

General and Central Obesity in Two Iranian Ethnic Groups Living in Urmia, West Azerbaijan, Iran: Effect of the Neighborhood Environment

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Abstract

Background: Emerging evidence suggests that neighborhood characteristics can have direct and indirect effects on the weight status of the residents.

Objectives: To assess the relationship between general and central obesity and the neighborhood environment in two ethnic groups (Azeri Turks and Kurds) living in Urmia city, Northwestern Iran.

Patients and Methods: In this cross-sectional study, 723 participants (427 women and 296 men) aged 20 - 64 years from two ethnic groups (Azeri Turks, n = 445; Kurds, n = 278) were selected from 38 neighborhoods using a combination of cluster, random, and systematic sampling methods. Neighborhood characteristics were obtained by a validated 22-item neighborhood and health observational checklist. General and central obesity were measured and evaluated using standard methods. Principal component analysis (PCA) was used to define the dominant neighborhood environment. The association of neighborhood characteristics with general and central obesity was analyzed by a logistic regression model.

Results: Three common neighborhood environments were identified: modern and affluent, central-high access, and 3) marginal. These three factors explained 73.2% of the total variance. Overall, the participants living in a higher tertile of the central-high access neighborhoods had an increased chance of central obesity (OR = 1.63, 95% CI: 1.13 - 2.34). Azeri Turks living in the highest tertile of the modern-affluent neighborhoods had a significantly higher likelihood of having general obesity (OR = 2.49, 95% CI: 1.37 - 4.01). Adjustment for age, gender, marital status, socioeconomic status (SES), energy intake, and physical activity did not change the results. However, after adjustment for educational level, the association was not significant.

Conclusions: The findings point to a relationship between neighborhood characteristics and obesity only in the Azeri Turks. However, educational level was more important than neighborhood quality in predicting the risk of obesity

Keywords: Obesity, Residence Characteristics, Ethnology, Iran

1. Background

Obesity is a multifactorial health problem, influenced by various social, behavioral, cultural, socioeconomic, physiological, metabolic, and genetic factors (1). Up to now, most obesity research have focused on individual risk factors (2, 3). Such approaches have been partly successful in treating individual cases of obesity; however, they have failed to prevent or restrict obesity trends at the population level (4). Recently, neighborhood-level characteristics, including the availability of healthy food, quality of the physical environment, and socioeconomic status (SES) of the residents, have been reported to be important factors

affecting the continuing obesity epidemic (5, 6). Neighborhood characteristics can have direct and indirect effects on the health status of the residents (7). The previous literature confirmed that the prevalence of obesity varied widely among countries, states, cities, and neighborhoods (8, 9). Therefore, exploring the wider social and contextual determinants of body weight and obesity-related behaviors seems necessary to define the exact causes of obesity. Previous studies have also shown that the prevalence of obesity and possible individual risk factors varied among various ethnic groups. However, the effect of the physical neighborhood environment on the risk of obesity in various ethnic groups living in a multiethnic environment has been

less well studied (10).

In Iran, as a country experiencing accelerated nutrition transition, the increased prevalence of overweight and obesity is becoming a major public health problem (11). Planning and policy making to combat this problem requires a clearer analysis of the associated factors. Current knowledge on the various features of Iranian ethnic groups' health is negligible. West Azerbaijan province, located in Northwestern Iran and close to Turkey and the Iraq-Kurdistan borders, is home to a heterogeneous population in terms of ethnicity, including Azeris (76.2%), Kurds (21.7%), Persians (0.8%), and others (1.4%) (12). Urmia, as the capital city of the province, has a diverse ethnic composition, of which Azeris and Kurds are the major ethnic groups (13). According to a national survey conducted in 2008 on the risk factors of noncommunicable diseases (14), the province has a high prevalence of overweight and obesity (54.9% and 44.6% in women and men, respectively) and ranks sixth nationwide for obesity among men and women.

2. Objectives

The aim of this study was to define the association between the neighborhood environment and general and central obesity in two Iranian ethnic groups living in Urmia, Iran.

3. Patients and Methods

This cross-sectional study is part of a larger project entitled Designing and testing a multilevel model to explain the effects of neighborhood, household and individual levels on anthropometric factors in men and women living in the city of Urmia. The sample size of the original study was 723. The same sample size was used in this study. In the sample size calculation, the body mass index (BMI) was used as the main dependent variable. According to the most recent report on noncommunicable disease risk factors, published in 2008, (14) the mean (confidence interval: CI) BMI of 500 women and 500 men living in West Azarbaijan was 26.6 (27.1 - 26.1) and 24.6 (25.2 - 24.0) kg/m², respectively. Standard deviation (SD) was calculated by using error = Z (SE) and SE = SD/√N formulas. Considering statistical power equal to 20%, Z CI: 95% equal to 1.96, and d = 0.6 kg/m², the sample size was calculated using the following formula:

$$n = \frac{Z_{1-\frac{\alpha}{2}} \times S^2}{d^2} \quad (1)$$

The calculated sample size was 322 women and 462 men. A sample size of 462 was selected. To increase the precision of the study, 723 participants (Azeri Turks, n = 445;

Kurds, n = 278) aged 20 - 64 years were included. A power analysis based on previous research on food insecurity and obesity in Iranians (15) confirmed that the aforementioned sample size was sufficient to detect similar results (power = 89.1%).

A multistage cluster systematic sampling frame was employed. The subjects were selected from all four geographical zones (north, south, east, and west) of Urmia city. From 38 available health centers (clusters), 10 health centers were randomly selected based on population size. At each health center, a systematic random sampling approach was used to select neighborhoods and households. In each household, two members (one man and one woman) were interviewed by trained local nutritionists who could speak Turkish or Kurdish. In some households, female interviewees were substituted for uncooperative male respondents. The response rate was approximately 80%. Therefore, the results of the study can be generalized to the studied population.

According to the main aims of this study, the inclusion criteria were current residency in Urmia, a member of either the Azeri Turkish or Kurdish ethnic group, not being pregnant or lactating, and no history of endocrine or metabolic disorders. Subjects (n = 3) who left more than 50% of questions relating to food items blank on their food-frequency questionnaire and subjects (n = 25) who misreported energy intake, based on the method suggested by Ghalichi et al. (16), were excluded from the study.

An informed consent form was signed by each participant included in the study. In this form, the participants confirmed that they were fully aware of the aims, methods, and implementation process of the study. They also confirmed that they voluntarily participated in this study and gave full consent. Furthermore, the participants were informed that they could leave the study at any time without giving a reason and that all information they provided would remain confidential. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki, and the study was approved by the ethical human research committee of the national nutrition and food technology research institute (NNFTRI), faculty of nutrition sciences and food technology, Shahid Beheshti University of Medical Sciences (approval code: 048501, date: 1/4/2013).

3.1. Neighborhood Quality and Characteristics

Neighborhood characteristics were obtained using a 22-item neighborhood and health observational checklist that assessed four categories (general characteristics, public green areas, access to services, and undesirable features) (16). Each item was assigned a score of 0, which denoted a lack of facilities and an absence of desirable characteristics and features, or 1, which denoted easy access to facil-

ities and desirable characteristics and features. The total score was calculated for each neighborhood. The checklist was designed by Ghalichi et al. and validated previously in Tehran city (16). The content validity of the checklist was evaluated and approved by local experts in Urmia city. Two independent trained observers administered the checklist in selected neighborhoods to assess inter-observer variation. There was strong agreement between the two observers' total mean scores for neighborhood characteristics ($r = 0.91$). Therefore, the checklist was considered reliable for assessing the neighborhood characteristics of Urmia city.

3.2. Anthropometrics

Using a calibrated scale, each participant's weight was measured to the nearest 100 g, with minimal clothes and bare feet. The subject's height was measured to the nearest 1 mm, with the shoulders in a normal position and without shoes. The BMI was calculated as the weight in kilograms, divided by the squared height in meters. Obesity was defined as a BMI of $\geq 30 \text{ kg/m}^2$.

Using a standard inelastic plastic tape measure, the subject's waist circumference was measured to the nearest 1 mm at the narrowest point between the lowest rib and iliac crest. The tape was placed directly on the subject's skin while the subject stood balanced on both feet after expiration (17). Central obesity was defined using national cutoffs of waist circumference ($\geq 95 \text{ cm}$ for both genders) (18, 19).

3.3. Assessment of Demographic and Socioeconomic Characteristics

Demographic (age, gender, and marital status) and socioeconomic data (educational status, total income/head, homeownership, house size/head, and household's assets) were gathered by a questionnaire through a face-to-face interview. Socioeconomic status (SES) was defined by scoring the socioeconomic characteristics according to a previous study (20), and the total score was computed. The total score was categorized into tertiles t, with T1, T2, and T3 labeled as low, middle, and high SES, respectively.

3.4. Physical Activity

Physical activity was assessed by the international physical activity questionnaire, which has been validated in Iranians (21). The activity levels were expressed as metabolic equivalents/minute per week (METs-min/week).

3.5. Statistical Methods

The data were analyzed using SPSS software V.16 (SPSS Inc., USA). Principal component analysis (PCA) was used

to identify major neighborhood patterns based on the 22-item neighborhood quality checklist. Factors with eigenvalues of ≥ 1.0 were retained. The selection of the factors was based on the inflexion of Scree test and interpretably. A varimax rotation was applied as a solution to obtain an orthogonal rotation to simplify the factor structure and render it more easily interpretable. After processing the PCA, two items general sanitary condition of the street and access to domestic shopping centers (malls and supermarkets) were relatively similar in all three neighborhood environments. Thus, these items were removed, and the analysis was conducted with the 20 remaining items. The derived factors were labeled on the basis of interpretation of the data.

The Kolmogorov-Smirnov test and histograms were used to test the normality of the variables. The data followed a normal distribution. To compare the general characteristics within the two ethnic groups, independent sample T-tests and chi-square tests were used, wherever applicable.

The multiple logistic regression method was used to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) for general and central obesity in four models. Model 1 was a crude or unadjusted model. Model 2 was adjusted for age, gender, marital status, duration of residence in Urmia, and SES. Model 3 was also further adjusted for educational level because this factor had an important effect on the significance of the association between the quality of the neighborhood and obesity. Thus, it was adjusted for separately. Model 4 was additionally adjusted for energy intake and physical activity. A value of $P < 0.05$ was considered significant.

4. Results

A total of 723 men and women participated in the study. After eliminating some participants from the study based on the exclusion criteria, 695 remained in the data analysis. Using PCA, three common neighborhood environments were extracted and labeled as "modern-affluent, centrally located with high access to social services (central-high access), and marginally located (marginal) neighborhoods. The factor loading of the constituent items of each neighborhood environment is displayed in Table 1. Overall, these three factors explained 73.2% of the total variance. The general characteristics of the participants from the two ethnic groups, Azeris and Kurds, are presented in Table 2. Education levels, SES, general obesity, and central obesity were higher in the Azeris than in the Kurds. There was also a higher percentage of the Azeri group in the second and last tertiles of

the modern-high quality and central-high access neighborhoods and a lower percentage in the marginal neighborhood. The mean \pm SD of age, BMI, waist circumference, and total score of the neighborhood's quality were significantly higher in the Azeri group, as compared to the Kurdish group. A comparison of the SES of the three neighborhoods showed that those with higher SES were in the highest tertile of modern-affluent. Those with moderate and high SES also resided in the central-high access neighborhoods. In contrast, residents with the highest SES were in the lowest tertile of the marginal neighborhoods. The association of general and central obesity with the quality of the neighborhood environment is presented in Table 3. Overall, the participants who lived in the central-high access neighborhoods had a greater chance of central obesity. This association remained significant after adjusting for demographic factors (age, gender, and marital status) and SES. However, after adjusting for education level in model 3, the result was not significant. After further adjusting for energy intake and physical activity (model 4), the association remained insignificant. In the Azeri ethnic group, living in the highest tertile of the modern-high quality neighborhoods was associated with a significantly higher chance of general obesity. After adjustment for demographic factors (age, gender, and marital status) and SES, the results remained significant. However, in common with the findings for the association between central obesity and the central-high access neighborhood, the association was not significant after including the educational level variable (model 3). Additionally, adjusting for energy intake and physical activity did not have a significant effect on the ORs.

5. Discussion

In the present study, the association of neighborhood quality with general and central obesity was explored in Kurdish and Azeri ethnic groups in Urmia, Northwest Iran. To the best of our knowledge, this is the first study on obesity and its relationship with the quality of the living environment in Iranian ethnic groups. Three different neighborhood environments were identified in Urmia city. General and central obesity were more prevalent in the Azeri ethnic group who mainly resided in the modern-affluent or central-high access neighborhoods. The education level of the subjects had a considerable effect on the positive association between central obesity in all the participants and general obesity in the Azeri Turks. In other words, higher educational achievement attenuated the effect of the living environment on obesity.

In the present study, the chance of central obesity increased among those living in central-high access neigh-

Table 1. Factor Loading Matrix for the Identified Neighborhoods Using PCA^a

| Items | Modern | Central-High Access | Marginal |
|---|--------|---------------------|----------|
| Absence of road traffic | 0.94 | - | - |
| Buildings with high-quality appearance | 0.94 | - | - |
| Absence of beggars, ramblers, or child workers | 0.92 | - | - |
| Absence of unattended land or buildings | 0.89 | - | - |
| Huge trees along neighborhood streets | -0.82 | 0.20 | 0.24 |
| Easy access to playgrounds | 0.80 | 0.40 | 0.22 |
| Easy access to parks | 0.69 | - | 0.29 |
| No threat of traffic to pedestrians | 0.70 | 0.43 | - |
| Easy access to exercise facilities | 0.69 | 0.57 | - |
| Construction and reconstruction | 0.65 | 0.28 | -0.30 |
| Absence of noise | 0.61 | 0.47 | -0.29 |
| Easy access to banks | - | 0.79 | 0.27 |
| Easy access to commercial centers | 0.28 | 0.76 | - |
| Structured streets | - | 0.74 | - |
| Easy access to restaurants, fast food centers, and coffee shops | - | 0.65 | - |
| Easy access to police stations | -0.416 | 0.64 | -0.30 |
| Easy access to mosques | - | 0.33 | 0.85 |
| Easy access to drugstores | - | 0.20 | 0.84 |
| Easy access to public transport | - | - | 0.78 |
| Easy access to press selling points | - | - | - |

^aValues of < 0.20 were excluded for simplicity.

borhoods. These neighborhoods were characterized by access to fast food centers, restaurants, and coffee shops, and this may have had an effect on the higher likelihood of central obesity among the inhabitants of these areas. However, this relationship did not remain significant when the two ethnic groups were analyzed separately. Various studies have indicated that frequent fast food consumption may increase the risk of obesity (22-24). However, few studies have examined neighborhood characteristics, including the geographic distribution of fast food restaurants,

Table 2. Major characteristics of the Azeri and Kurdish ethnic groups in Urmia^{a,b}

| Variables | Azeri | | Kurd | | Total | P Value |
|--|-------|------|-------|------|-------|---------|
| Gender | | | | | | |
| Female | 263 | 59.1 | 163 | 59.0 | 427 | 59.1 |
| Male | 182 | 40.9 | 114 | 41.0 | 296 | 40.9 |
| Marital status | | | | | | |
| Single/widow/divorced | 65 | 14.7 | 38 | 13.7 | 103 | 14.3 |
| Married | 378 | 85.3 | 240 | 86.3 | 618 | 85.7 |
| Educational level | | | | | | |
| Illiterate | 35 | 7.9 | 107 | 38.5 | 142 | 19.7 |
| Low | 133 | 30 | 114 | 41.0 | 247 | 34.3 |
| Moderate | 147 | 33.2 | 40 | 14.4 | 187 | 25.9 |
| High | 128 | 28.9 | 17 | 6.1 | 145 | 20.1 |
| SES | | | | | | |
| Low | 137 | 31.1 | 104 | 37.4 | 241 | 33.5 |
| Moderate | 149 | 33.8 | 91 | 32.7 | 240 | 33.4 |
| High | 155 | 35.1 | 83 | 29.9 | 238 | 33.1 |
| Obese | 150 | 33.7 | 72 | 25.9 | 222 | 30.7 |
| Centrally obese | 213 | 47.9 | 121 | 43.5 | 334 | 46.2 |
| Quality of the Neighborhood Environment | | | | | | |
| Modern-high quality | | | | | | |
| Tertile 1 | 59 | 26.2 | 166 | 60.8 | 225 | 32.4 |
| Tertile 2 | 203 | 48.1 | 22 | 8.1 | 225 | 32.4 |
| Tertile 3 | 160 | 37.9 | 85 | 31.1 | 245 | 35.3 |
| Central-high access | | | | | | |
| Tertile 1 | 89 | 21.1 | 175 | 64.1 | 264 | 38.0 |
| Tertile 2 | 155 | 36.7 | 23 | 8.4 | 178 | 25.6 |
| Tertile 3 | 178 | 42.2 | 75 | 27.5 | 253 | 26.4 |
| Marginal | | | | | | |
| Tertile 1 | 193 | 45.7 | 109 | 39.9 | 302 | 43.5 |
| Tertile 2 | 72 | 17.1 | 95 | 34.8 | 167 | 24.0 |
| Tertile 3 | 157 | 37.2 | 69 | 25.3 | 226 | 32.5 |
| Age, y (Mean ± SD) | 43.4 | 12.4 | 40.9 | 12.0 | 42.4 | 12.3 |
| BMI, (Mean ± SD) | 27.9 | 5.7 | 26.9 | 5.8 | 27.5 | 5.7 |
| Waist circumference, (Mean ± SD) | 93.5 | 13.8 | 91.7 | 13.0 | 92.8 | 13.5 |
| Neighborhood environment Quality score, (Mean ± SD) | 16.2 | 5.4 | 10.38 | 2.55 | 13.95 | 5.34 |
| Energy intake (Kcal/day), (Mean ± SD) | 2927 | 1100 | 2964 | 1080 | 2942 | 1092 |
| Physical activity (MET.min/week), (Mean ± SD) | 5619 | 7723 | 8052 | 9637 | 6575 | 8602 |

Abbreviations: BMI, body mass index; SD, standard deviation; SES, socioeconomic status.

^aValues are expressed as No. (%) unless otherwise indicated.^bP values were obtained by an independent sample T-test and a chi-square test, where appropriate.

Table 3. The Association of General and Central Obesity With the Quality of the Neighborhood Environment^a

| | Modern-high quality | | | | | | Central-high access | | | | | | Marginal | | | | | |
|------------------------|---------------------|-------------------|------|------|-------|------|---------------------|------|------|------|-------|-------------------|----------|------|------|------|-------|------|
| | Azeri | | Kurd | | Total | | Azeri | | Kurd | | Total | | Azeri | | Kurd | | Total | |
| | T2 | T3 | T2 | T3 | T2 | T3 | T2 | T3 | T2 | T3 | T2 | T3 | T2 | T3 | T2 | T3 | T2 | T3 |
| Obesity | | | | | | | | | | | | | | | | | | |
| Model 1 ^b | 1.95 | 2.49 ^c | 1.37 | 0.87 | 1.28 | 1.12 | 0.72 | 0.92 | 1.40 | 1.50 | 1.03 | 1.28 | 1.35 | 0.97 | 0.67 | 0.92 | 0.89 | 0.95 |
| Model 2 ^d | 1.90 | 2.31 ^c | 1.06 | 0.74 | 1.14 | 1.20 | 0.67 | 0.91 | 0.96 | 1.55 | 0.76 | 1.11 | 1.32 | 0.86 | 0.67 | 0.80 | 0.86 | 0.80 |
| Model 3 ^e | 1.52 | 1.56 | 0.99 | 0.80 | 1.12 | 1.16 | 0.64 | 1.04 | 0.84 | 1.70 | 0.87 | 1.36 | 1.30 | 0.84 | 0.57 | 0.78 | 0.86 | 0.80 |
| Model 4 ^f | 1.33 | 1.34 | 0.85 | 0.69 | 1.00 | 0.95 | 0.69 | 1.05 | 0.77 | 1.71 | 0.83 | 1.31 | 1.28 | 0.79 | 0.64 | 0.75 | 0.91 | 0.78 |
| Central obesity | | | | | | | | | | | | | | | | | | |
| Model 1 ^b | 0.93 | 1.23 | 1.52 | 0.80 | 1.20 | 1.18 | 0.74 | 1.27 | 1.97 | 1.44 | 1.15 | 1.63 ^g | 0.96 | 0.81 | 0.69 | 1.01 | 0.73 | 0.89 |
| Model 2 ^d | 0.95 | 1.23 | 1.34 | 0.77 | 1.05 | 1.07 | 0.71 | 1.20 | 1.66 | 1.39 | 0.97 | 1.45 ^c | 0.91 | 0.81 | 0.69 | 0.99 | 0.75 | 0.86 |
| Model 3 ^e | 0.99 | 1.17 | 1.40 | 0.73 | 0.94 | 0.93 | 0.73 | 1.24 | 1.67 | 1.28 | 0.90 | 1.33 | 0.95 | 0.85 | 0.76 | 1.02 | 0.80 | 0.90 |
| Model 4 ^f | 0.98 | 1.22 | 1.46 | 0.75 | 0.93 | 0.94 | 0.70 | 1.20 | 1.72 | 1.29 | 0.89 | 1.31 | 0.95 | 0.85 | 0.72 | 1.03 | 0.79 | 0.90 |

^a Values are reported as ORs. T1: first tertile (reference tertile [OR=1] not shown in the table), T2: second tertile, T3: third tertile.

^b Crude model.

^c $P < 0.05$.

^d Adjusted for age, gender, marital status, duration of residence in Urmia, and SES.

^e Additionally adjusted for educational level.

^f Additionally adjusted for energy intake and physical activity.

^g $P < 0.01$.

in relation to this risk. Easy access to fast food restaurants and a higher density of fast foods were reported to be positively related with the BMI (25). A higher density of fast food centers was also suggested to be strongly related to weight gain and obesity (26). However, a U.S. study found no association between living close to fast food restaurants and the BMI (23). Furthermore, the presence of supermarkets in a neighborhood was associated with a lower risk of obesity risk in another U.S. study (27). In the U.S., supermarkets carry a wide variety of foods, especially fresh and healthy foods, at discounted prices (27). In the present study, the access to domestic shopping centers (grocery stores and supermarkets) was relatively similar in all three of the defined neighborhoods. Therefore, it is not assumed to be a determining factor in residents of central-high access neighborhoods. In addition, central-high access was highly loaded for easy access to facilitating factor in higher obesity risk. Proximity to commercial centers and administrative centers may lead to a reduction in routine daily physical activity among the residents of these neighborhoods. The inverse association of physical activity and weight gain and obesity is well known (28).

The present study is part of a larger project designed to examine various features of obesity risk factors on anthropometrics indices. Defining the major dietary patterns of the studied population by the PCA method revealed that those in the highest tertile of the central-high access neighborhoods, had a higher score for the transitional dietary pattern that was highly loaded for fast foods (unpublished data).

In the present study, the marginal neighborhoods were

the most deprived of the three types of neighborhoods. However, living in a marginal neighborhood was not associated with a risk of obesity. In accordance with the findings of the present study, a previous study also found no evidence that a poorer social environment was associated with a greater BMI (10). However, several studies found a direct association between living in divested areas and obesity risk (10, 29, 30). For example, in a study conducted in Glasgow, the neighborhood environment was significantly associated with the BMI, even after controlling for individual characteristics, such as age, gender, social class, and material deprivation, with the individuals living in the most deprived neighborhoods having a higher BMI (31, 32).

Separate analysis of the relation between neighborhood quality and obesity revealed a significant association between Azeri ethnic group; and living in modern-affluent neighborhoods, as the wealthiest neighborhood in the current study, and increased chance of general obesity. The results of studying the neighborhood aspects on obesity risk in ethnic group are contradictory and due to differences of other ethnicities in terms of socioeconomic status, behavioral characteristics, and cultural attitudes regarding eating, physical activity, and body size, the observed results in our study cannot be comparable with those of other studies. However, in most multiethnic studies, living in an affluent neighborhood, which was characterized by better walking environments, availability of healthy foods, and higher SES, was associated with a lower BMI, independent of race/ethnicity (10, 33).

Similar to the findings of the present study, a study conducted in Taiwan showed that the risk of obesity was

significantly higher in wealthier neighborhoods (31). Poston and Foreyt (34) suggested that overeating and low activity were primary characteristics of a toxic environment. However, other factors, such as SES and place of residence, contributed to the prevalence of obesity. Furthermore, they pointed out that the relationship between SES and body weight differed in developing and developed societies. Other studies reported a strong positive association between SES and obesity in women, men, and children in developing countries (35, 36). As shown in the literature, low SES individuals were more likely to engage in physically demanding work, whereas those with greater resources were likely to have access to better nutrition, nontraditional foods, and labor-saving devices. In addition, in developing nations, being overweight was often viewed positively (i.e. as an outward sign of affluence and success) (34).

One of the most important findings of the present study was the strong effect of higher educational achievement on attenuation of the positive associations between general obesity and residing in a modern-affluent neighborhood and between central obesity and residing in a central-high access neighborhood. Hence, educational level was more important than neighborhood quality in predicting the risk of obesity. Most recent studies have confirmed the protective effect of higher educational levels against obesity (6, 31, 37). For example, a study of Canadian teens found that the risk of unhealthy eating and weight gain increased among those who lived in an area with a less educated population (37). In another study of French men and women, the risk of being overweight increased among those living in an area where the residents had a lower education level (31).

A considerable strength of the present study was the sample, which was representative of the population, and the high response rate (80%). Therefore, the results can be generalized to the studied population. In interpretation of the study results, its limitations also need to be considered. First, causality cannot be assigned to the associations observed in this study due to the cross-sectional nature of the data (38). Furthermore, other latent factors that were not assessed in the current study may have influenced the relationship between neighborhood quality and obesity within the studied population.

In conclusion, the findings suggest that the relationship between neighborhood characteristics and obesity held only in the Azeri ethnic group. Educational level was more important than neighborhood quality in predicting the risk of obesity. Further studies using hierarchical multilevel methods may help to discover more accurate associations.

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