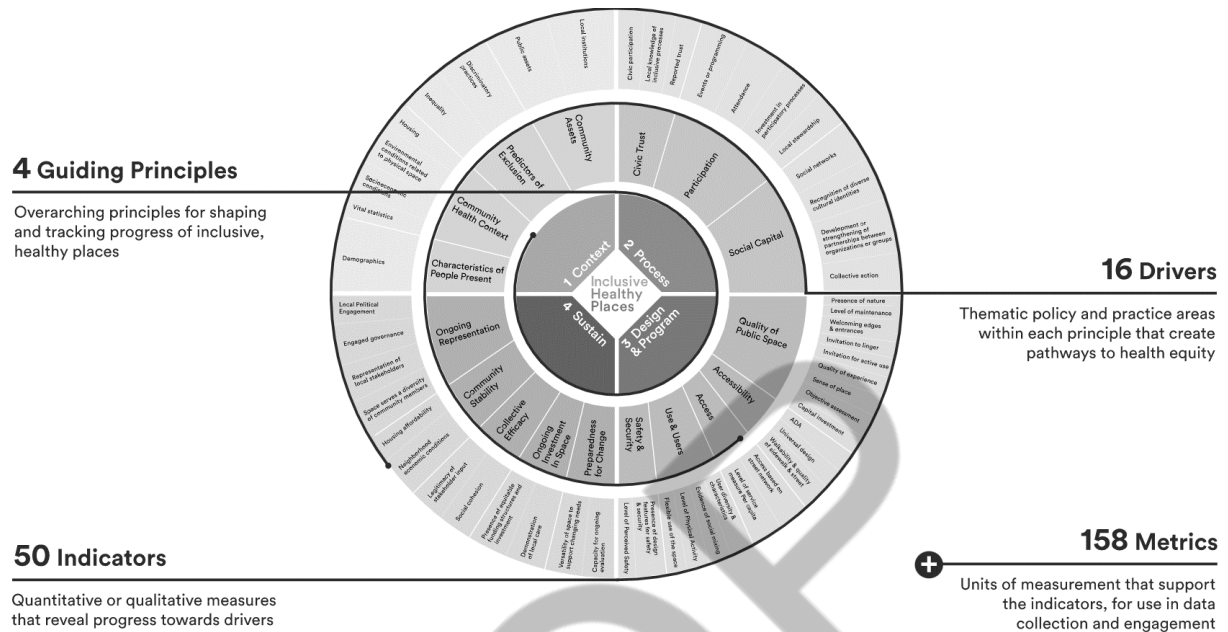

Fig. 1 – Inclusive Healthy Places - Inside the Framework.
Fig. 1 – Lugares Saudáveis Inclusivos - Dentro da Estrutura.
Source: Gehl Institute, 2018.

Another example that underlines the importance of the public space regarding its impact on general well-being, is the American Project for Public Spaces (1975), as one of the first attempts to systematize what makes a Great Place based on a set and sub-set of principles (fig. 2). The systematization has a form of a wheel with 3 layers from the centre to the edge of the wheel, where in the centre there is four main principles-dimensions: 1) sociability, 2) uses and activities, 3) access and connections, and 4) comfort and image, each one of them sub-divided into attributes in a second layer, and finally the third layer with the identification of the parameters, which should guide an urban intervention that comes closer to citizens' needs. The importance of current health promotion through public spaces and outreach relationships has guided the 'Project for Public Spaces' to achieve partnerships with companies and foundations that provide funding, technical assistance, and capacity building to local organisations. In this way, it is possible to ensure that more people have access to public spaces with community power as if they were collective living rooms.
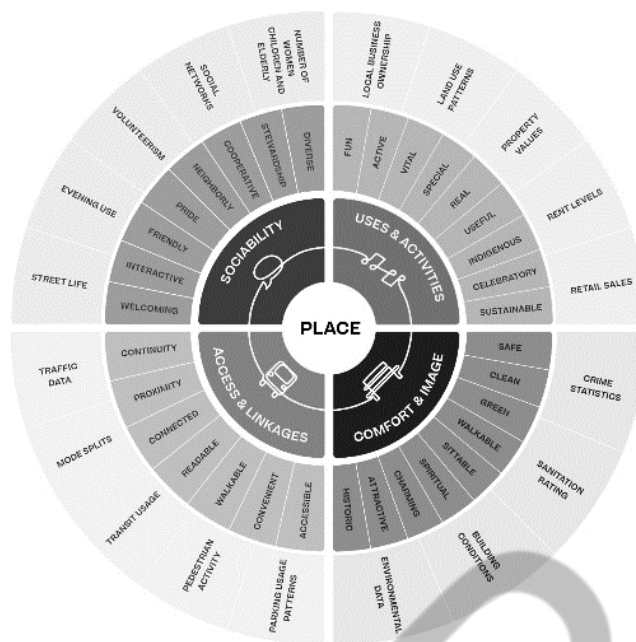
Fig. 2 – What Makes a Great Place?
Fig. 2 – O que é que faz um grande lugar?
Source: Project for Public Spaces, 2020.

«Public civic space is not a residual space between streets and buildings. Nor is it an empty space considered public simply for legal reasons. Nor is it a "specialised" space, to which one has to go, like someone who goes to a museum or a show. Rather, these spaces are potential public spaces, but something more is needed for them to be public civic spaces.» (Borja & Muxi, 2003, p. 15).

It is also through public space that solutions were tailored to each era's flavours of time, and some of those solutions still are inspiring for many current interventions. Here are some of the cities labels or buzzwords of the epoch: 'Garden' (Howard, 1899), 'Soft' (Raban, 1974), 'Sustainable' (from the diffusion of the term 'sustainable development', Bruntland, 1987), 'Global' (Sasken, 1991), 'Smart' (Deakin *et al.*, 2011), 'Innovative', 'Resilient', 'Equitable', the '15 minute' (Moreno, 2021) or the five, ten, or twenty-minute cities or 'neighbourhoods', depending on the scales and the means of mobility.

From 'ecocities' (Register, 1987) to 'healthy cities' or 'healthy communities' which, for the first time, puts health and urban design together in the perspective of understanding and mitigating the stress on human health. The 'Healthy Cities and Villages' initiative in 1986 by UN-WHO brought the importance of the topic to public health policies and produced the first international agreement in this context, the Ottawa Charter for Health Promotion, more than 30 years ago, the cornerstone document for public health promotion.

According to the EC «Public spaces make up between two and 15% of land in city centres in Europe. Both their physical and social functions are essential and can relieve some of the pressures exerted on a city by a growing population. (...) In future cities, we will need to optimise the distribution and use of public space to ensure that it is safe, accessible and inclusive for all.» (EC *et al.*, 2019, p. 92).

III.   HEALTH(S): THE HUMAN, THE URBAN AND THE MENTAL

1. Health

It is in the preamble to the Constitution of the World Health Organization – «(…) adopted by the International Health Conference held in New York from 19 June to 22 July 1946, signed on 22 July 1946 by the representatives of 61 States (…), and entered into force on 7 April 1948» – that the notion of 'Health' is defined and comes to the present day, incorporating the revisions that follow. «The States Parties to this Constitution declare, in conformity with the Charter of the United Nations, that the following principles are basic to the happiness, harmonious relations and security of all peoples: Health is a state of complete physical, mental and social well-being and not merely the absence of

disease or infirmity.» (UN-WHO, 1946). According to Evans and Stoddart this definition expresses «(...) that there is much more to health than simply a collection of negatives – a state of not suffering from any designated undesirable condition.» (Evans *et al.*, 1990, p. 1347).

Several circumstances influence human health, namely the personal characteristics of each individual and environmental factors, be they social, economic, or physical. These factors – health determinants – are defined by WHO as the range of behavioural, biological, socio-economic, and environmental factors which influence the health status of individuals or populations (WHO, 1998, p. 6).

Whitehead and Dahlgren's 'rainbow model of the determinants of health', has become an iconic illustration of the major groups of determinants, adopted by WHO and adapted by several authors, referring, from the inside out: 1) age, sex and hereditary factors; 2) individual lifestyle factors; 3) social and community networks; 4) living and working conditions; and 5) general socio-economic, cultural and environmental conditions (Dahlgren and Whitehead, 1991). The weight represented by each of these determinants is variable and has been the subject of study in recent decades. The Health Mission states that biological and genetic factors together with health behaviours affect health up to 25%, while factors of the social and physical environment together with the health service account for 75%. (Health Mission, 2017).

In an article that takes as reference the 'County Health Rankings Framework' (Stiefel *et al.*, 2020), what is inherent to human conditions is confined to the personal socio-economic context (which represents an importance of 40%) and behaviour (where genetic and acquired issues can be included) which represent 30%; what depends on externalities includes access to healthcare (20%) and the built environment which represents, for this proposal, the shortest slice of this influence (10%).

The concepts of health exist along a *continuum*, without distinct boundaries; however, this does not preclude us from acknowledging their distinctions. Various concepts are neither correct nor incorrect; they simply serve different purposes and have different areas of applicability. Regardless of the level of health definition employed, it is crucial to differentiate it from the issue of determining the factors that contribute to that definition of health (Marmor, 1989).

2. Urban Health

The urban health concept, accordingly, to one of the definitions of WHO's development, includes 'urban governance', 'population characteristics', 'the natural and built environment', 'the social and economic environment', 'food quality' and 'emergency health services and management' as factors contributing positively or negatively to urban health, but also about individual health within the urban context. «For example, in developing countries, the best urban governance can help produce 75 years or more of life expectancy. With poor urban governance, life expectancy can be as low as 35 years. (…) While most of these root causes lie beyond the direct control of the health sector, local leaders have direct influence over a wide range of urban health determinants, from housing and transport policies to social services, to smoking regulations and the policies that govern food marketing and sales.» (WHO, 2010, p. 5)

Therefore, it's critical to identify and reorganize, upfront the determinants that go beyond human health or the "health of cities" and are not restricted to social ones (social health determinants), on which there has been focusing the majority of the research on the topic in recent decades.

Moreover, it is important to mention that the proposal of determinants here presented (fig. 3), correlates the built environment with both physical and mental health, as they are inseparable. Indeed, urban health reflects the impact of the physical and social environment on the quality of life and well-being of individuals and communities living in urban areas. The physical and built environment, including urban structures, infrastructure, and spaces, can significantly affect health, particularly when issues such as water quality or air pollution arise. On the other hand, the urban environment can also contribute positively to health through the presence of open, green, and recreational spaces. (Michalos, 2014, p. 6835)

3. Mental Health

The built environment possesses the capacity to influence physical and mental health in both favourable and unfavourable ways, emphasizing the significance of purposeful planning and policy

initiatives that incorporate a health perspective. Mental health is a complex matter with no single cause but is instead shaped by numerous factors that can affect an individual's mental well-being. (Van Winckle, 2022, p. 2)

According to the WHO, «Mental health is a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community.» (WHO, 2018, p. 1). In this regard, emphasizing the community value, David Sim highlights the role of everyday places and proximity where urban interventions can flesh out social relationships and communities. In David Sim own words «'Neighbourhood is not a place. Neighbourhood is a state of mind." (Sim, 2022 in *'How to build neighborhoods we actually like' film, 00'20'')*.

Moreover, to underline the high importance of promoting mental health and global well-being, the EC report The Future of Cities points out that mental illness is «…one of the leading causes of disability at the global level and, on average, people with severe mental disorders generally die 10-20 years earlier than the general population (Hayes *et al*., 2015). Yet, the United Nations has estimated that up to 75% of people suffering from mental illness in low-income countries are not getting access to care, whereas in high-income countries the percentage still oscillates between 35% and 50%. Mental health problems affect about 84 million people across the EU (OECD/EU, 2018), and the associated costs (both direct and indirect) are substantial. Following one of the awareness message from these leading organizations, an increasing number of European countries are implementing comprehensive policies addressing mental health promotion and awareness.» (EC, 2019, pp. 62, 65)

4. Urban stress cuts across physical and mental health

Stress is a transversal problem that aggregates various organic and psychological disorders caused by diversified stimuli such as physical, emotional, and living conditions, among others. Stress, therefore, affects physical health and/or mental health. Belonging to the social domain, according to Koene, the study of stress has great scientific relevance to the extent that it is researched from social, psychological, or medical perspectives (Koene, 2018a, p. 149). According to the same author «Urban stress is stress in humans, caused by the urban environment.» (Koene, 2018b, p. 3).

Although stress and mental disorders occur mainly in urban environments, the physical and spatial causes have not yet been properly associated (Lederbogen *et al*., 2011), at least at the time of reference. However, due to the increasing number of papers that have been published on the topic most recently, there are reasons to believe that will change and soon, more than just build evidence on associations between the urbanite and stress and mental disorders, causality is on the way. From this interdisciplinary research endeavour, guidelines to integrate urban planning and public health policies will result to foster mental health and prevent or reduce mental illness.

Regarding our proposal of urban health determinants, it is important to note that it was considered that these determinants are the ones that if not considered and taken into account in urban planning then it may be classified as "urban stressors". On the other hand, if they are part of the urban planning and urban design process then it can be named as beneficial elements that increase well-being, happiness, and quality of life, or as "urban conciliators or restorers" in the positive perspective of these determinants.

IV. IDENTIFYING THE DETERMINANTS OF URBAN HEALTH

5. 'Urban' as a determinant

The knowledge that the built environment impacts health has ancient foundations. Until the time of Hippocrates, health and disease were divine attributions of gift or punishment. In his treatise "Of Airs, Waters and Places" he argued that human nature did not depend on the gods and justified the natural influence of the environment and its geographical factors, as well as the influence of physical characteristics of inhabitants of different regions, on health and disease.

The physical dimension of the places and their inhabitants acquired, in the face of growth and development, characteristics that demonstrate differences that were 'labelled' as urban and rural despite being complementary in their functions.

However, in a broader view, the "urban" itself – perceived as a spatial condition and as a way of life – is understood as a determinant of health because it provides unique insights into defining characteristics of cities such as size, density, diversity and complexity (Vlahov *et al.* 2007, p. 22).

The proposed collection of urban health determinants derives from a comprehensive review of the literature. Here, some initial musings, key concepts, through the lens of urban planning and urban design are found and,as a result, five groups of urban determinants, that have a direct or indirect impact on health, emerged. Figure 3 illustrates the methodological approach.
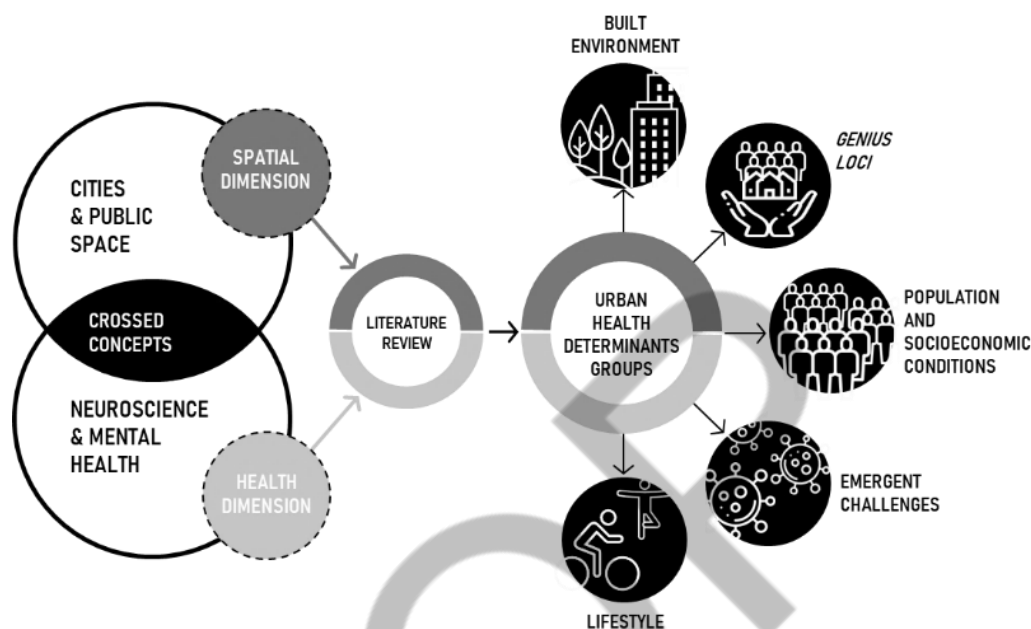
Fig. 3 – A proposal diagram to explain how achieved the five groups of the urban health determinants.
Fig. 3 – Uma proposta de diagrama para explicar como foram alcançados os cinco grupos dos determinantes da saúde urbana.

Conceptually, the representation of the 'determinant collection wheel' (fig. 4), intends to illustrate that any of the determinants can impact negatively or positively on human health (depending on the conditions in which each one is found), that is, they can assume the role of "urban stressors" or "urban conciliators or restorers". Figure 4 also reflects the distribution of the groups of determinants by interpreting the different levels presented in Dahlgren and Whitehead's diagram (fig. 5) and figure 6 show the seven 'sub-determinants' relative to 'urban morphology'.

To explain each of the identified determinants, a table that systematizes and summarizes the findings across the comprehensive review of the literature on the relationship between the built environment and physical and mental health, was built (table 1).

Currently, the scientific work that has made it possible to ascertain the factors that condition mental and physical health in an urban context (table 1), has mainly come from the fields of environmental psychology in dialogue with architecture and, more recently, with urbanism and urban planning.

The advances made in the technological field allow accessing neural signals in real-time as people interact with the built environment, avoiding the limitations and subjectivity of the studies from environmental psychology. Mobile EEG, health wristbands, wearable eye tracking and other wearable biological devices allow to cross biological data with contextual-geographical data and explore associations. (Neale *et al.,* 2019; Pykett *et al.*, 2020)
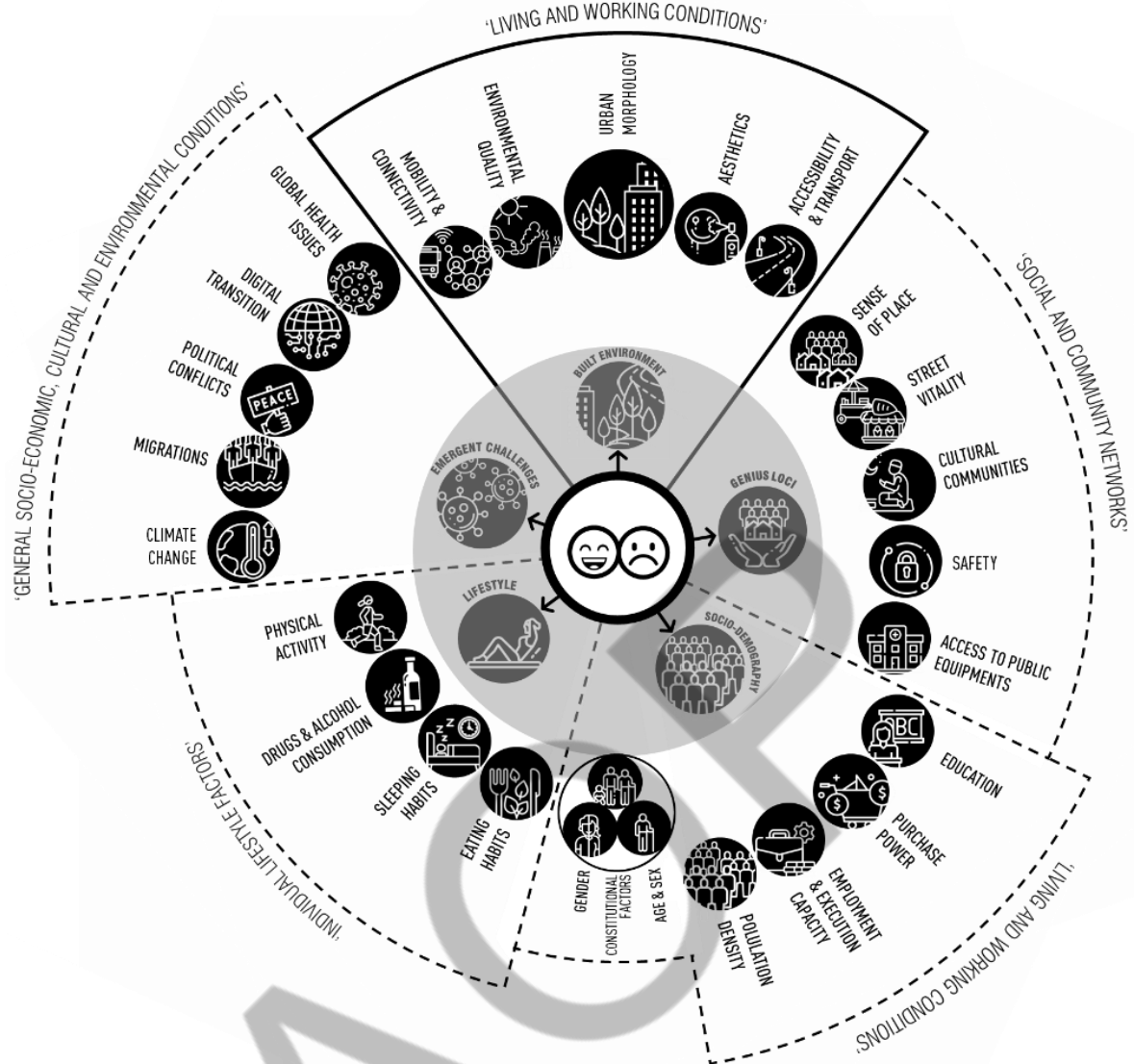
Fig. 4 – Urban health determinants
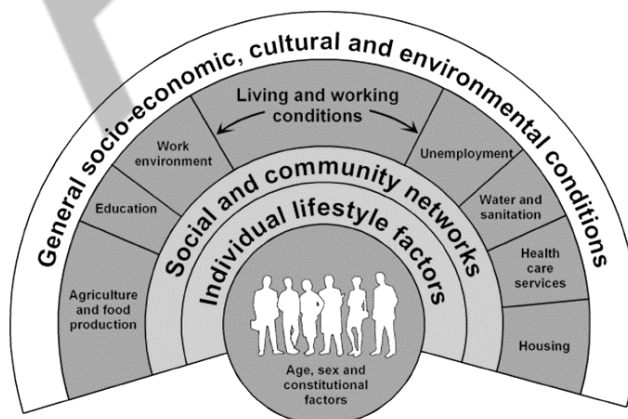*Fig. 4 – Determinantes da saúde urbana*

Fig. 5 – Rainbow model of the determinants of health
Fig. 5 – 'Modelo arco-íris' dos determinantes da saúde
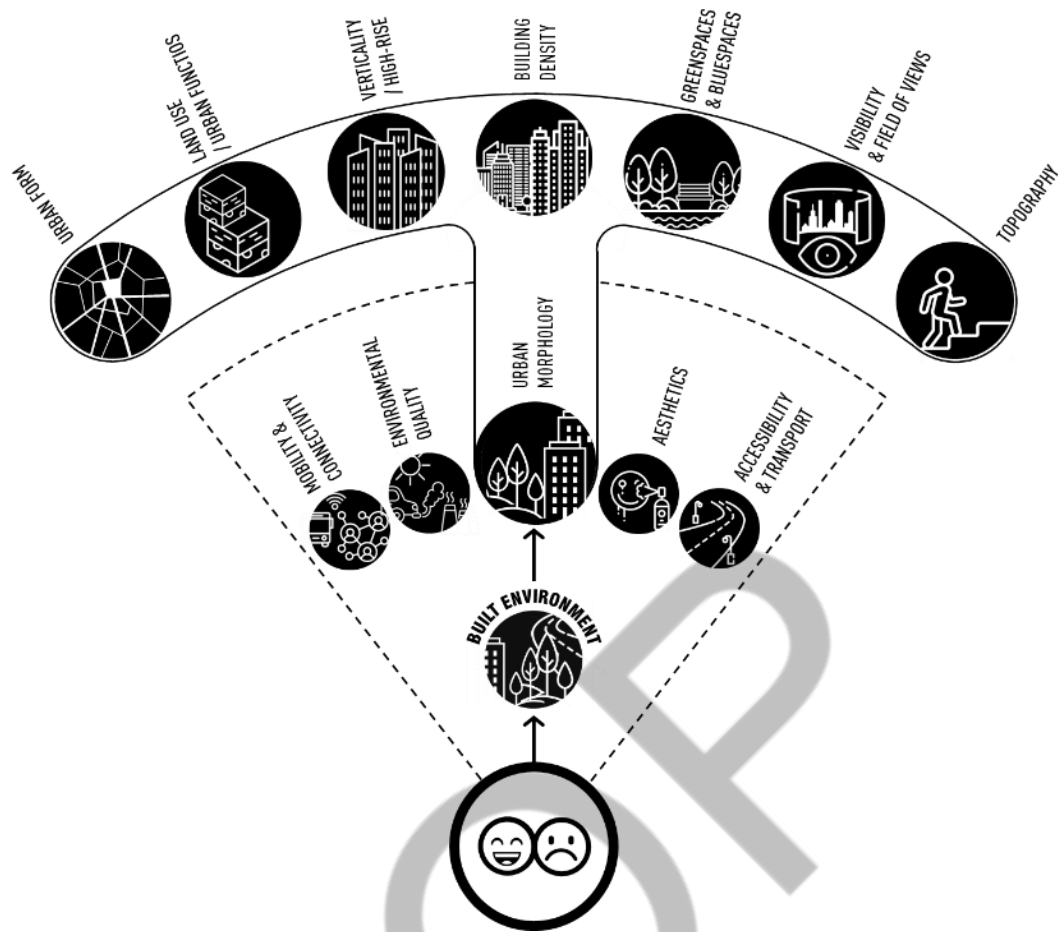Source: Dahlgren and Whitehead, 1991

Fig. 6 – Built environment determinants

Fig. 6 – Determinantes da saúde urbana

Table 1 – Built environment determinants description and its negative impacts

Quadro 1 – Descrição dos factores determinantes do ambiente construído e seus impactos negativos

DETERMINANTS	NEGATIVE IMPACTS
BUILT ENVIRONMENT «Urban environment is defined as ecosystem of an urban area in which the urban residents interact with biotic and abiotic factors.» (Dandotiya, 2019). «What meaning does the built environment have for the inhabitants and the users, or the public or, more correctly, the various publics, since meanings, like the environments that communicate them, are culture specific and hence culturally variable? The point made is that the meaning of many environments is generated through personalization-through taking possession, completing it, changing it. From that point of view the meaning designed into an environment (even if it can be read, which is far from certain) may be inappropriate, particularly if it is a single meaning. What is wrong, I argued, is that we tend to overdesign buildings and other environments.» (Rapoport, 1982, p. 21) «The man-made or modified structures that provide people with living, working, and recreational spaces. (WHO, 2020) OR Buildings, roads, parks, and all other improvements constructed by people that form the physical character of a community.» (Zeenat *et al.*, 2021, p. 6)	
Urban morphology «Urban morphology is the study of human settlements, their structure and the process of their formation and transformation (···) Urban morphology provides a range of concepts and tools that articulate the different aspects and elements of urban form, the relations between them and our role as the agents who create, use and transform them..» (Kropf, 2018).	
Urban form or Urban spatial configuration «The term "urban form" is used to describe a city's physical characteristics. It refers to the size, shape, and configuration of an urban area or its parts. How it will be understood, structured, or analyzed depends on scale. Characteristics of the urban form range from, at a very localized scale, features such as building materials, facades, and fenestration to, at a broader scale, housing type, street type, and their spatial arrangement or layout. The concept of urban form encompasses also non physical aspects such as density.» (Živković, 2020, pp. 862-863). «(...) there is much research revealing that urban areas characterized by a traditional urban fabric are more pedestrian friendly and therefore walkable, so linking these correlations to the effect of neighborhoods versus suburbs on somatic symptoms, anxiety/insomnia, social dysfunction, and severe depression is a natural next step.» (Iravani, 2021, p. 4)	The less friendly the urban form, the more likely it is to cause: – Alienation – Anxiety – Confusion / disorientation – Insomnia – Social dysfunction – Depression
Land Use or Urban function «Land-use: The term used to describe the human use of land. It represents the economic and cultural activities (e.g., agricultural, residential, industrial, mining, and recreational uses) that are practiced at a given place. Public and private lands frequently represent very different uses. For example, urban development seldom occurs on publicly owned lands (e.g., parks, wilderness areas), while privately owned lands are infrequently protected for wilderness uses.» (Kotval *et al.*, 2021, p. 7)	The lack of functional diversity can cause: – Alienation – Depression – Social isolation

	«Urban function can be conceptualized as function of city in relation to the society, hinterland, or other settlements; as activities taking place inside of cities; or as a relation between urban (social) needs and urban (spatial) forms. Urban functions are generator that shape morphological characteristic of urban space. The location, size, and shape of urban space are in direct relation to functional needs of inhabitants or society.» (Živković, 2020, p. 863).	
	Verticality / High-rise «Oppressiveness is defined as the negative feeling resulting from being surrounded by high-rise buildings. Building oppressiveness when combined with other urban stresses contributes towards making compact cities unsustainable.» (Asgarzadeh *et al.*, 2010, p. 555) «Specific urban designs (e.g. tall buildings that may be perceived as oppressive), or more physical threats (e.g., accidents, violence), thereby likely increasing stress levels with negative effects on mental health (…) Moreover, urban street canopy can reduce the "oppressive" effects of tall buildings.» (Gruebner, 2017, pp. 124-125)	The taller the building, the more likely it is to cause: – Oppressiveness – Fear – Anxiety – Stress
	Building density «We seek the density of large cities for their variety of leisure activities, rich cultural life, better access to employment and anonymity; but this seems to come at a cost. We may be paying for it with our health.» (Adli, 2011, p. 3) «Also, as we shall see, high perceived density is based on inferences made by matching perceived characteristics, many of which are related to maintenance, against certain contexts, images, schemata, and norms. Similarly, the sensory cues indicating positive environmental quality often include appearance of newness (that is, low perceived age and no obsolescence), appearance of expensiveness, high levels of maintenance with no deterioration or disorder, and harmony with nature, such as greenery, open space, naturalness, and privacy (Peterson, 1967a, 1967b).» (Rapoport, 1982, pp. 159, 162)	The higher the building density, the more likely it is to cause: – Stress – Anxiety – Mood disorders – Schizophrenia – Depression – Social isolation
	Greenspaces & bluespaces (acessibility and availability) «(⋯) unintentional daily contact to nature through street trees close to the home may reduce the risk of depression, especially for individuals in deprived groups. This has important implications for urban planning and nature-based health interventions in cities.» (Marselle, 2020, p. 1) «Mental health is significantly related to residential distance from parks, with the highest MHI-5 scores among residents within short walking distance from the park (400m) and decreasing significantly over the next distances. The number of visits and physical activity minutes are significantly and independently related to distance, although controlling for them does not reduce the association between distance and mental health.» (Sturm, 2014) «There is an indication that experiencing the natural environment reduces stress levels. The impact of green spaces to mental health also include improved general mood, reduced depressive symptoms, enhanced cognitive functioning, improved mindfulness, short-term memory performance and enhanced creativity.» (Marques da Costa, & Kállay, 2020, p. 7) «(…) the promotion of urban green spaces gains special relevance, namely for the contribution, scientifically proven, of ecosystem services in the regeneration of urban space (Food and Agriculture Organization of the United Nations [FAO-UN], 2019; Haines-Young & Potschin, 2018). According to the Common International Classification of Ecosystem Services (Haines-Young & Potschin, 2018), these are divided into three categories: provisioning, regulating and maintaining, and also cultural.» (Vidal *et al.*, 2021, p.140) «The greenness of European cities has increased by 38% over the last 25 years, with 44% of Europe's urban population currently living within 300 metres of a public park. Well-designed public and green spaces can have a multitude of benefits: improving air quality, providing microclimate regulation, and enhancing safety, social integration and public health.» (EC *et al.*, 2019, p. 7) «Low levels of physical activity have negative implications for the National Health Service [in Portugal] and also for local governments. In fact, the decision making process at this level should frame the relationships of physical activity practice with the proximity of equipment and the mobility of individuals.» (Franco & Marques da Costa, 2021, p. 200) «Blue spaces are: "outdoor environments - either natural or manmade - that prominently feature water and are accessible to humans either proximally (being in, on or near water) or distally/virtually (being able to see, hear or otherwise sense water)" (Grellier *et al.*, 2017, p. 3). Examples include coasts, lakes, ponds and pond systems, wadis systems, artificial buffer basins and water courses. Together with green spaces they form the green-blue infrastructure.» (WHO-UN, 2021, p. 24)	Inadequate interaction with nature, and the lack of natural spaces, the lack of access to and enjoyment of greenspaces or bluespaces can cause: – Decline in overall health – Nuisances – Stress – Depression – Anxiety – Increased mortality – Increased cardiovascular morbidity – Increased prevalence of diabetes
	Visibility / Field of views «Visibility is defined as the relative size of isovist areas, retrieved from an analysis of multiple positions by computing the visibility of positions regularly distributed over the whole environment (Turner *et al.*, 2001). Visibility has been positively related to perceivedsafety in public buildings (Kuliga *et al.*, 2013) and higher pedestrian safety (Stoker *et al.*, 2015).» (Knöll *et al.*, 2018, p. 4). «Visibility is predominant in the human perception of the urban fabric. As illustrations, (Morello & Ratti, 2009) notices that there were "many attempts to translate visual-perception research into architectural and urban design" and, in a famous contribution, (Lynch, 1960) deals with the visual appearance of cities. They assert that city mental maps contain many elements that can describe our experience and the image of the environment.» (Leduc, 2012, p. 67)	The lack of visibility and of an ample field of views can cause: – Stress – Anxiety – Disorientation – Depression – Nuisances
	Topography «Unless factors like weather conditions or topography are controlled for, our understanding of how built environments influence travel will remain murky. (⋯) Our research reveals that urban landscapes in the San Francisco Bay Area generally have a modest and sometimes statistically insignificant effect on walking and bicycling. Although well-connected streets, small city blocks, mixed land uses, and close proximity to retail activities were shown to induce nonmotorized transport, various exogenous factors, such as topography, darkness, and rainfall, had far stronger influences.» (Cervero, 2003, p. 1482)	A very hilly topography can cause: – Fatigue – Cardiovascular diseases An uneven (flat) topography can cause: – Spatial disorientation
	Mobility & connectivity «Commuting by car already starts to have negative effects after only 15 minutes (Office for National Statistics, 2014). There are many reasons for stress in the car, such as traffic jams, construction, long distances (Cityclock, 2014), parking problems (Levy-Leboyer, 1982) and so on. Unpredictability, loss of control and being unable to communicate from the car are the reasons for stress in traffic (Cityclock, 2014)» (Koene, 2018, p. 32) «Mobility: The quality or state of being mobile or movable (Merriam-Webster, 2021).» (Cit by Kotval *et al.*, 2021, p. 9)	Traffic congestion, parking problems, lack of mobility services and lack of connectivity can cause: – Irritability – Anger – Anxiety – Stress

	«Levy-Leboyer (1982, p. 9) states that parking problems make us "experience slavery and alienation". The stress is mainly caused by a lack of parking spaces. This does not only make us stressed, it also makes us violent towards other people (Wilde, 2017). Different resources indicate that 20-44% of the people think that parking is a stressful experience, mostly because of the lack of space, expensive car park charges, incorrect parking and people who take up too much space (England, 2017; Wilde, 2017)» (Koene, 2018, p. 33)	
	Accessibility & transports «Montgomery (2014) states that public transport makes us stressed and unhappy. Commuting by bus is the worst, for trains, trams and subways, the negative effects only start to appear after 30 minutes of commuting (Office for National Statistics, 2014). This stress is probably mostly caused by human behaviour (Zipcar, 2012)» (Koene, 2018, p. 34) «Transportation: (~Transportation Geography) Mobility of people, freight, and information and its spatial organization considering attributes and constraints related to the origin, destination, extent, nature, and purpose of movements.» (Kotval *et al.*, 2021, p. 9) «Transit: The conveyance of persons or goods from one place to another by means of a local or regional public transportation system.» (Kotval *et al.*, 2021, p. 9)	The lack of diversity and frequency of accessibilities and transport can cause: – Unhappy mood – Irritability – Stress
	Aesthetics «The effect of aesthetics on emotions has been documented extensively. We know, for example, that the frequent sight of garbage, graffiti, and disrepair produces alienation and depression, especially among the elderly.» (Montgomery, 2013) «In studying crime and defensible space on the neighborhood level (Taylor *et al.*, 1979), it is clear that signs of disintegration of the social order, including physical deterioration, signs of vandalism, and litter, are extremely important in fear of crime. In other words, deterioration in the physical environment and signs of lack of caring about it are interpreted as signs of erosion of the social order and hence perceived as crime, with resultant fear.» (Rapoport, 1982, p. 171).	The physical deterioration, signs of vandalism and lack of caring can cause: – Alienation – Apathy – Social dysfunctions – Fear – Insecurity – Depression
	Environmental Quality To determine this indicator we considered the following factors: 1) **air pollution**; 2) **noise pollution**; 3) **light pollution**; 4) **natural light conditions**; and 5) **urban comfort**. About **air pollution**: According to the European Environment Agency (EEA) «Air pollution is the largest environmental health risk in Europe and significantly impacts the health of the European population, particularly in urban areas. While emissions of key air pollutants and their concentrations in ambient air have fallen significantly over the past two decades in Europe, air quality remains poor in many areas.» (EEA, 2022) According to Gosling, «In the US, the *Air Quality Index* is determined by the maximum concentration of ozone, particulate pollution, carbon monoxide, sulphur dioxide, and nitrogen dioxide, where the concentration of each pollutant is normalized on a unitless 1‑500 scale, where a value of 100 corresponds to the relevant national ambient air quality standard.» (Gosling *et al.*, pp. 279, 280) About **noise pollution**: «The human ear is the organ of the body that directly responds to sound and can be damaged if the sounds are too loud. Unwanted, uncontrollable, and unpredictable sounds, whether soft or loud - labelled noise - can be annoying and very disturbing. The body reacts to the annoyance of these unwanted sounds, or noises, through a complex set of physiological responses that are collectively labeled stress. These physiological responses can include: a rise in blood pressure, excessive secretion of certain hormones, a change in heart rhythm, or a slowing down of digestion. Should the noise continue to be disturbing and the stress reaction sustained, then permanent ailments may occur in the circulatory, cardiovascular, or gastrointestinal system. Thus, noise mediated by stress can affect many organs of the body indirectly.» (Bronzaft, 2002, p. 501) «Noise: Any sound that is undesirable because it interferes with speech and hearing, is intense enough to damage hearing, or is otherwise annoying.» (Kotval *et al.*, 2021, 2021, p. 8) About **light pollution**: Is described by Chepesiuk as «artificial outdoor lighting becomes inefficient, annoying, and unnecessary. (···) a growing body of scientific research suggests that light pollution can have lasting adverse effects on both human and wildlife health. (···) Melatonin, a hormone produced by the pineal gland, is secreted at night and is known for helping to regulate the body's biologic clock. Melatonin triggers a host of biologic activities, possibly including a nocturnal reduction in the body's production of estrogen.» (Chepesiuk, 2009, pp. A21, A22, A26) «Unfortunately, modern society has modified this life-governing cycle by stressing maximum production and by giving insufficient attention to the ecological balance and homeostasis of the human metabolism. The concept of light pollution is well-known today as the presence of electrical light during a period of natural darkness (Falchi *et al.*, 2011; Riegel, 1973; Settele, 2009).» (Harb *et al.*, 2015, p. 368) «Light pollution: Artificial outdoor lighting extending over its functional role (to enhance visibility or aesthetics in the night-time environment). Light pollution comes in many forms, including sky glow, light trespass, glare, and over illumination.» (Kotval *et al.*, 2021, p. 8) About **natural light conditions**: «(···) not only may light pollution affect human physiology but also lack of exposure to natural light is related to high levels of cortisol and lower levels of melatonin at night, and these, in turn, are related to depressive symptoms and poor quality of sleep. (···) This light pattern has been correlated with an increased prevalence of obesity (Ruger & Scheer, 2009; Suwazono *et al.*, 2008), psychiatric disorders (Healy *et al.*, 1993), cardiovascular disease (Ruger & Scheer, 2009) and breast cancer (Lie *et al.*, 2006; Stevens *et al.*, 2011).» (Harb *et al.*, 2015, pp. 368, 369) About **urban comfort**: Urban comfort can be considered as a set of tangible and intangible factors, from the physical to the social, and cannot be reduced to the thermal comfort already widely studied by science. According to Tavares «Urban comfort presents an innovative	**Air pollution** can cause: – Anxiety – Autism and child behaviour problems – Cognitive impairment – Dementia – Stress – Mood disorders – Respiratory diseases (asthma, pneumonia, lung cancer, etc.) – Myocardial infarction – Arrhythmia – Heart congestive failure – Cardiovascular diseases – Neonatal disorders – Deep venous thrombosis – Diabetes – Systemic inflammation – Increase in mortality **Noise pollution** can cause: – Annoyance – Sleep disorders or insomnia – Cognitive impairment – Depression – Learning impairment in children – Stress – Tinnitus or deafness – Cardiovascular diseases – Respiratory diseases – Cerebrovascular diseases – Gastrointestinal diseases – Increase in mortality – Reduced cognitive performance in children – Premature deaths – Ischemic heart disease **Light pollution** can cause: – Deconcentration / Distraction – Depression – Sleep disorders or insomnia – Obesity – Cardiovascular diseases – Breast cancer The lack of **natural light** can cause: – Sleep disorders – Deconcentration – Poor memory – Irritability – Mood disorders – Anxiety – Depression The lack of **urban comfort**, in particular the urban heat, can cause: – Cognitive impairment

perspective regarding the influence of local sociocultural values on responses to climate. It is a cultural product, which takes human adaptation as central to the urban climate experience. The urban comfort concept is based on the premise that people adapt to the urban microclimate if they have reasons to do so, however, these reasons vary according to culture The physical and social landscape as constituent of the climate experience.» (Tavares, 2017, p. 49). From the perspective of outdoor thermal comfort, Gosling defines the universal thermal climate index (UTCI) as «(···) an international standard performed by the European Cooperation in Science and Technology (COST) Action 730, based on recent research in human response-related thermo-physiological modelling(COST2011). For any combination of air temperature, wind, radiation, and humidity (stress), UTCI is defined as the iso-thermal air temperature of the reference condition that would elicit the same dynamic response (strain) of the physiological model (Jendritzky *et al.*, 2012).» (Gosling *et al.*, p. 301)	– Deconcentration – Dementia – Neurodegenerative diseases – Respiratory diseases – Cardiovascular diseases – Cerebrovascular diseases – Hypertension – Breast cancer – Obesity – Diabetes – Metabolic syndrome – Colon cancer – Increase in mortality

V.   FINAL REMARKS

Although urbanization and city living offer many socioeconomic advantages, it can also be stressful. Today, there's a growing recognition that health, and more specifically mental health, must be addressed taking into account social and environmental context. Therefore, health inputs are critical to urban planning, as mental health/illness is highly correlated with the urban environment and lifestyle. However, we argue that not enough work has been done to integrate neuroscience content into urban planning and urban design.

To create healthier and sustainable cities and promote general well-being, urban planning must adopt neurourbanism principles, which means capturing brain signals triggered by the built environment stimulus and objectively uncovering how this impacts on people's perception, cognition/emotions, and behaviour.

A healthy city and community contribute to citizens' empowerment which in turn raise awareness on politicians and professionals for taking action and address risk factors, e.g. noise, pollution, traffic jam, high density, accessibility, lack of green spaces and shadows, etc. that impact negatively on peoples mental health and well-being.

In the same sense, urban planning and design can positively contribute to mental health. Having scientific evidence, on what type of built and natural environment triggers positive emotions, promotes physical activity, reduces levels of stress and anxiety, will inform urban planners and urban designers, and empower them to (re)design healthier and more people-friendly cities.

The consolidation process of this new discipline, whose empirical evidence has claims to be fundamental for the future of cities and citizens, involves finding scientifically sound answers to a set of still open questions, such as:
–   When and where will neuroubanism be practised?
–   Who will be the agents disseminating and practising the discipline?
–   Will it only be the Academy that educates this new discipline, bringing together neuroscience and urbanism?
–   Hou urban design of public spaces can be re-designed?
–   How to integrate co-creation and place making within neurourbanism?
–   How to involve local communities and stakeholders in the process?
–   Will health centres be the first vehicle for the practice of neurourbanism, where, for example, family doctors (with complementary training in the new discipline) may prescribe the directed fruition of urban spaces, green spaces or waterfronts, instead of anxiolytics and antidepressants?
–   Which spatial planning toolkit integrates guiding measures coming from neurourbanism?
–   How to have citizens as a reliable source of information?
–   What methods and techniques should be adopted to produce, capture and analyse data?
–   Who's responsible to produce and disseminate such data at neighbourhood/street scale level?

The relevance of this issue was pre-pandemic, however, it was covid-19 pandemic that bring people's attention to the importance of mental health and its relationship with the built environment. The European Union created a 'European Urban Health Cluster' before the pandemic under the theme 'Innovative actions to improve urban health and well-being', addressing environmental, climatic and socio-economic factors with the objectives of optimising synergies and promoting urban health in the European Urban Agenda.

There is a long-term search to identify urban variables and indicators related (directly or

indirectly) to mental health, at different scales, with different natures and typologies, being very difficult to set universal parameters given the territorial and cultural differences of the multiple territorial settings analysed. For this reason, the diversity of social contexts, case studies and scales of analysis and the non-inclusion of factors of cultural contexts are pointed out as limitations in most articles. The lack of use of technology to obtain quantifiable biosensory data are also some of the limitations detected. As a consequence, scientific papers are often restricted in their analysis to "empirical evidence", surveys and policy documents. The evidence results, mostly, from experiences in urban spaces, by structural or ephemeral interventions or by the absence of either, whose conclusions are the result of continuous observation, not always standardized and whose conclusions constitute empirical knowledge in continuous development.

In the relationship between what is scientific and what is empirical, science must continuously add new knowledge to what has already been acquired, respond to new challenges and draw inspiration from reality. Public policies should seek robustness in this new scientific knowledge. Based on evidence from current projects (such as the one's forming the Urban Health Cluster) and future ones, by 2050 (when an estimated two-thirds of the world's population live in cities) neurourbanism must be a full-fledged discipline.

This paper stands as a contribution towards that end. However, future research is currently under development to dive more in-depth into the topic, namely to 1) find indicators that can make the determinants measurable; and consequently 2) to define actions that can be translated into public policies on urban planning and health. Moreover, with the general recognition that science supports the better decision and help policymakers to meet people's needs, it is anticipated that will be opportunities for more pilot studies on human-scale which in turn will push authorities to provide more meaningful and trustworthy data, with suitable scale granularity and that can be systematically produced and collected, and integrated into urban planning, and from there to the street's realm.

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ORCID ID

Ana Bonifácio https://orcid.org/0000-0002-1704-147X
Paulo Morgado https://orcid.org/0000-0002-3220-4943
Angeliki Peponi https://orcid.org/0000-0001-6191-7320
Leonardo Ancora 0000-0002-3928-5395
Diego Andrés Blanco-Mora https://orcid.org/0000-0003-2232-0999
Marta Conceição https://orcid.org/0000-0002-7254-2592
Bruno Miranda https://orcid.org/0000-0003-4660-6051

AUTHOR'S CONTRIBUTIONS

Ana Bonifácio: Conceptualisation; Methodology; Formal analysis; Research; Collection of scientific literature and policy documents; Infographics; Writing - preparation of original draft; Writing - revision and editing. **Paulo Morgado**: Conceptualisation; Methodology; Formal analysis; Research; Writing - revision and editing; Visualisation; Supervision. **Angeliki Peponi**: Methodology. **Leonardo Ancora**: Research. **Diego Andrés-Blanco Mora**: Research. **Marta Conceição**: Research. **Bruno Miranda**: Visualization; Research.

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