

Rethinking Urban Living Environments: Investigating the Influence of Built Environment Features on Physical Activity Levels – Evidence from a Cross-Sectional Study in Ankara, Türkiye

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Abstract

Built environment (BE) epidemiologists aim to elucidate the pathways through which BE characteristics are linked to the prevalence of chronic diseases. Our study identifies the direct and indirect effects of urban living environments on overall perceptions of physical health. Our cross-sectional geospatial study involved 4015 residents of Ankara. We fitted multinomial logit models to assess relationships between residents' locations, demographic and socioeconomic statuses (SES), obesity prevalence, PA levels, life satisfaction, and evaluations of urban living environments and overall health perception. We found significant relationships between BE characteristics and health perception, particularly with SES, age groups, green space availability, environmental perception, PA levels, and obesity prevalence. Our findings provide evidence of the relationship between public health policy and urban design and planning.

Keywords: Healthy Neighbourhood Planning, Physical Activity, Public Health

1. Introduction

Cities consist of living environments with different built environment characteristics, which inherently present complex and multidimensional structured environments formed from various processes. While some areas are healthy, safe, and attractive, integrated with urban activities, others are unattractive due to a lack of infrastructure, open and green spaces, and urban services. In developing countries, particularly in fast-growing, high-density cities that receive constant immigration, such areas are more common due to uncontrolled, spontaneous development. Restructuring these areas and transforming them into sustainable, livable, walkable, high-quality, and healthy environments is gaining importance both in Türkiye and worldwide. This study aims to link the overall health assessment of individuals with built environment characteristics, physical activity levels, and obesity prevalence, while controlling for the confounding variables of demographic and socioeconomic status.

The built environment characteristics should enable individuals to prioritize a healthy and active lifestyle while meeting their basic needs, such as shelter and nutrition. Thus, the importance of the relationship between city planning, urban design, and public health is revealed. Although central and local governments have existing practices, producing new approaches that are more comprehensive, location-specific, multi-level, multi-sectoral, participatory, and community-oriented should be the priority. To have a healthy city that supports physical activity, citizens do not need high-cost residential projects; public interventions to increase the presence of walkable, mixed-use, and accessible green areas in living environments will increase overall health perception along with physical activity and contribute to reducing NCDs in society.

The promotion of physical activity – walking, cycling, sports participation, and the broader dissemination of active recreational pursuits – is recognized as a critical component within the framework of the United Nations Sustainable Development Goals (SDGs). This emphasis reflects not only its profound health implications but also its substantial social and economic benefits. Specifically, it aligns with and advances the objectives of SDG 3 (Good Health and Well-Being), SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals).

In this context, the research questions are as follows:

- How do built environment characteristics, socioeconomic statuses, physical activity, and BMI levels influence

overall health perception?

- What are the significant urban planning policies that enhance the perceived health of individuals?

2. Literature Review

Scientific studies have shown that the characteristics of a built environment significantly influence the lifestyle and preferences of its inhabitants and effective urban public health policies can effectively manage these factors (Bennett et al., 2024; Sarkar and Webster, 2017). Cities are composed of neighbourhoods with various built environments and geographical characteristics developed and controlled by city plans. These environments are complex and multidimensional, forming different morphologies and plan periods.

Increased population growth, extensive migration from rural areas to cities, rapid urbanization, and the close relationship between social welfare and neighbourhood quality have heightened the significance of health for societies. Among the Sustainable Development Goals (SDGs) of the United Nations, SDG3 Healthy Individuals and SDG11 Sustainable City and Living Spaces are the two goals that cities have to adopt along with the quality they provide to support 'health' and 'well-being' (Ramirez-Rubio et al., 2019; WHO, 2023). In particular, following the COVID-19 pandemic, the quality of neighbourhoods has become increasingly important, and guidelines have been established to plan and design them through city plans and design (Mouratidis and Yiannakou, 2022). Healthy cities have become the focus of urban planning, and built environment characteristics have gained importance.

Walkable, accessible, mixed-use neighbourhoods supported by robust urban infrastructure are essential for physically active and healthy living (Cerin et al., 2018), and therefore require a new examination of the specifics of socio-spatial attributes of urban living. The physical setup of the neighbourhoods, including residential density, land use diversity, accessibility, centrality, availability of health infrastructure, and sufficiency of green spaces, define the level of physical activity (PA) and health (Sarkar et al., 2014; Ho et al., 2023; Lai et al., 2023; Italia, 2001). A city should offer walkable urban areas and ample spaces supporting mobility; the built environment appears to decrease physical inactivity, thus eliminating the risk factors of NCDs (Haskell et al., 2009). In this context, the planning and design strategies of neighbourhoods ensure the control of the demographic structure and socio-economic and environmental elements and will be effective in promoting health and mitigating the risks, such as physical inactivity (Haskell et al., 2009) that underlie non-communicable diseases (NCDs).

NCDs are responsible for 74% of the death rates in the world (WHO, 2023) and 90% of deaths in Europe (EEA, 2020). NCDs are increasingly responsible for 70-80% of European health costs (EC, 2020). For example, worldwide, adult obesity has more than doubled since 1990, and adolescent obesity has quadrupled; in 2022, 1 in 8 people in the world were living with obesity (WHO, 2024). The environmental relationship between inactivity and obesity has been discussed elsewhere (Gray et al., 2018), but in this paper, we aim to focus on a method to differentiate the neighbourhoods according to the factors known to be associated with PA.

This study shows that some characteristics, in particular land use diversity, health facility infrastructure, and green space size, play a significant role in identifying an urban pattern and are the products of different plan periods, which can influence the physical activity levels of its inhabitants.

Adequate housing involves evaluating the living unit as a physical entity within its environment and as a qualitative, complex formation that encompasses social, economic, and psychological aspects. In this context, the neighbourhood becomes a priority for investment to meet the needs of its residents. It has a fundamental impact on determining the quality of life for an individual (Pacione, 2003). Urban living conditions affect both their physical and mental health (Handy et al., 2002). For example, to promote healthy aging, public housing neighbourhoods should include more accessible spaces and community facilities along walking paths to support PAs and daily needs (Ho et al., 2023).

In transportation and built environment research, some scholars have classified how the physical attributes of neighbourhoods can be evaluated (Ewing and Cervero, 2010; Handy et al., 2002). Initially, they specified these

attributes as density, diversity, and design (Cervero and Kockelman, 1997), and this has been expanded by adding destination accessibility and distance to transit features (Ewing and Cervero, 2001). Next, the affiliation of these attributes with physical activity, walking, and mobility has been specified. It was found that physical activity is directly related to land use diversity, density of road network intersections, presence of urban green areas, distance to public transportation stops, and the number of destinations within walking distance (Ewing and Cervero, 2010; Zhang et al., 2022). In addition, green space size and its accessibility, the presence of green areas, opportunities and land use variability in a neighbourhood, and urban sprawl are specified as other influential factors on physical activity and physical and mental health (Carmona, 2019).

In a recent study, when examined in terms of urban health, eleven dimensions appear: i) housing and land use diversity (mixed-use), ii) accessibility, iii) access by public transportation, iv) design of movement networks, v) attractiveness of active transportation modes, vi) density, vii) distribution of labor force, viii) management of demand for urban services, ix) destination proximity, x) disaster mitigation, xi) distributed interventions and resources (Giles-Corti et al., 2022).

Physical activity is one of the most prominent healthy lifestyle behaviors in preventing both physical and mental diseases, including reducing the risk factors for NCDs, including obesity and type II diabetes, and one of WHO's main strategy recommendations for 'Healthy Cities' is to create a physical and social environment that supports physically active life (WHO, 2018). Neighbourhoods that support physical activity will enhance healthy living and should be accessible to all segments of society, particularly women, children, individuals aged 65 and above, and those in special needs groups who are considered disadvantaged. In settlements where all segments of society have equitable access to high-quality neighbourhoods and where individual and social interests are balanced, the sense of belonging towards the living environment will increase, and the quality of life will be high. In our analysis, the neighbourhood characteristics that support physical activity have been identified through variables derived from the literature review.

3. Methodology

The survey took place between 21 December 2021 and 15 March 2022, and 4015 interviews were reported to be valid. They are distributed across 76 neighbourhoods in Ankara. The research employed a spatial sampling strategy, where neighbourhoods were classified by specific factors linked to physical activity and well-recognized in the literature. The clustering criteria covered key variables: Built Environment Variables (Residential Density, Average Building Height, Average Building Volume, Green Space per Capita (km²/person), Green Area Ratio (green area / total area)), Street Network / Accessibility Variables (FAR (Floor Area Ratio), MAD1000 (Mean Angular Distance within 1000 m), MAD5000 (Mean Angular Distance within 5000 m), TPBtA1000 (Total Pedestrian Betweenness within 1000 m), TPBtA5000 (Total Pedestrian Betweenness within 5000 m)), Local Health Services Variables (Number of Physicians (per 1000 inhabitants), Number of Family Health Centers (FHCs) (per 1000 inhabitants)), Centrality Variables (Number of Chain Markets (per 1000 inhabitants), Number of Food & Beverage Establishments (per 1000 inhabitants), Number of Pharmacies (per 1000 inhabitants)), Land Price (TRY). We used clustering techniques – the Elbow method and specified 7 clusters. The total population, the share of population, the sample size, and the actual distribution of the interviews across clusters are shown in Table 1.

Table 1. Population (2020), Share of Population, Sample Size, Actual Distribution of Interviews by Clusters

Cluster	Population 2020	Share of Population	Sample Size		Actual Distribution of Interviews	
			Number	%	Number	%
1	1,393,621	0.28	929	23.23	953	23.74
2	326,598	0.07	450	11.25	420	10.46
3+7*	39,286	0.01	176	4.40	177	4.41
4	1,112,234	0.22	830	20.75	828	20.62
5	1,217,823	0.24	869	21.73	878	21.87

6	898,796	0.18	746	18.65	759	18.90
Toplam	4,988,358	1.00	4000	100.00	4015	100.00

* The clusters are merged due to the size and proximity of cluster 3 and 7.

Figure 1 illustrates the locations of the selected neighbourhoods in the Ankara study area. These neighbourhoods are selected based on their cluster and socioeconomic (SES) status. The sample included households from across all neighbourhoods.

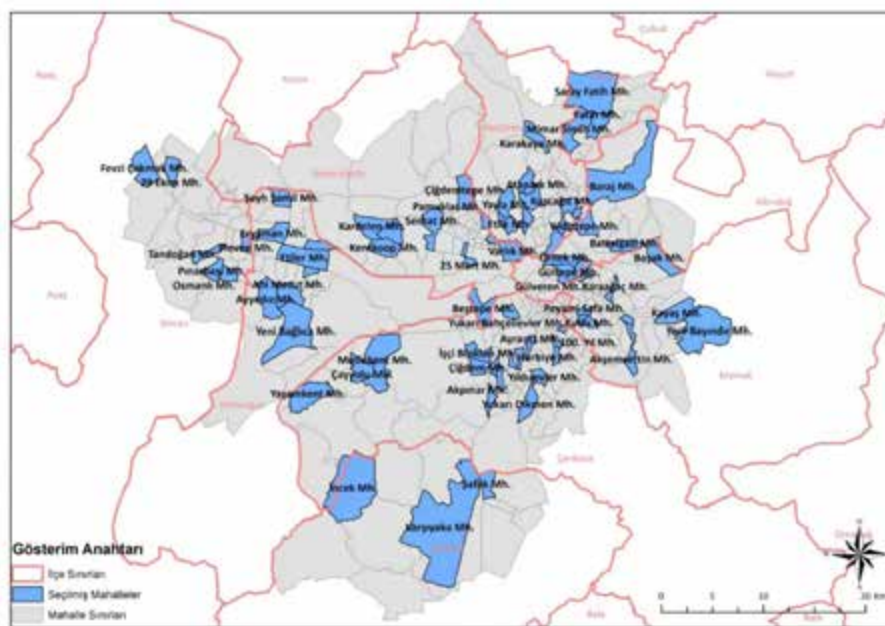


Figure 1. Selected Neighbourhoods in the Study Area

The dependent variable (overall health perception) was classified into three nominal categories ("good and very good", "moderate", and "bad and very bad"). The analysis required the relational statistical assessment of independent variables (built environment characteristics, physical activity levels, obesity prevalence (assessed by BMI) along with confounding factors of demographic and socioeconomic statuses. The model estimates the probability of each category relative to a reference category, based on the independent variables. In our analysis, we chose "bad and very bad condition" as the baseline.

4. Multinomial Logistics Model Results: Health Perception

Tables 2 and 3 show the output of a multinomial logistic regression model (MNL) where the dependent variable, overall health assessment, has three levels: bad/very bad (the reference category), moderate, and good/very good. In the model, the independent variables explain how and whether built environment characteristics, socioeconomic status (SES), age, physical activity level, green space, environmental attitude, obesity prevalence (assessed by Body Mass Index), and life satisfaction are related to perceived overall health assessment.

Table 2 illustrates how the selected independent variables affect individuals' probability of health assessment in the moderate category compared to the reference category, which is the perception of "bad and very bad". For example, individuals' SES and age groups affect their overall health assessment. Individuals with lower SES are 16% less likely to have moderate level health assessment ($B=-0.175$, $p<0.001$, $\text{Exp}(B)=0.840$); individuals of higher age groups are 21.6% less likely to have moderate level health assessment ($B=-0.244$, $p<0.001$, $\text{Exp}(B)=0.784$). Individuals with moderate levels of physical activity have 2.7 times the odds of being in the moderate health assessment category compared to the reference group ($B=0.955$, $p<0.001$, $\text{Exp}(B)=2.705$). Similarly, individuals who perceive their urban living environments negatively are 55% less likely to perceive their health as medium

compared to the “bad” and “very bad” perception categories ($B = -0.796$, $p < 0.001$, $\text{Exp}(B) = 0.450$). This suggests that individuals who perceive their urban living environments positively are more likely to have a more favorable perception of their overall health status. The Body Mass Index (BMI) significantly shows that people with low BMI (18-24.99-underweight and normal weight) have 2.9 times the odds to have moderate level health perception ($B = 1.072$, $\text{Exp}(B)=2.922$, $p<0.001$) and surprisingly, individuals with higher BMI (25-29.99-overweight) also have 2.2 times the odds to have moderate level health perception ($B = -0.777$, $\text{Exp}(B)=2.175$, $p<0.001$).

Table 2. Multinomial Model Results (Overall Health Assessment is at Moderate Level)

Parameter Estimates									
Overall Health Assessment		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Moderate	Intercept	3.169	0.510	38.585	1	0.000			
	Education	-0.073	0.089	0.670	1	0.413	0.930	0.780	1.107
	SES	-0.175	0.055	10.059	1	0.002	0.840	0.754	0.935
	Age Grouped into 4 Classes	-0.244	0.094	6.663	1	0.010	0.784	0.651	0.943
	[Greenspaceref=1.00]	-0.113	0.171	0.433	1	0.510	0.893	0.639	1.250
	[Greenspaceref=2.00]	-1.341	0.321	17.392	1	0.000	0.262	0.139	0.491
	[Greenspaceref=3.00]	0 ^b			0				
	[EnvironmentAttitude=1.00]	-0.799	0.194	16.907	1	0.000	0.450	0.307	0.658
	[EnvironmentAttitude=2.00]	0.141	0.218	0.420	1	0.517	1.152	0.751	1.767
	[EnvironmentAttitude=3.00]	0 ^b			0				
	[PhysicalActivityLevel=1.00]	0.995	0.175	32.324	1	0.000	2.705	1.920	3.813
	[PhysicalActivityLevel=2.00]	0.593	0.274	4.694	1	0.030	1.809	1.058	3.092
	[PhysicalActivityLevel=3.00]	0 ^b			0				
	[BMI=1]	1.072	0.220	23.701	1	0.000	2.922	1.897	4.499
	[BMI=2]	0.777	0.203	14.715	1	0.000	2.175	1.462	3.236
	[BMI=3]	0 ^b			0				
	[LifeSatisfaction=1.00]	-0.796	0.307	6.733	1	0.009	0.451	0.247	0.823
	[LifeSatisfaction=2.00]	-0.893	0.290	9.489	1	0.002	0.409	0.232	0.723
	[LifeSatisfaction=3.00]	0 ^b			0				

a. The reference category is: bad/very bad.

b. This parameter is set to zero because it is redundant.

Table 3 shows that individuals with a health perception have a higher probability of being in the “good” and “very good” categories compared to those with “bad” and “very bad” perceptions. The results show that, across age groups, individuals’ overall health assessment is 50% times less likely to be in the “good/very good” category ($B = -0.690$, $p < 0.001$, $\text{Exp}(B) = 0.502$). Individuals who do not have green space in their urban living environments are 52.8% times less likely to be in “good/very good” category ($B=-0.750$, $p<0.001$, $\text{Exp}(B)=0.472$). Individuals who perceive their urban living environments negatively and at moderate level are less likely (81% and 37.4% times respectively) to perceive their health at “good/very good” level compared to “bad” and “very bad” assessment categories ($B=-1.662$, $p<0.001$, $\text{Exp}(B)=0.190$; $B=-0.469$, $p<0.001$, $\text{Exp}(B)=0.626$).

Table 3. Multinomial Model Results (Overall Health Assessment is at Good/Very Good Level)

		Parameter Estimates							
Overall Health Assessment		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Good/Very Good	Intercept	4.337	0.507	73.090	1	0.000			
	Education	0.167	0.089	3.540	1	0.060	1.181	0.993	1.405
	SES	-0.067	0.055	1.485	1	0.223	0.935	0.839	1.042
	Age Grouped into 4 Classes	-0.690	0.094	53.603	1	0.000	0.502	0.417	0.603
	[Greenspaceref=1.00]	0.066	0.172	0.149	1	0.699	1.068	0.763	1.495
	[Greenspaceref=2.00]	-0.750	0.301	6.198	1	0.013	0.472	0.262	0.853
	[Greenspaceref=3.00]	0 ^b			0				
	[EnvironmentAttitude=1.00]	-1.662	0.194	73.496	1	0.000	0.190	0.130	0.277
	[EnvironmentAttitude=2.00]	-0.469	0.217	4.668	1	0.031	0.626	0.409	0.957
	[EnvironmentAttitude=3.00]	0 ^b			0				
	[PhysicalActivityLevel=1.00]	0.841	0.176	22.940	1	0.000	2.320	1.644	3.273
	[PhysicalActivityLevel=2.00]	1.041	0.267	15.166	1	0.000	2.832	1.677	4.782
	[PhysicalActivityLevel=3.00]	0 ^b			0				
	[BMI=1]	0.910	0.218	17.437	1	0.000	2.484	1.621	3.808
	[BMI=2]	0.458	0.200	5.218	1	0.022	1.580	1.067	2.340
	[BMI=3]	0 ^b			0				
	[LifeSatisfaction=1.00]	0.166	0.304	0.297	1	0.586	1.180	0.650	2.144
	[LifeSatisfaction=2.00]	-1.321	0.291	20.602	1	0.000	0.267	0.151	0.472
	[LifeSatisfaction=3.00]	0 ^b			0				

a. The reference category is: bad/very bad.

b. This parameter is set to zero because it is redundant.

Individuals who do not have green space (Greenspaceref=2) in their urban living environments are 70.7% less likely to have “bad” and “very bad” health status ($B = -0.750$, $\text{Exp}(B) = 0.293$, $p < 0.001$). Individuals with negative life satisfaction are 73.2% less likely to have good or very good health perceptions ($B = -1.321$, $\text{Exp}(B) = 0.267$, $p < 0.001$).

5. Discussion: Potentials and Challenges for Urban Living Environments

Built environment characteristics and socioeconomic factors (such as education, socioeconomic status), lifestyle preferences (physical activity levels, BMI) have a significant impact on overall health assessment. Individuals with SES levels times higher perceptions of good and very good health. Individuals with lower BMI have a significant relationship with health perception. Similarly, physically active individuals are more likely to have moderate to “good” or “very good” health perceptions. Individuals with lower life happiness also have a similar effect on health perception.

These findings, in line with the World Health Organization’s health determinants (WHO, 2018) and the “Health in All Policies” approach, demonstrate that health outcomes cannot be attributed solely to the health sector; instead, socioeconomic and physical environmental factors play critical roles. Similarly, the social determinants framework, as emphasized by Wilkinson and Marmot (2003), has highlighted the significant impact of education, income, environmental quality, and social support mechanisms on health. The findings of this study also support the propositions in the literature, indicating that urban planning, education, and social welfare policies should be addressed together in health improvement strategies, particularly in urban areas.

This evidence-based research supports a holistic framework that enables the development of healthier societies by transforming the social and physical environments in which individuals live. The focus should be at the community level rather than solely on individual behavioral change.

This holistic approach will enable the construction of healthier societies by transforming the social and physical environments in which individuals live, rather than focusing solely on individual behavioral change. Some of the significant policies can be listed as follows:

- Increasing investments in education, supporting programs for lifelong learning, and improving individuals' health literacy
- Prioritizing physical environmental criteria such as walkability ease of access and proximity to green areas in urban planning,
- Developing mechanisms to strengthen life satisfaction and social connectedness through community-based interventions,
- Establishing multi-sectoral collaborations to promote healthy weight management and physical activity.

Acknowledgements

The Scientific and Technological Research Council of Türkiye

TUBİTAK - 1003 Project: Prioritizing Quality of Life and Urban Living Environments

Grant No. 218K368 & 218K371

Title: The Relationship of Built Environments with Health Indicators and Quality of Life: A Community Participatory Model Proposal for Healthy Cities

Project Duration: 01/12/2019 – 01/06/2023

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