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Identifying the Dimensions and Components of the Health-oriented Urban Form with An Emphasis on the Epidemic Disease: A systematic scoping review

Helia Sareminia[1], Fatemeh Mohammadniay Gharaei[2*], Sanaz Saeidi Mofrad[3], Sulmaz Ghahramani[4,5]

[1] *PhD candidate, Department of urbanism, Mashhad Branch, Islamic Azad University, Mashhad, Iran.*
[2] *Assistant professor, Department of Urbanism, Mashhad branch, Islamic Azad University, Mashhad, Iran.*
[3] *Assistant professor, Department of Urbanism, Mashhad branch, Islamic Azad University, Mashhad, Iran.*
[4] *Department of Urbanism, Mashhad branch, Islamic Azad University, Mashhad, Iran*
[5] *Health Policy Research Center, Institute of Health, Shiraz University of Medical Sciences, Shiraz, Iran*

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Abstract

A review of human history, activity and technology shows that, the changes in the environment and the health of citizens have gone together as an inseparable factor. Cities are complex systems that Recent developments in the lifestyle of people have caused the emergence of non-communicable diseases among the residents of cities. Furthermore, in recent decades, the world has witnessed a variety of emerging infectious diseases, some of which developed to pandemic world threatening outbreaks. This paper, as far as we know of, is the comprehensive and first review to evaluate relationship between the characteristics of urban form and urban health with an emphasis on epidemic diseases. Through a systematic review, the first step, compiled urban form characteristics that affect urban health, and then identified potential synergies and trade-offs between these dimensions. Research sources were examined based on the world's most authoritative scientific database. In the second step, resource retrieval was performed based on keywords, title and abstract, and finally, in the third step, analysis and conceptual model were developed. A framework based on the Health-oriented Urban Form (HUF) is proposed, synthesizing the inter linkages between urban form and urban health; providing a new holistic perspective on the topic. Looking at the communicable and non-communicable disease -physical and non-physical-urban form characteristics - technology and nature relationships simultaneously may contribute to practical guidance opportunity to build better and more sustainable societies and cities.

Keywords: *urban form, urban health, epidemic diseases, technology, nature, systematic review*

1. Background

Cities are considered the most obvious environment of human life, currently, more than half of the world's population lives in cities, with the growing trend of urbanization, urban issues have also become more complex, but cities are responsible for meeting the needs of their residents.

*Corresponding author: mohammadnia5204@mshdiau.ac.ir

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The needs that have never been fixed and with the advancement of technology and changes in the lifestyle of citizens, have overshadowed the different aspects of human life. Meanwhile, health is one of the issues that should be paid attention to because all social efforts are aimed at providing a center that leads to the development of peace and physical and mental health of the people of that society, but without knowing the factors that affect health, this is impossible. Today, this concept has gradually expanded and has become a social model and a global goal from an individual concept. Recent developments in the lifestyle of people have caused a decrease in the level of public health among the residents of cities. The environment of cities is one of the places that influence this issue. This literature covers a wide range of possible elements for both physical and non-physical features, which represent urban form. However, not all elements of urban form described in the literature can be simply examined and applied in this study.

In general, neither urban form nor health can be easily defined and measured. Both are very broad concepts and the relationship between them is complex. No single study can address the full spectrum of the issue, especially when there is still no consensus on definitions. The discovery and comprehensive investigation of the relationship between urban form and urban health is beyond the timeline and capacity of the present research. The lack of research that examines all the dimensions, characteristics and components of this concept and provides a comprehensive understanding of the HUF is felt. Therefore, this study examines several aspects of this relationship and is more comprehensive than other existing studies. Quantitative measurements of urban form elements require a large amount of data, including land use, street layout, buildings, and demographics at very fine scales, and urban health measures economic, social, and environmental dimensions. In other words, spiritual, social, psychological and physical dimensions that also require a wide range of data at a local and accessible level.

To help create a HUF in line with the development of public health in cities, this paper aims to review (a) the available evidence on how urban form has been related to the public health of citizens; (b) provides a list of HUF indicators used in these studies. c) It identifies potential synergies and exchanges between these two dimensions and (d) a framework based on the health approach to identify the dimensions and components of the concept of HUF to discover mutual links in relation to health and urban form and to try to achieve It offers a comprehensive understanding of it.

2. Methods

2.1. Search Strategy

In the leading research, the effort is to eliminate the gap in the field of lack of coherence and the possibility of comparing the studies conducted in the field of extensive literature related to the identification and measurement of the relationship between urban form and health. A systematic review was conducted to identify studies that linked health with urban form, and the indicators used in their analyzes were extracted. A database search was performed (Elsevier/Science Direct). For the dimension of public health, the selected keywords were ("health" or "public health" or "urban health") and ("physical health" or "mental health" or "infectious diseases") as well as the terms "pandemic" and "epidemic" used in health studies. The keywords "health" and "public health" were used to retrieve a wide range of studies in this dimension, while "physical health" and "mental health" and "infectious diseases" were used to collect studies in the field of urban health. For the urban form dimension, the term "urban form" was used.

The next step of terms was included to guide the search towards studies that not only describe urban form, but also examine its indicators. In both searches, terms in the title, abstract, or keywords specified by the author were included. There were no restrictions on geographical location and time period.

Research Method

In this article, the recent literature in the field of the relationship between "urban form and health" in the mentioned scientific database (Elsevier /Science Direct), keywords "urban form and health" and "relationship between urban form and health" were searched in the subject or title, which was found 4795 articles were found. In order to identify a manageable subset of these articles, the most relevant articles containing both the words "urban form" or "health" and their derivatives were selected from among the obtained results. In the following, the articles that, despite the fact that their titles contain the desired words of this research, were removed from the list of sources of this article due to the lack of consistency in terms of content with other articles considered in this research and belonging to other fields of science. This process led to finally meta analyzing 9 articles on the relationship between urban form and health with an emphasis on epidemic diseases as case examples of this study. It should be noted that the articles that examined only one component of the urban form were also removed from the list of selected articles. Figure 1 shows this systematic process of selecting the articles to be studied.

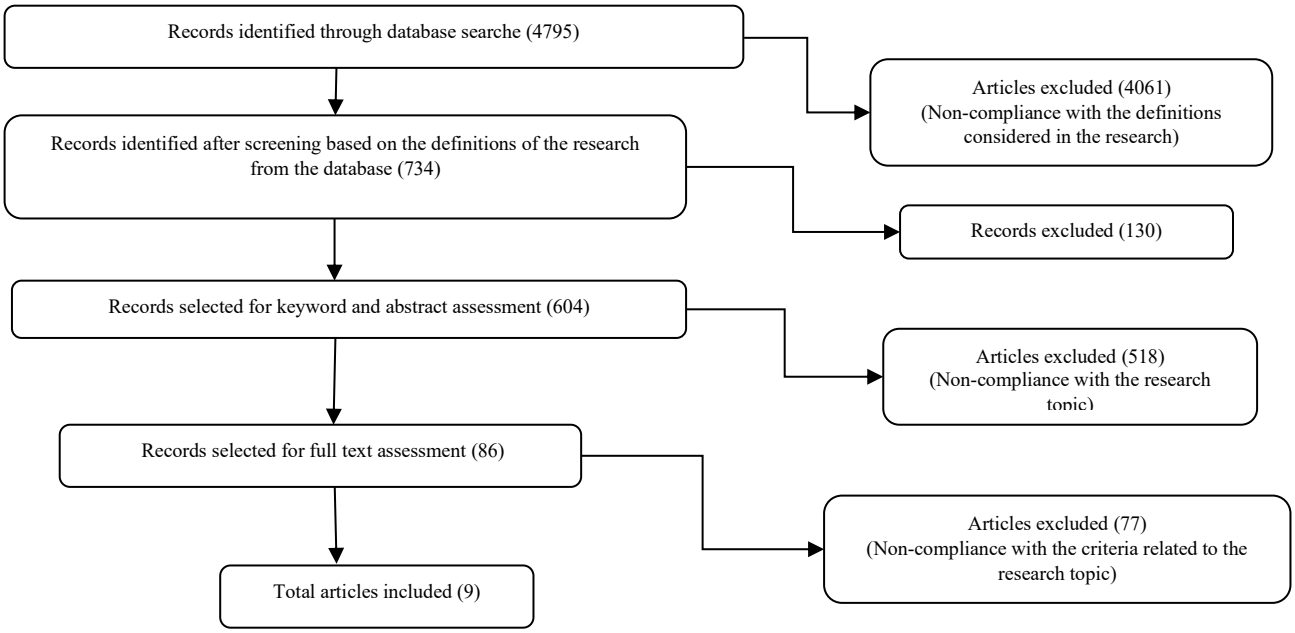

Fig. 1. Flow diagram illustrating the selection process of studies included in the systematic review

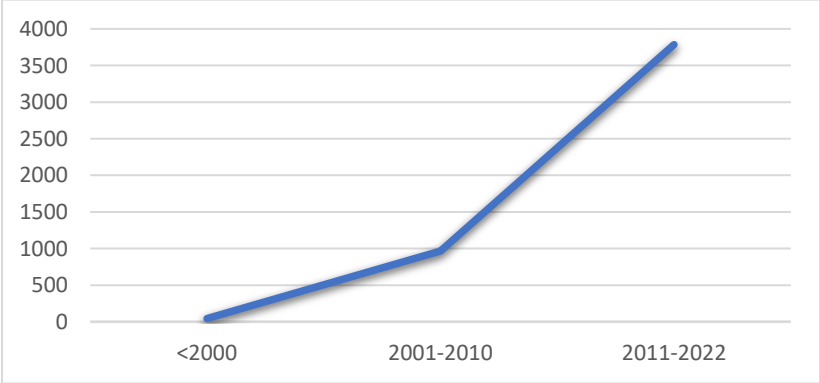

Chart 1. The number of reviewed articles of the current research based on the year of publication

The above graph shows that the issue of the relationship between urban form and health over time, especially in the last decade, has attracted the attention of many researchers.

2.2. Eligibility and selection criteria

Records were selected for full-text evaluation based on titles and abstracts. Articles that were not compatible with the definitions of urban form, public health, physical and mental health, and disease and urban form components adopted in this study and described below were excluded. Only records in English were included. Articles were selected that presented more than one significant effect of urban form characteristics on measures related to health or its support and described how the index was measured.

In this study, urban health, physical and mental health, infectious diseases and pandemics or epidemics were considered, the definition of health that is widely accepted is the definition stated by the World Health Organization in the introduction of its statutes. It is as follows: "Health is a state of complete physical, mental and social well-being and not only the absence of disease and disability" [1]. Articles were excluded when the studied subjects were not included in the field of urban studies, or its characteristics were integrated into the main component factors and its effects could not be evaluated.

Cities consist not only of land, buildings, streets, blocks (physical elements), but also of human characteristics (non-physical characteristics). A place without human habitation cannot even be defined as a city. From this point of view, urban form as a term is capable of describing physical and human (non-physical) attributes. Therefore, for the urban form, the definition of Dempsey et al. (2010) [2] and Živković (2019) [3] was used, a definition that describes the urban form as the physical and non-physical characteristics of the city.

Following a wide range of measurements related to urban form components, we eliminated articles that only focused on one component and indicator. Articles that integrated the characteristics of the urban form into the main component factors and its effects could not be evaluated or only one characteristic of the urban form were examined were excluded. Therefore, the articles that evaluated both the main keywords of the research were evaluated in the final analysis.

Finally, for urban health, we considered response variables that are reflected in physical and mental health and disease, which are related to the components of the urban form to cope with changes and meet the daily life needs of citizens. In the cases that were not limited to the city and urban form, also the health effects in the city and citizens were not considered and the focus was on other fields, tendencies and concepts, the articles were removed.

2.3. Data extraction

From each study, we systematically extracted the following data:

(a) Indicators of urban form quality that were statistically significant, and their description (independent variables);

(b) The measure used to quantify health outcome or state (dependent variables);

(c) The observed effect of the independent variable on the dependent variable. We only considered analysis with clear and significant results (i.e., p-value <.05 and 95% CI not overlapping with zero), and with the direction of the relationship (i.e., positive or negative effect for continuous variables, and the category with the strongest effect for categorical variables);

2.4. Framework development

Although the dimensions that make up urban health, that is, physical health, mental health, and diseases, should be considered equally, studies under this approach have usually focused on physical and mental health in the urban environment. Also, in most of the urban form components investigated in the existing studies, only a few components and limited indicators have been discussed and physical components are examined in most of the studies, while considering non-physical components is also

important in the field of urban health studies. Based on data extracted from the systematic review, we developed a framework that (a) illustrates the factors that link urban form to health; (b) The relationship between urban form and urban health. c) Connections between two dimensions. and (d) external stimuli that potentially affect the system.

3. Results

A general search in the field of health and urban form presented 4795 scientific sources including articles and books, while most of the mentioned sources did not match the criteria of the present research, therefore, by focusing on urban health and urban form according to the previously mentioned definitions, the screening of the sources was obtained. It was stated that the search in the urban health dimension resulted in 734 files, which included 515 research articles, 88 review articles, and 130 chapters of books and encyclopedias, according to the purpose of the research, which is to review articles, a total of 603 articles were identified through the steps Data in Figure 1 were screened, resulting in 9 articles included in this review. After screening the titles and abstracts using the selection criteria, 86 articles were selected for the full text evaluation, considering that the aim of the upcoming research is to examine the common and comprehensive criteria regarding the health-oriented urban form. Finally, 9 studies that met the criteria presented, were considered in this review. In the table below, the number of articles by topics is given separately, which shows the frequency of studies in the field of physical and mental health.

Table 1: The number of articles on various topics separately

Selected keywords	Number	Type		
		Review article	Research article	Book or encyclopedia
""Infection disease" +"urban form	7	2	4	1
"pandemic disease" +"urban form"	3	0	2	1
"epidemic disease" +"urban form"	13	0	7	5
"mental health" +"urban form"	459	62	312	85
"physical health" +"urban form"	252	24	190	38
Total	734	88	515	130

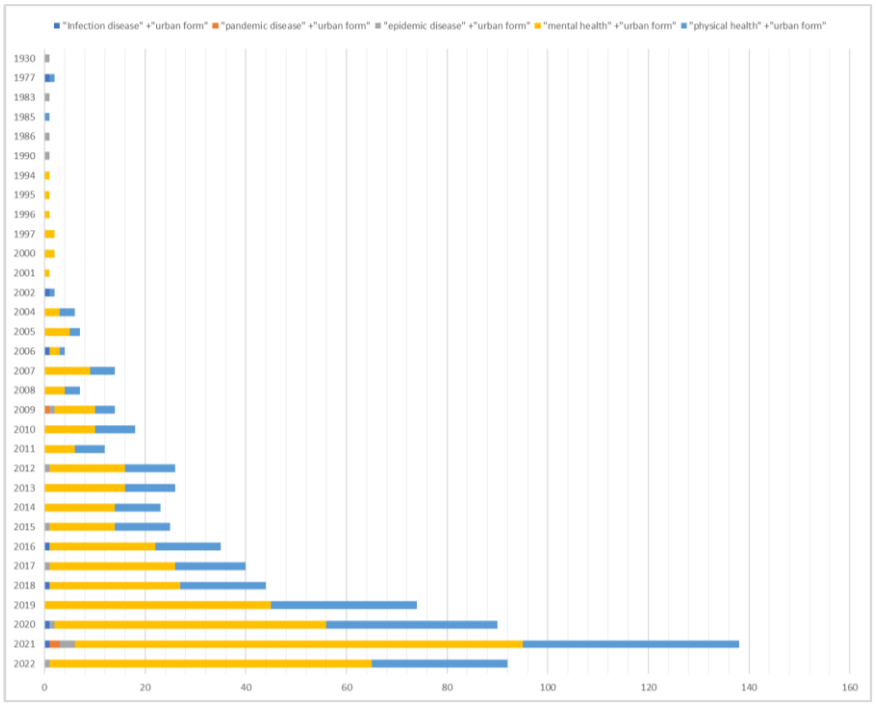

Chart 2: Articles obtained based on the number and year in each health field

From all health articles screened, two main study designs were identified. The first one includes epidemiological studies where health data are collected about communicable and non-communicable diseases. The design of the second study refers to experimental studies in the field of physical and mental health, and due to the novelty of studies in this field, comprehensive studies that examine form and health together are limited.

3.1. Indicators of health-oriented urban form

From the selected articles, 59 indicators of urban form were obtained with an emphasis on urban health (Table 4). The obtained indicators are divided into two parts: physical components with indicators of density, diversity, mixing of land use, access, design and housing and non-physical components with managerial (3 factors), social (4 factors), economic (3 factors) indicators.) and environment (3 factors) and we divided the number of indicators obtained separately in the following diagram. In general, physical indicators make up the majority of indicators. Three studies examined social indicators and only one study examined all the above dimensions and components.

Table 2: non-physical components in selected articles

Table 3: Physical components in selected articles

First Author, Year	Scope	Research Areas	Non-Physical Components			
			Environmental	Social	Economical	Managerial
			Indicators			
Qin, 2017[4]	The relationship between the observed and perceived neighborhood environment (physical and social)	Components of Built environment and social capital	-	social capital	-	-
Mouratidis, 2017 [5]	How urban form affects social life and personal relationships	Components of urban form (built environment) and determinants of personal relationships	-	personal relationships (number of friends, opportunity to meet new people and support from friends)	-	-
Sharifi ، 2020 [6]	Environmental quality, socio-economic effects, management and governance and transportation and urban design	Air quality, environmental factors and urban water cycle socio-economic impact Governance and smart city Transportation and urban design	Including: traffic and non-traffic pollution, environmental factors such as temperature, humidity and wind speed, etc., urban water cycle including: pollution of water sources, water disinfection and wastewater treatment and variety of water uses in businesses and industries	social inequalities in urban neighborhoods and vulnerable groups, sense of community	diversity of economic structure, local supply chain, support of vulnerable groups	management planning (perspective and urban governance) and community participation, access to urban data and benefiting from technology in all dimensions.

First Author, Year	Scope	Research Areas	Physical Components					
			Density	Concentration And Proximity	Diversity	Access	Design	Housing
			Indicators					
King, 2013 [7]	Spatial effects on health outcomes (assesses of built environment characteristics, walkable urban form)	built environment	residential density	-	mixing of land use (area based on entropy and landscape based on the number of lands uses in the neighborhood cluster)	intersection density	-	-
Qin, 2017 [4]	The relationship between the observed and perceived neighborhood environment (physical and social)	Components of built environment and social capital	-	proximity to the urban park	mixed land use	-	neighborhood size	area ratio, building coverage ratio
Mouratidis, 2017 [5]	How urban form affects social life and personal relationships	Components of urban form (built environment) and determinants of personal relationships	population density	distance from the city center	mixing of land use (cafes, restaurants, etc. at a distance of 1000 meters)	-	-	-
Sharifi, 2020 [6]	Environmental quality, socio-economic effects, management and governance and transportation and urban design	Air quality, environmental factors and urban water cycle socio-economic impact Governance and smart city Transportation and urban design	density	amenities and urban infrastructure	-	active transport	green, open and public space, compact urban developments	-
Sharifi, 2021 [8]	Factors of urban form	Physical environment, land use and public transportation facilities	building density	utilities and facilities to meet the daily needs of residents. these include the availability and distribution pattern of uses and amenities such as neighborhood centers and chain stores.	-	transportation facilities (i.e., subway stations, bus stations, and gas stations)	green and open space ratio, to show the open level of the neighborhood	-
Mouratidis, 2021 [9]	The physical characteristics of cities change to	Built environment	-	land use	-	transportation systems	urban design	housing

	accommodate new residents.							
Han, 2021 [10]	Analysis of the main characteristics of the city and design components and urban form	City size, city density, urban form and city connectivity	population size, density	-	-	intra-city connection (public transport), inter-city connection	the shape of the city (urban morphology)	-
Mouratidis, 2022 [11]	The built environment is related to far and near activities	Built environment	neighborhood density	distance to city center, local amenities, (ict) technology	-	public transportation	green space	-
Mouratidis, 2022 [12]	Compact urban form indicators	Built environment	neighborhood density	local amenities, distance to city center	-	public transportation	green space	apartment, housing size

4. Discuss

Based on both historical and contemporary perspectives, the components of urban design and urban planning (city density, street design, public transportation, public spaces, parks and green areas, and building design) in facing cities with major risks such as epidemics, with an increasing number of cases Positive and mortality related to the size of cities and population density are related to the health of the population.

The limited but developing literature on the relationship between urban form and public health indicates that density is one of the elements of urban form that is much discussed in such studies. In the field of community planning and land development, “density” is a term that has been widely used without fully understanding [13]. It should be noted that there is no right or wrong application among these density definitions and measurements, only the most appropriate one to use in different scenarios.

Among the factors of urban form (physical environment, land use and public transportation facilities), the strongest relationship with the disease rate in neighborhoods is related to land use. Also, when all three main measures of urban form are examined in one model, it is the distance to the city center that has the strongest and most significant overall effect on satisfaction with personal relationships. Residents who live closer to the city center are significantly more satisfied with their personal relationships and have larger networks of close relationships, meet friends and relatives regularly, and receive stronger social support [5].

Based on the results, the fact that social life and personal relationships are facilitated by compactness can be attributed to three factors related to its structural features: (1) more people in close proximity due to high density and centrality, (2) greater access to "third places" (community centers, cafes, restaurants, etc.), and (3) greater accessibility to and from other areas due to centrality and public transportation.

The most important and fundamental finding is that local amenities are associated with less change (decrease) in public health from pre-Covid-19. This finding suggests that those living in close proximity to multiple local facilities experienced less decline in general health during the pandemic.

Public transportation has been severely affected during the pandemic, with many people turning to private vehicles and cycling/walking as safer alternatives. While the increasing interest in personal vehicles poses a threat to achieving sustainable development, the increasing number of cyclists in many cities around the world provides a unique opportunity to promote a cycling culture in cities. This may turn temporary cyclists into permanent cyclists [6]. According to a study by Birch 2020 [14], [15]; If neighborhoods are changed to be more walkable and placed services and jobs in those communities; cities can be able to mitigate the intense congestion and crowding that you have in various systems such as public transit".

Anthropologically, walking isn't only a kind of human movement, but also a culture and social practice that can promote physical activity and affect the residents' health besides increasing the value of urban spaces [16], [17]. Numerous other research demonstrated the importance of incorporating the walkability index in the urban environment and its beneficial effects on health, economic, and other aspects [18], [19]. In addition, when redesigning the streets and taking into account increased pedestrian spaces and active mobility, many public health goals can be achieved [20]. It aims to create healthier and more social-sustainable cities that affect citizens' behavior in the time of pandemics [21].

City and urban design may need to be revised from a population density point of view, which is one of the most basic factors affecting the spread of an epidemic; In other words, the greater the population density, the greater the risk of infection [22].

Among the five observed neighborhood form characteristics (distance, building coverage ratio, mixed land use, neighborhood size, and proximity to an urban park), proximity to an urban park is the only one that shows a significant association with subjective well-being [4].

A great proposed idea for green infrastructure, which improves public health benefits, is to have a connected system of green areas. This system is more useful than scattered parks and means having a network of different scales and using parks through which residents can move more easily and connect with nature. It is urgent to rethink how land is used with landscapes and urban farming integrated approaches [23]. Urban agriculture has been recently growing, strengthening self-sustaining communities to become more resilient to the epidemic. Farming could improve food security and nutrition, reduce climate change impacts, and lower stress. In this context, vertical and urban gardens should be flourishing [24]. Urban farming integrated approaches have been implemented using the latest designs and technologies with other architectural approaches [25].

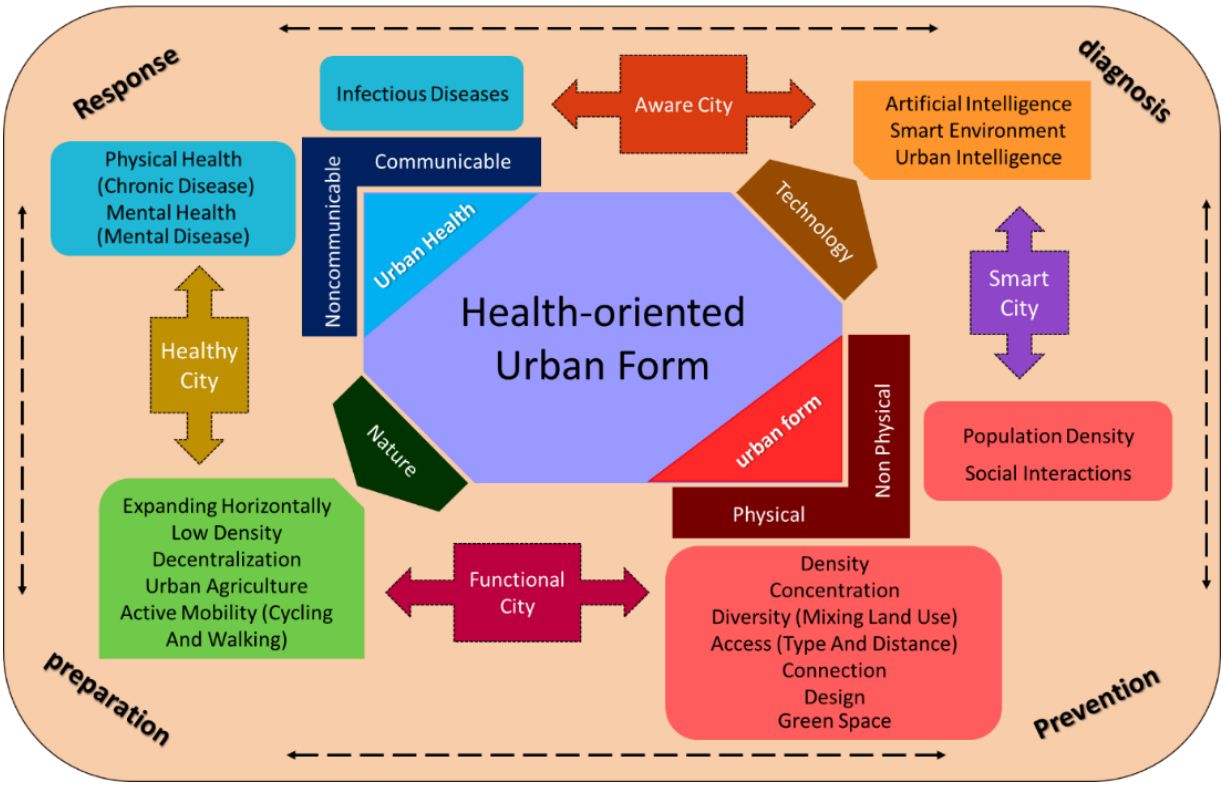

Figure 2: Development framework of health-oriented urban form

The framework for the development of a health-oriented urban form

According to a study by Elgheznawy and Eltarabily 2020, it is found that the optimal design for cities, especially during the current crisis, is based on three main pillars, which consider the city to be smart, sustainable, and comprehensive, taking into account societal design. These characteristics will make cities more effective in the direction of future crises [26]. Through the study, resulted in a list of potential synergies and trade-offs between urban form and health. Here, we propose an integrative framework based on HUF that summarizes the findings of the systematic review and identifies key interlinkages between the components of urban form (physical and non-physical) and urban health (physical, mental health, and disease).

Specifically, it depicts the relationships at the levels of urban form, urban health, nature and technology as complementary to the main components and is structured in such a way that all the indicators and effective variables extracted in this survey create the framework.

According to the findings obtained in the research, the components of urban form focused on two physical dimensions with specified indicators in the framework and non-physical dimension focusing on social indicators, urban health components with emphasis on physical and mental health and diseases. And the two components of nature and technology were considered as complements to the development of a health-oriented urban form.

From the relationship of both specified components, four approaches were obtained, which are specified in the figure 2. The approach of the healthy city is the integration of the components of nature and urban health, where the presence of nature as an effective element on urban health with specified indicators and derived from studies is an inseparable component of a healthy city, the application of its indicators to create and improve the level It helps citizens' health and reduces diseases. Also, the aware city of the combination of health and technology components that lead to the diagnosis of the status of each health indicator, the exposure to infectious epidemics and timely diagnosis to prevent and deal with the diseases, therefore simultaneous attention to this Two components make the city awareness of the city's health status, which, along with the increase in physical and mental diseases caused by lifestyle changes and policies adopted during epidemics, seems necessary. A smart city includes the components of urban form and technology that creates a smart city approach with all the specified indicators, an approach that harmonizes the urban form with the changes of the society and the development of technology and provides more interaction between the environment and humans. And finally, a functional city is obtained from the combination of nature components and urban form, a city with hard and soft aspects, also considers human interactions in the form of social indicators and nature as an inseparable element of healthy and active urban life. According to the analyzes and with emphasis on the examined theories, the conceptual model of the research is presented. The indicators of each component are clearly stated in the figure2.

5. Conclusion

In addition to providing a comprehensive list of existing indicators in the research fields of health and urban form, the purpose of this study is to explore insights into potential synergies and trade-offs that may arise when considering the integration of these dimensions. This study is more comprehensive than other existing studies by examining all aspects of the subject. Therefore, we chose general search terms that allowed us to retrieve records on different dimensions of health, from diseases to physical and mental dimensions.

The components of urban form and health is a challenge that has not been comprehensively investigated so far, and the existing studies have

examined only some components of urban form and sometimes physical components. To the best of our knowledge, this study is the first study that comprehensively combines urban health by considering all physical, mental and disease dimensions and all the components of the urban form related to health. We provide insights for optimizing HUF that promotes synergistic effects on urban health, as well as trade-offs that should be considered. In addition, using the perspective of urban form with physical and non-physical components to discover parts of the multiple relationships involved in form and health and providing a comprehensive framework and list of indicators that can be operationalized helps to expand the research field.

Although future studies are necessary in each dimension, it supports holistic approaches and interdisciplinary studies integrating the components of the urban form and different dimensions of health, which proved to be useful in expanding the knowledge of health in the urban context. The results of the collected studies that considered the dimensions separately and combined them in an exploratory approach. Future studies should address both dimensions simultaneously to identify synergies and trade-offs under the same environmental and socioeconomic conditions. It is important to find the synergy between urban form and health so that it can be effectively developed to maximize specific objectives. However, many aspects of the subject are still unproven or even initially studied.

Studies and lists of urban form indicators include significant statistical results, excluding indicators that have been proven ineffective in other studies. In addition, potential different perceptions according to age, gender, or specific ethnic groups have not been addressed, but emphasizing this distinction is important for a more inclusive presentation of the issue.

Finally, it is argued that future research should simultaneously address the multiple dimensions of the HUF that reveal the complexity of the relationships. Adopting this holistic approach to urban planning and design may allow us to create healthier urban environments, where urban form effectively promotes urban health.

Abbreviations

HUF: Health-oriented Urban Form

Declaration of competing interest

None.

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