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Obesity, Physical Activity, Spatial Environmental Characteristics in Three Types of Residential Settings

Ebru Cubukcu[a]*, Burcin Hepguzel[a], Burak Tumer[b], Zeynep Onder[c]

[a] *Department of City and Regional Planning, Faculty of Architecture, Dokuz Eylul University, Buca, Izmir, 35160, Turkey*
[b] *City Planner, Izmir, 35000, Turkey*
[c] *City Planner, Bursa, 16000, Turkey*

Abstract

Obesity relates to physical activity and the level of physical activity a person could be involved is influenced by his/her physical environment. This study aims to investigate the relation between these characteristics via an empirical study, in Izmir, Turkey. Randomly selected 676 people completed household surveys and revealed their address, body mass index (BMI) and mean energy consumption for various activities (PA). The study area involved planned and unplanned developments for low, moderate, and high income neighborhoods. Three spatial setting characteristics (SC) were calculated for the streets within 400 meter network distance to each participants' residence via geographic information systems: (1) destination density, (2) accessibility to destinations and (3) betweenness index. The participants' mean BMI and PA and the spatial setting characteristics were compared in low, middle and high income neighborhoods. Results, showed no differences.

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Keywords: Obesity; physical activity; quality of life; residential settings

1. Introduction

Obesity and overweight constitute a serious problem for both wealthy and poor nations. The number of people dying from illnesses related to obesity and overweight throughout the world cannot be under-estimated. The percentage of overweight and obese people has been rising in Turkey as well. In parallel to reports of World Health

* Corresponding author. Tel.: +90-232-301-8461; fax: +90-232-453-2986.
E-mail address: ebru.cubukcu@deu.edu.tr

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Organization, Turkish Government stressed (in various publications) that obesity and overweight can be prevented if people are encouraged to do more physical activity. However, research repeatedly showed that people tend to do less activity than before. Lifestyle changes may be one reason why people are less active than before. Transformations in physical environment may also lead to less activity. It is undeniable that, nowadays cities are designed for cars, not for people. According to Gibson's theory of 'environmental affordances', physical environmental characteristics leads people's course of action. Put it differently, people may prefer to be active in some environments and inactive in some others. This study aims to investigate the relation between obesity, physical activity, and physical environmental characteristics.

2. Background

Research shows that obesity prevalence continues to increase rapidly throughout the world (WHO, 2011). This finding applies to Turkish population as well (T.C. Saglik Bakanligi, 2009; 2010). It has been found that % 56 of the Turkish population is overweight and %16 is obese (Iseri & Aslan; 2008). General and scientific knowledge suggest that obesity affects people's quality of life by influencing their physical, social, and emotional functioning (Fontaine & Barofsky, 2001; Larsson, Karlsson & Sullivan, 2002; Kushner & Foster, 2000).

Obesity relates to physical activity (T.C. Saglik Bakanligi, 2009; 2010; Mokdad et. al., 2003; Ogden et al. 2006). Thus, increasing physical activity for decreasing obesity has been a priority on the policy agendas for almost all governments, including Turkish government (U.S. Department of Health and Human Services, 2000; Department of Health Physical Activity; Health Improvement and Promotion, 2004; Ministry of Health, 2003; Badland et. al. 2008; Hoehner et. al. 2005; Witten et. al., 2008; T.C. Saglik Bakanligi, 2009; 2010). Yet, research repeatedly showed that people's level of physical activity is insufficient (WHO, 2004; US Department of Health and Human Services, 2000; Badland et. al. 2008). It has been repeatedly pronounced that the number of commuters who are walking or cycling for transportation needs has dropped significantly. Research showed that university students' tendency to walk is low (Cubukcu & Niyazoglu, 2010) and todays' children are less active than before (Cubukcu et. al. 2010). Studies in Asian cities claimed that people walk less than before (Azmi & Karim, 2012; Azmi et. al. 2013; Azmi, Karim & Amin 2012; Sapawi & Said, 2013; Cubukcu, 2013). An extensive research, held in 7 cities in 7 regions of Turkey, investigated 15,468 adults' level of physical activity (T.C. Saglik Bakanligi, 2009; 2010). Results showed that, only 3.5 % of participants do sufficient physical activity (at least 30 minutes of moderate level physical activity for 3 days per week). Another study surveyed 11,481 people in 5 regions of Turkey and revealed similar results (T.C. Saglik Bakanligi, 2009; 2010). About 20 % of participants were sedentary and 16% had insufficient physical activity.

The level of physical activity a person could be involved is influenced by his/her physical environment (Berrigan & Troiano, 2002; Giles-Corti & Donovan, 2002; Williams et. al., 2005; Sallis et. al. 1997; Saelens & Handy, 2008; Humpel et. al., 2002). The physical environment that surrounds a person can enhance or limit physical activity. In other words, one can claim that the physical environment indirectly relates to physical activity and obesity.

This study aims to investigate the relation between obesity, physical activity, and spatial setting characteristics. An empirical study was held in Izmir, Turkey. Randomly selected 676 people participated in the study. Household surveys were held to calculate the body mass index and the level of physical activity for each participant. The study area involved neighborhoods with varying income groups, including: (1) low, (2) middle, and (3) high. The participants' mean body mass index and mean energy consumption for various activities were compared in these three areas. Moreover, (1) destination density, (2) accessibility to destinations and (3) mean betweenness indices were calculated for the streets in the study area within 400 meter network distance to each participant's residence via geographic information systems. These spatial setting characteristics were compared in low, middle high income neighborhoods as well.

3. Methodology

3.1. Site and spatial setting characteristics

This study is an extension of a previous study. As explained in Cubukcu et al. (2014), the study was held in Izmir Turkey, third largest city on the west coast of Turkey. The study area, (9 neighbourhoods in Karşıyaka district) is

located on the northern part of Izmir and involved planned and unplanned residential developments for low, moderate and high income level people (Fig. 1.).

About 6500 ‘street segments’ were digitized in the study area. Each segment between two street intersections were called ‘street segments’. When the street segment is too short, it is connected to a longer one. Using this street network data ‘betweenness’ indices were calculated via an ArcGIS extension called ‘Spatial Network Analyst’ which was developed by Cardiff School of Planning & Geography and the Sustainable Research Institute (for more detail see Cubukcu et al., 2014). The ‘betweenness’ index refers to the number of times each street segment lies on the shortest paths between other pairs of street segments. The previous study (Cubukcu et. al., 2014) was improved by calculating mean betweenness scores for the location of respondents’ house. Based on ‘betweenness’ indices per each street segment a ‘mean betweenness score’ was calculated for the location of respondents’ house. In order to do that, the street segments within 400 meter network distance to each participant’s residence was analyzed via Geographic Information Systems. For these analyses, “Network Analyst / Service Area Calculator” extension of ArcGIS was used.

Moreover, the location of commercial activities, green areas, schools, bus stops, ferry, light rail stops have been obtained (for more detail see Cubukcu et al., 2014) . The previous study (Cubukcu et al. 2014) was improved by calculating (1) mean destination density scores and (2) mean accessibility to destinations scores for each respondent’s house location via Geographic Information Systems. Density refers to the total area of destinations within the 400 meter network distance of each respondent’s house. Accessibility refers to the network distance between the respondent’s house and the closest destination such as green areas or schools. For these analyses, “Network Analyst / Service Area Calculator & Closest Distance” extensions of ArcGIS were used.

Fig. 1. Study Area.

Source: Google Earth

3.2. Participant's demographic & physical activity characteristics

676 people (327 male, 349 female) participated in the study. Participants' ages ranged from 15 to 64 with a mean of 40.52 (SD=13,64). 6 participants did not reveal either their height or weight (or both) to calculate body mass index (BMI). Thus they are dropped from the sample. For the remaining the BMI ranged from 14 to 45 with a mean of 24.77 (SD=4,37). 141 participants were living in planned and high income level residences (yellow dots), 379 were living in planned and moderate income level residences (red dots), and 150 were residing in unplanned and low income level residences (green dots) (Fig.2.).

'7 Days International Physical Activity Questionnaire' was used to measure the participants' level of energy consumption. This structured survey form is a well known survey form to measure physical activity, and it has been used extensively throughout the world (Hoehner et. al., 2005; Boarnet et. al., 2011; Rodriguez et. al., 2007). Reliability and validity tests for this structured from was completed in various countries (Craig et. al., 2003), including Turkey (Vural et al. 2010; Parmaksız, 2007). Participants answered questions about how many days a week and for how long they do the following four activities; (1) vigorous physical activity, (2) moderate physical activity, (3) walking, and (4) sedanter activities such as sitting. Based on these answers energy consumption could be calculated as MET. Minimum, maximum and mean energy consumptions are presented in Table 1. It should be noted that, only about %15 (115 participants for vigorous physical activity and 135 participants for moderate physical activity) reported that they do vigorous or moderate physical activity.

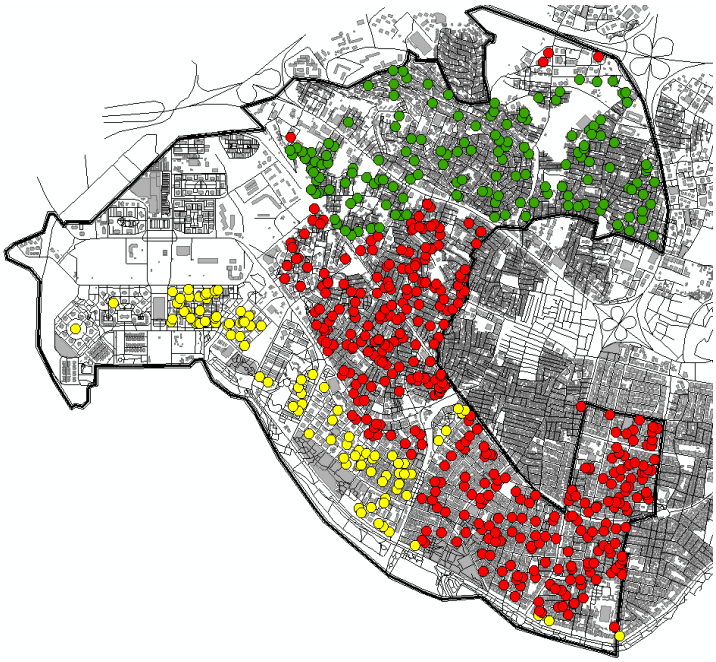

Fig. 2. Participants were living in planned and high income level residences (yellow dots), planned and moderate income level residences (red dots), and in unplanned and low income level residences (green dots).

Table 1. The descriptive statistics for ' 7 days International Physical Activity Questionnare'.

Year	N	Minimum	Maximum	Mean	Std. Deviation
Vigorous Physical Activity	115	4	384	41,89	50,46
Moderate Physical Activity	135	1	196	20,92	34,41
Walking	626	1	346	20,17	32,99
Sedanter	629	2	85	28,10	14,43

4. Results

Table 2 shows the comparisons of participants' BMI and physical activity level in three types of residential settings: (1) planned and high income level residences, (2) planned and moderate income level residences, and (3) unplanned and low income level residences. Results showed that people who live in a different type of residential settings have similar obesity indices. Considering the vigorous and moderate physical activity and sedentary behavior the three types of residential environments do not differ. However, for walking there is a statistically significant difference (F=7.29, df=2,669; p=0.00). On the contrary to expectations, people who are living in unplanned areas (poor physical conditions) reported that they are walking more than others who are living in planned developments. This finding may indicate that people are walking not because they are willing to but because they have to. In other words, people who are living in poor physical environmental conditions are walking because they are not able to afford other means of transportation. Thus further studies should consider walking for transportation and recreation separately.

Table 2 also shows the comparisons of physical environmental characteristics in three types of residential settings. Results provide statistical evidence that three settings differ for "mean betweenness", "destination density" and "destination accessibility" scores. Higher "betweenness sores" indicated that the street network in respondents' neighborhood lies between the shortest path of more links. As planned developments for high income groups involved gated communities, "betweenness scores" are lower for such areas than residential areas for moderate and low income groups. Destination density was higher residential areas for moderate income groups. This is expectable considering the mixed land use in these areas. For destination accessibility, residential areas for moderate income groups seem to be more advantageous than others. People who are residing in planned developments for moderate income group tend to walk less to closest amenity. This finding is acceptable considering the gated community developments and large zonings in planned developments for high income groups and lack of social areas in unplanned developments for low income groups.

Table 2. Comparisons of participants' BKI, physical activity levels and neighbourhood environmental characteristics in three types of residential settings.

		Planned development / High Income Group	Planned development / Moderate Income Group	Unplanned development / Low Income Group	Statistical Difference
	BKI	24.08 (3.58)	25.03 (4.53)	24.78 (4.58)	F=2.46, df=2,669; p=0.08
PHYSICAL ACTIVITY	Vigorous Physical Activity	7.52 (18.64)	7.36 (29.13)	6.46 (24.31)	F=0.08, df=2,669; p=0.93
	Moderate Physical Activity	2.35 (5.28)	3.99 (18.02)	6.54 (22.85)	F=2.16, df=2,669; p=0.12
	Walking	14.35 (15.47)	17.14 (29.92)	27.39 (45.64)	F=7.29, df=2,669; p=0.00
	Sedantary Behavior	25.58 (15.3)	26.9 (15.59)	25.83 (15.6)	F=0.49, df=2,669; p=0.61

PHYSICAL ENVIRONMENTAL CHARACTERISTICS	Mean Betweenness Score	0.04 (0.02)	0.07 (0.04)	0.06 (0.04)	F=43.47, df=2,669; p=0.00
	Destination density in walking distance	0.99 (0.36)	1.26 (0.6)	0.62 (0.37)	F=85.48, df=2,669; p=0.00
	Destination accessibility (standardized distance to closest amenity)	3.18 (1)	2.58 (0.55)	3.69 (0.49)	F=161.66, df=2,669; p=0.00

5. Conclusions

Results of the study failed to provide evidence that physical activity and obesity differ in planned and unplanned areas for low moderate and high income groups. However the study is important as it was held in a developing country. The literature on this issue is lead by developed countries. Majority of those studies pronounced a significant relation between the physical environmental characteristics and obesity and physical activity. However, the findings of this study could not provide support for such a statement. Cultural differences may lead to such an inconsistent finding. Perhaps, in developed countries the influence of social economic class on obesity and physical activity surpass the influence of physical environment. Moreover, physical activity was measured subjectively in this study. The results may change when objective measures of physical activity could be used. In addition, the physical environmental factors investigated in this study was limited. Future research should consider other potential physical environmental characteristics. In brief, more research is on call for obesity and physical activity investigation in developing countries.

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