

# Healthy cities — walkability as a component of health-promoting urban planning and design

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**Abstract:** Health impairments due to inactivity are related to the car-oriented urban development of recent decades, along with sedentary lifestyles. A health-maintaining environment must therefore not only reduce direct health risk factors (pathogenic concept), but also contribute to health chances that may indirectly support health (salutogenic concept). Walking has been identified as the most influenceable behavior; it is also the most environmental-friendly mode of transport, social and health. From the planning view, the concept of walkability therefore aims at a built environment facilitating physical activity. It is increasingly recognized that walkability has become an important topic in the field of planning, urban design and health, since the built environment affects certain behaviors. From practice, concrete guidance is demanded as to the type of urban design features to be captured or applied to evaluate the walkability or to create active cities. The measurement of features of the built environment plays a special role in this context, but also the question of how research results can reach policies as well as planning and building practice.

**Keywords:** health-promotion, urban design, urban planning, built environment, walkability, physical activity

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## 1. Introduction — Reconnecting Urban Planning and Public Health

The rapid increase of people living in cities will be among the most important global health issues of the 21st century<sup>[1]</sup>. Though in developed countries, as well as in many developing countries, the standard of living and economic prosperity are increasing compared to the past, it is not always and necessarily going hand in hand with the “quality of life” and health of the population. Improved urban supply and disposal systems, as well as living conditions, have led to health enhancement of the urban population. This — in combination with the progress in different sectors such as health care, hygiene, nutrition and working conditions — resulted in an increase of life expectation. This surely might be a merit of the

traditionally close collaboration between the professions of urban planning and public health with the common goal of reducing harmful impacts of industrialization and urbanization.

According to the planning ideology of the car oriented city in the 1960s, urban spaces have since then been created with negative impact on health. At the same time the close connection between both professions broke off. Public health concentrated on individual biomedical factors. Urban planning lost sight of its original mission of tackling the health problems of the least well-off and merely focused on spatial and functional structures<sup>[2]</sup>. Health experts have now identified new primary health risks and adverse health effects that are closely connected to car-oriented urban development in recent decades<sup>[3]</sup>. Yet, still many parts of the world currently follow the traditional car friend-

ly city model with separation of functions and sprawl, ignoring human scale and resulting in oversized roads for motorized individual traffic. Since in many countries development and modernity are still associated with technology, external financing favors large construction projects such as urban highways, elevated pedestrian pathways or skyways<sup>[4]</sup> (Figure 1).

This has resulted in unhealthy living environments due to congestion, noise emissions, street fatalities, increase of CO<sub>2</sub> and global greenhouse gases, and at the same time support unsustainable, inactive lifestyles and inequity in street use. In cities of northern China, levels of the most dangerous particulates reach almost 50 times of the maximum limits stipulated by the World Health Organization<sup>[5]</sup>. As a result, there has been a shift from primarily infectious diseases to more non-communicable chronic diseases such as cardiovascular disease, diabetes or neurological disorders<sup>[6]</sup>. There is also a lack of social interactions in cities that evidently increases mortality risk significantly<sup>[7]</sup>. Moreover, a continuous increase of obesity around the world within the last decades is associated with the built environment<sup>[8,9]</sup>. This is not only observed in Western countries but also in China, Vietnam or India<sup>[10]</sup>. “Yet health policies in most rapidly urbanizing countries remain dominated by disease-focused solutions that ignore the social and physical environment. As a result, health problems

persist, and health inequities have increased”<sup>[11]</sup>. From an individual point of view, health development leads apart from reduced life span to reduced quality of life. From a social point of view, it is the high financial burden of the health care system, which leads to growing research in this field.

Because negative health developments still proceed in many developing countries which run parallel to urbanization processes, even though with a time lag compared to developed countries, the challenges, effects and health outcomes worldwide are expected to be comparable in spite of differences in spatial scale and size. However, the strategies and policies to tackle these health issues are different due to culture and mentality.

The causes for health and illnesses cannot be explained on an individual level anymore. Rather, it is found that health occurs as an interaction between individual, social and built environment. Individual measures alone are not sufficient to allow urban population to lead a healthy lifestyle. Rather, fundamental environmental changes are necessary in order to permanently establish healthy behavior for all<sup>[11]</sup>. A health-maintaining environment must therefore not only reduce direct health risk factors such as noise and particular matter (pathogenic concept), but also contribute to health chances that may indirectly promote healthy behavior (salutogenic concept) on which the



**Figure 1.** Car-oriented urban development in Shanghai (Source: Alexander Schmidt)

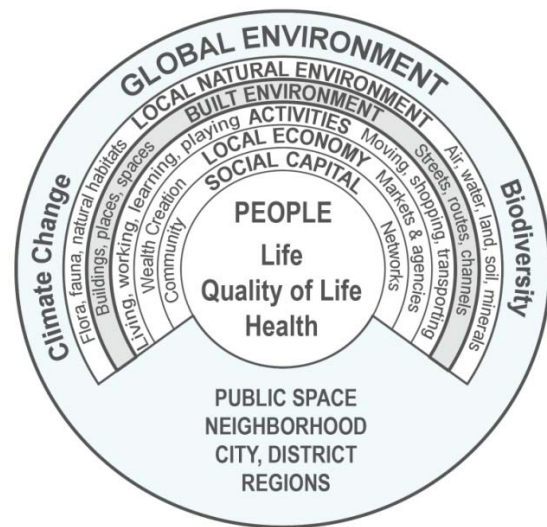
focus of this article is explained here. The health promoting city not only stays an issue for the health sector but is also part of the mission statement of a sustainable urban development.

This article primarily deals with the concept of walkability and outlines an overview of the walkability research. Based on current studies, it is exemplified by the type of features of the built environment, the level of walkability that can be identified, the challenges of creating activity-friendly cities and neighborhoods, and approach of the research results that are able to satisfy the policy as well as planning and urban design practices.

## 2. Conceptual Issues – Health-Related Factors in Urban Planning

A comprehensive understanding of urban structure, design of spaces and city planning processes as critical determinants of population health is crucial<sup>[12]</sup>. On World Health Day 2010, the World Health Organization recommended the following five calls to action to build a healthy and safe urban environment: (i) promote urban planning for healthy behaviors and safety, (ii) improve urban living conditions, (iii) ensure participatory urban governance, (iv) build inclusive cities that are accessible and age-friendly, and (v) make urban areas resilient to emergencies and disasters<sup>[13]</sup>. To address the lack of a conceptual framework for integrating health into spatial planning decisions, Barton<sup>[14]</sup> developed a conceptual model of settlements that places human health and well-being at its heart (Figure 2). The model combines an ecosystem analysis expressing the relationship between people and their environment with a public health approach, which identifies the relevant social and environmental determinants of health. This does not include heredity factors since the focus of this health map is on the social and environmental determinants of health<sup>[14]</sup>.

Regarding the effects of the built environment on health, numerous evidence-based findings exist<sup>[16,17]</sup>. For example, individual behavior and lifestyle are affected by the presence, safety and quality of routes and uses, by the density and structure of cities, and by the distances to certain destinations. Broader environmental conditions, including air, water, soil and climate, are affected by planning policy and can even be critical to health in some contexts<sup>[18]</sup>. A study lead by WHO identified twelve health objectives for planning, related to equity, exercise, social cohesion, housing, work, accessibility, food, safety, air quality,



**Figure 2.** Health map. Own illustration based on Barton<sup>[14]</sup> developed from the model by Dahlgren and Whitehead<sup>[15]</sup>.

water, earth and climate<sup>[19]</sup>. This provides an agenda for analyzing health impacts. A holistic approach for health promoting urban planning should ideally consider all of these factors and at the same time integrate their interrelations.

Since this article represents the urban design perspective, further focus lies on the sphere of the built environment<sup>[20]</sup>. The built environment of a city incorporates not only buildings, streets, squares, and green spaces as well as urban planning features like land use, density, infrastructures and transportation systems, but also urban structures and urban form.

## 3. From Car-oriented to Health-promoting Active Cities and Neighborhoods

It has been proved that health derives from the interaction between the individual and its social and built environment<sup>[19,21]</sup>. Car-oriented urban spaces increasingly impede daily physical activity, coincidentally with our modern inactive lifestyles. The lack of green open spaces, for sojourn and physical activity and safe traffic areas for environmental-friendly local mobility negatively affects the health and quality of life of city dwellers. This results from a minimum of daily walks<sup>[22]</sup>. In many countries 80% of adults do not achieve the recommended level of activity of 150 minutes of exercise a week<sup>[23]</sup>. Correlations between the lack of exercise and a high risk, for example, of developing cardiovascular disease and cancer, are well known<sup>[24]</sup>. Lack of physical activity is the developed world's fourth largest risk of death after smoking, high blood

pressure and overweight/obesity<sup>[25]</sup>.

Walking has been identified as the movement behavior that can be influenced most easily and is also the most common and simplest form of physical activity. It is increasingly recognized that the pedestrian is not only an important object of traffic planning and that walking is more than just another form of mobility; it is also a human behavior and thus has internationally become an important topic in the field of urban planning, urban design, mobility and health, since the built environment affects behavior<sup>[26]</sup>. Recently, more and more interdisciplinary research is dealing with interrelations among activity-friendly urban spaces and long-term benefits for society<sup>[21]</sup>. At the same time, the readiness to develop new forms of mobility and the reclaiming of urban spaces for pedestrians and cyclists seem to give additional impetus to this trend (Figure 3).

### 3.1 Walkability — More than Just Walking Friendly

The concept of walkability pursues a holistic approach and aims at an environment encouraging active living taking into account different spatial levels (macro and micro levels). Generally, walkability describes the level of pedestrian-friendly urban structures and spaces motivated and promoted active mobility<sup>[27,28]</sup>. Design recommendations is not limited to using individual measures such as the improvement of traffic lights or speed limits, because it is not only about security for pedestrian traffic, but at the same time about the creation of urbanity, identification and quality of life through activity-friendly public urban spaces.

People who live in a pedestrian-friendly designed environment participate much more in social life and have greater confidence in their environment. That

proved a significant gain in “social capital” and thus a better quality of life<sup>[29]</sup>. To date, we speak of walkability and its different dimensions<sup>[30]</sup> (Figure 4). Against this backdrop walkability is understood as a comprehensive approach for a livable sustainable city and does not only mean walk-friendliness.

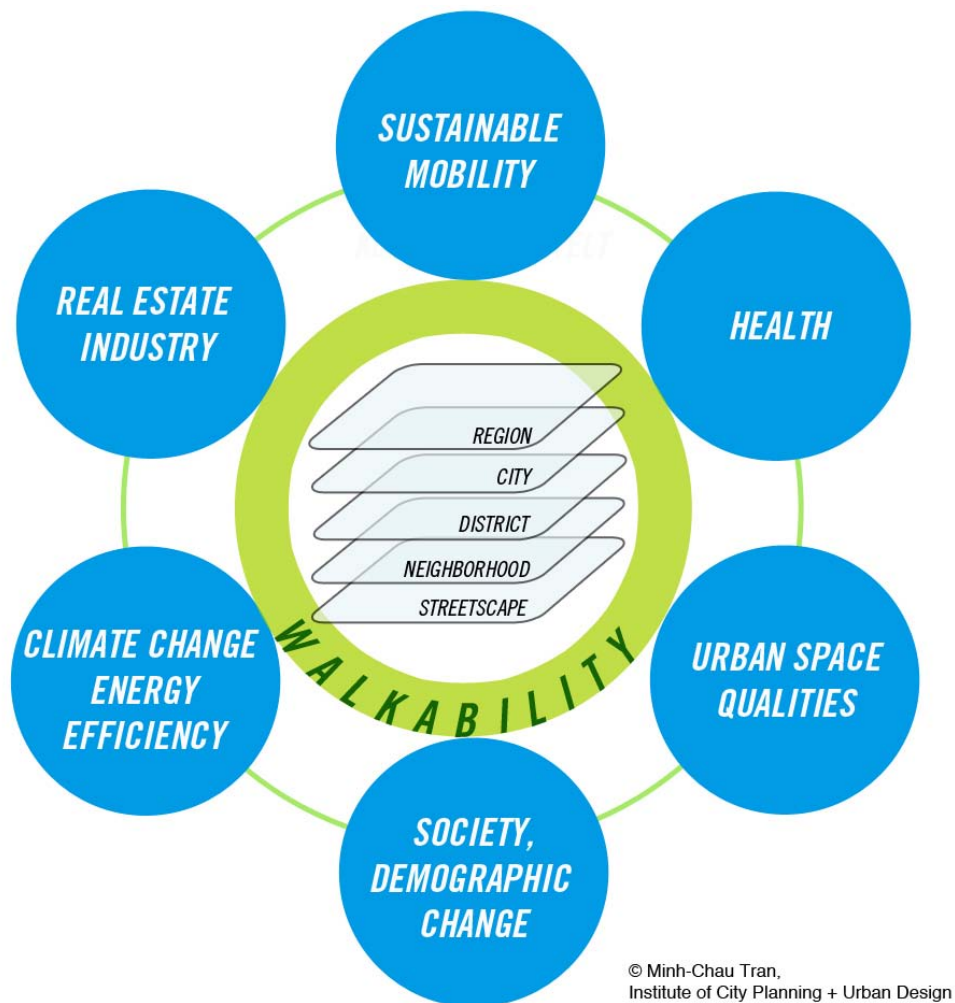
### 3.2 Walkability Research — A Multidisciplinary Field

Walkability as a research field was first initiated in public health from concerns about the constantly rising obesity rates worldwide. Since the 1990's multidisciplinary walkability research has accumulated, namely of the Health Sciences as well as the traffic planning and later also of urban planning, especially in English-speaking countries<sup>[9,31]</sup>. The idea of walking to be facilitated by good planning and urban design is also not new in many countries, e.g. in Germany<sup>[32–34]</sup>. Although overall awareness of the importance of health in the last three decades has grown in the field of urban planning, walking basically seemed to play a minor role as a mode of transport in planning. Because today in developing countries there is supposedly no direct acute health hazard emanating from the built environment compared to the industrialization phase, “urban planning can apparently (...) only broach health problems as design problems (...) where health is objectified, measurable and generalizable”<sup>[35]</sup>.

Walkability research in the fields of traffic planning and health science is therefore focusing strongly on the measurable extent or likelihood of walking in relation to different environmental characteristics based on analysis models<sup>[36,37]</sup>. Measuring walking behavior serves to inform policy and planning and to evaluate its impact<sup>[38]</sup>. An increased interest in research on an international level was very promising, reinforced by



**Figure 3.** Car-oriented street space versus people-oriented street space. (Source: Institute of City Planning and Urban Design)



**Figure 4.** The dimensions of walkability. (Source: Institute of City Planning and Urban Design)

new evaluation methods and technologies<sup>[38]</sup>. This research showed, for example, interrelations between population density, connectivity, mixed use and walk frequency<sup>[9]</sup>.

These results underpin empirical studies in objectively measurable ways. However, they fall short as urban walking areas are too complex for quantifications. Walking does not comprise only purpose-oriented utilitarian walking, but allowed the utmost spontaneity and communication of all types of mobility.

Therefore, in the field of urban design there are studies that examine the measurable and qualitative characteristics on site<sup>[39]</sup>. Here, subjective qualities such as human scale, transparency and linking street spaces are measured with the objective to establish operational definitions for measuring urban design qualities of these spaces. These qualities are closely linked to basic urban principles that were formulated in various senior key publications in the fields of architec-

ture and urban design, and are still valid to this day<sup>[25,40–42]</sup>. By observational studies they deal primarily with the influences of urban space on behavior patterns and social activities in order to better understand the use of public spaces.

Finally, the consideration of objectively measured environmental characteristics and the subjective perception of the environment are essential for a more comprehensive understanding of walkability.

### 3.3 Balance Matters — Urban Design Characteristics to Evaluate Walkability and for the Planning of Walkable Neighborhoods

Despite the increase in evidence-based knowledge and the desire to actively intervene with the help of study results for a change in urban planning policies and practices, there seem to be a lack of clarity about the urban features needed in the weighting to promote active behaviors. Urban planners and policymakers

call for clear instructions from research regarding principal urban design features that promote health and healthy behavior, such as walking<sup>[43]</sup>. In addition, it was often unclear about the appropriate methods that should be selected or are present to capture these characteristics best. There are a number of different methods to measure the characteristics of the built environment. This can be divided into three categories: (i) interviews or questionnaires that capture primarily perceptions, (ii) methods that collect (existing) data, often by using geographic information system (GIS) analysis, and (iii) systematic observations or audit tools<sup>[37,44]</sup>.

**The Five “D”s**

Empirically proven criteria for walkability are the five “D”s: Density, Diversity, Design, Destination accessibility, Distance to transit<sup>[39,45]</sup> (Table 1).

The five “D”s have the greatest impact when they act together. It therefore requires a balance of residential use, jobs, services and facilities in the vicinity of public transport stops and within walking radii and a fitting of all these elements in a fine-grained urban environment and in a cityscape that improves walking experience on street scale<sup>[39,45]</sup>. In relation to large-scale, car-oriented urban structures in the United States or Australia the density and diversity of European towns and cities have considerable potential to pro-

mote small-scale mobility in everyday life. Their structures and designs can serve as best examples.

**4. Case Study on Neighborhood Scale Linking Built Environments with Health Effects**

The current case study presented exemplifies a method applied on neighborhood scale about the connection of built environment features and health effects that could be assessed and evaluated.

This recent study by Sallis and colleagues<sup>[46]</sup> aimed at proving the evidence about the connection of built environments and moderate to intense physical activity by studying different built environments across 14 cities in ten middle-income and high-income countries. It was the largest study so far. Through linking objectively measured physical activity with objectively measured built environment features, it was observed that urban environmental factors account for large differences in the physical activity levels of adults.

The analyses were based on the International Physical Activity and Environment Network (IPEN) adult study and included 6822 adults aged 18–66 years. Neighborhoods divided into four different stratification groups were identified in order to maximize variation in neighborhood walkability and socioeconomic status (SES): (i) Higher walkability and higher SES, (ii) higher walkability and lower SES, (iii) lower walkability and higher SES, and (iv) lower walkability

**Table 1.** Overview of the five “D”s, the associated indicators and possible methods of measurement. (Source: Compiled on the basis of Ewing/Cervero (2010)<sup>[39]</sup>, Campoli (2012)<sup>[45]</sup>)

Criterion	Indicator	Method
<b>Density</b>	<b>Degree of density, e.g., population, housing units or jobs per hectare or km<sup>2</sup></b> As a measure, which is applicable to many of the characteristics of the built environment, density describes the intensity of a specific element or an activity.	e.g., GIS analysis
<b>Diversity</b>	<b>Level of diversity in land use and thus of people and places (Land use mix)</b> Diversity, or the mix of uses, creates a dense texture of destinations. A good mix of uses as to how residents can find more everyday products and services in their neighborhoods, and do not need to travel by car. The degree of diversity, or how many uses co-exist in one location and how close they are to each other, is crucial.	e.g., GIS analysis
<b>Design</b>	<b>Presence and design of streets, walking and cycling paths as well as interconnecting streets</b> To lower vehicle miles traveled (VMT) two strategies are important here: The network of streets (connectivity) in order to shorten travel distances, and creating pedestrian- and cycle-friendly roads to improve the quality of the journey. Intersection density has been identified as one of the most important indicator of the built environment for reducing VMT. Among the “D” variables street design is most difficult to measure due to complexity. It includes, for example, road and sidewalk width, safe crossing opportunities, street accompanying trees, shelter at bus stops and first floor design.	e.g., GIS analysis, on-site assessment by walk audits and checklists, interviews, surveys
<b>Destination accessibility</b>	<b>Distance or duration to key destinations of daily supply</b> The accessibility of destinations, or how close places are located to destinations people go to most regularly, is most strongly associated with reduced VMT. This variable may be measured by the distance to a central business district, the supply center or by how many jobs or attractions are within a three-minute drive or a fifteen-minute walk	e.g., GIS analysis, test walks
<b>Distance to transit</b>	<b>Distance from the starting point to the nearest public transport stop</b> Distance to transit, or public transit accessibility, is the key to attract more passengers. A dense network of routes and stops will ensure that public transport users have no long distances to travel to or from stops.	e.g., GIS analysis, testing, on-site assessment

and lower SES. The level of walkability was defined by using the neighborhood walkability index score. This included the variables of net residential density, intersection density and mixed land use developed within a geographic information system.

Physical activity was measured by using electronic accelerometers that recorded motion every minute, which is a valid and accepted method. Participants completed a survey and wore the accelerometers for 4 to 7 days around the waist, except during sleep, swimming and showering. Study dates ranged from 2002 to 2011 across countries.

Built environment variables were created with GIS software. Buffers around each participant's home within 0.5 km and 1 km, reachable by the street network, were defined to estimate accessible neighborhood features. The comparable variables used were: net residential density, street intersection density, retail and civic land use ratio to buffer area, public transport density, public park density and distance to nearest transport.

Statistical analysis was carried out to link environmental variables and physical activity (min/day) by implementing generalized additive mixed models. Four variables showed significant positive association with higher physical activity levels: higher residential density; higher number of intersection accessible to pedestrians; higher density of public transport; and more parks within walking distance (0.5 km) that were free and open to all. Mixed use was surprisingly not related to physical activity though this factor is one of the more consistent correlates of physical activity. This is explained by the lack of small scale data and the limitations of GIS measures where the data were based on a number of parcels of land, not on a number of shops or offices which might be more strongly related to use frequency and thus higher activity level.

Further results showed that adults living in walkable neighborhoods were 68–89 min/week more physically active than those in the least activity-friendly neighborhoods. This shows that built environments are able to assist residents to achieve 45%–59% of the recommended 150 min/week<sup>[23]</sup>. This study showed “clear evidence for the role of the built environment in enhancing physical activity levels for entire populations, across socioeconomic classes and cultures, and thereby preventing non-communicable disease.”<sup>[47]</sup>

## 5. How to Build Places that Facilitate Active Mobility in Everyday Life?

An important goal is to have these evidence-based res-

earch results embedded into planning and design practice. The objective of planning science in this field is, *inter alia*, to identify those characteristics and urban design configurations that prompt the decision to move actively and that influence the perception of pedestrians, and to operationalize them for the planning and urban design practice. Besides raising awareness for this topic, other necessary steps include identification and assembling of stakeholders and alliance partners, planning/projection, implementation and operation.

### 5.1 Methods to Obtain Addressee-focused Arguments

The challenge, among other things, is to convincingly point out the link between, on the one hand certain urban design and open space configurations, and on the other hand the actual impact on health-promoting behaviors and further social gains. In this policy, the following requirement plays a crucial role: “To what extent the growing social importance of health can be reflected in urban planning itself, (...) ultimately probably depends on whether the health aspect receives political support from local decision-making bodies.”<sup>[48]</sup>

Urban planners and policy makers themselves have pointed out that much practical evidence is required to evaluate the effectiveness of existing planning policy<sup>[43,49]</sup>. Therefore, one of the next steps could be to develop metrics to evaluate “success”, also economically, to address other parties such as investors, future residents and public representatives who make financial decisions, “What is the value added by designing for health? (...) – does it include enhanced productivity, longer lives, lower health care expenditures, more robust tax bases?”<sup>[17]</sup>

### 5.2 Awareness of Walkability Through Appropriate Participation Formats

At the same time, the question was crucial, as to determine whether the abstract results of these measurements can be applied in the concrete building design practice and whether the needs of different population groups can be considered. The difficult task of building physical activity, such as walking, into people's daily lives, is therefore likely to require innovative participation and communication formats and the appropriate tools in the future. Therefore, not only the aspect of spatial and building design, but also the common design of spatial processes with the local people on site is crucial to create health-promoting cities within the meaning of the Toronto Charter

(2010)<sup>[50]</sup>: “Make the healthy choice the easy choice!” Political education is a prerequisite when it comes to mobilizing planning and policy on the one hand and the people on the other for implementing health-promoting construction measures. The first step is to raise awareness among the participants and stakeholders for this topic.

### 5.3 Walk Audits, Temporary Urban Interventions and “Natural Experiments”

A powerful tool for raising awareness is systematic on-site assessments (walk audits), guided by an auditor, for example, an expert from the urban planning field, so that elaborated suggestions for improvement are adapted to the individual conditions of each area. There are walk audit tools consisting of checklists, questionnaire tools or computer-assisted audit techniques. A new set of digital tools for collecting data of the built environment and linking it with measured people’s health outcomes as a reaction to certain urban situations offers new possibilities; specially designed apps on mobile phones and biosensors allowed for recording participants’ movements and measuring their excitement, interest, and levels of stress, locating and visualizing them in a map such as in the experiments conducted by Ellard and Montgomery in New York, Berlin and Mumbai.<sup>[51]</sup>

Urban temporary intervention in public space is another instrument of procedural urban development seen as part of planning and participation processes. This could give impetus to possible long-term health-promoting behavioral change. Temporary street closures for automobiles, for example, can appear as a test and preliminary step to future project opportunities, how streets can be designed to be more pedestrian-friendly and thus inviting the people to reside

(Figure 5). With relatively few resources conditions can be created for more security and social participation in public space. People can perceive, feel and live their new space. Temporary conversions can activate streets and present local retail and community facilities. Through this process there will be a direct feedback from the users, and the effectiveness of the measures can be examined. In practice, these temporary changes have often given impetus to a permanent transformation: What had initially been regarded as an experiment by the city was rebuilt into a permanent solution following a positive evaluation. This method could meet “long-standing calls for ‘natural experiments’ in research.”<sup>[17]</sup>

Windows of opportunities should be recognized and utilized by these ideas as be linked to existing initiatives or urban redevelopment projects. Thus, this provides a specific opportunity for research to carry out “natural experiments” to evaluate before and after effects concerning health impacts, even if transport policy or structural changes are not primarily aimed at changing health behavior. These pre- and post-evaluations provide valuable information, which typical cross-sectional studies are unable to provide.

## 6. Conclusion

Apparently it is a worldwide phenomenon that planning and urban development are not committed enough to health issues but still to the automobile and to urban mobility, which is dealt in a highly sectoral way and not considering social and health implications. In the end, for all sectors dealing with the planning and design of health-promoting cities and neighborhoods it is a matter of pursuing the common goal of reducing health threatening conditions, promoting human health, and at the same time increasing the



Figure 5. Urban intervention “Urban Living Room” in Essen — before / after. (Source: Institute of City Planning and Urban Design)



quality of life for urban population. Cooperative research approaches based on findings in urban planning, urban design, transport planning, health sciences and socio-spatial research represent an important step in the efforts of creating healthier and more livable cities and neighborhoods.

But for those research findings to reach those in practice, who plan, design and build our cities, neighborhoods and street spaces, appropriate investment and communication formats and other support as by urban sociologists, educators and communication scientists are required. Strategic measures beyond mere changes in the built environment may also call for educational campaigns in public health, the exchange of information about health promoting urban planning as also the use of new media, changes in legal requirements, the encouragement of public dialogue and creating opportunities for participation and co-deliberation.

After 60 years of implementing the concept of a car-friendly city, it is time to return to a health-promoting and human oriented city. Facing energy shortages and social justice, it is important to apply a human scale in order to create healthy living and working conditions for all.

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No conflict of interest was reported.

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