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Socioeconomic Inequality in Overweight/Obesity and Related Factors in Adolescents in Kermanshah-Iran

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Abstract

Background: Overweight/obesity is increasing in both developing and developed countries. Its socioeconomic determinants have been well studied in developed countries. It has been reported that the family socioeconomic status is associated with overweight/obesity in childhood and adolescence. However, socioeconomic inequality has not been studied sufficiently in developing countries.
Objectives: This study aimed to determine the status of socioeconomic inequality in overweight/obese high school students and its related factors in Kermanshah, Iran.
Methods: Within a cross-sectional study and using stratified cluster random sampling, 1440 students in the academic year of 2015 - 16 were selected from all high schools in Kermanshah, Iran. To collect data, we used a demographic, socioeconomic status, and nutritional status questionnaire. Height and weight of the participants were measured and the status of obesity was determined by calculating body mass index (BMI). The concentration index and a concentration curve were used for the measurement of inequality. We used multinomial logistic regression to investigate the factors associated with obesity. The collected data were analyzed using Stata 11 software.
Results: The mean age of 1445 students participating in the study was 16.35 $\pm$ 0.84 years. Of all, 51.63% (746 students) were female and the rest were male. The median of BMI was 20.54 kg/m^2 (IQR = 4.32) in female participants, 21.20 (IQR = 4.42) in male participants, and 20.76 kg/m^2 (IQR = 4.49) in all the participants. Concerning asset index, Concentration Index for overweight/obesity was 0.09 in girls (95% CI: -0.14 - 0.33), -0.02 in boys (95% CI: -0.14 - 0.09), and 0.01 in the entire participants (95% CI: -0.13 - 0.17). The odds of overweight/obesity in males was 1.81 times higher than that in females; the odds of overweight/obesity in those consuming high-fat food was 1.61 times higher than that of people not consuming high-fat diet.
Conclusions: Overweight/obesity is more prevalent in adolescents with low socioeconomic level; this indicates the shift of the problem to the poorer groups of the community. Predominance of boys and the use of high-fat foods are affecting obesity/overweight; therefore, it must be considered in all health policy interventions.

Keywords: Socioeconomic Inequality, Overweight/Obesity, Adolescents, Concentration Index

1. Background

Health inequality refers to any unnecessary, avoidable, unfair, and unjust discrepancy, difference, and diversity in health measurement indicators and risk factors in different communities; it can be studied in terms of socioeconomic level, race, ethnicity, gender, disability status, and geographic location (1, 2). Nowadays, to interpret health status, we do not simply rely on the measurement of a general index in a community; rather we evaluate its distribution in various subgroups of the community. Socioeconomic inequalities in health mainly emerge due to the effects of socioeconomic factors such as income, education, and occupational status on health behavior and health status (3).

According to the available reports, socioeconomic inequalities are increasing in the prevalence of obesity and its associated risk factors (4). In recent decades, overweight has been considered as an important public health problem in children, adolescents, and adults (5). According to the World Health Organization's report in 2009, 44% of the burden of diabetes, 23% of the burden of ischemic heart disease, and 7% - 41% of the burden of some cancers are attributed to overweight and obesity (6). The obesity epidemic is continuously observed both in developed and developing countries (7). It is estimated that about 35 million children in developing countries and 8 million children in developed countries are living with overweight/obesity (8). Despite the known harmful effects of obesity on chronic diseases and health status, social determinants of obesity in developing countries have remained somewhat unknown (7). Overweight and obesity have remarkably increased in children and adolescents, especially among socially excluded populations (9). He et al. (2014) showed that family socioeconomic status (SES) is associated with overweight and obesity in childhood and adolescence. However, this might represent a conditional relationship which is dependent on the country's stage of

development (10). In developed countries, obesity is more common in individuals with low SES than in people with high SES (10, 11). However, in low-income countries, obesity is more common in higher socioeconomic groups (positive relationship between SES and obesity in males and females). In such countries, more affluent people and those with a higher educational degree are more likely to be obese. Based on the finding from Dinsa et al. (2012), in middle-income countries, socioeconomic inequality in obesity has a mixed pattern in males while there is a negative relationship between SES and obesity in females (12). In order to set new goals for making changes, it is very important to understand the extent and characteristics of inequality in a community and design clear plans. In addition, the health administrators must know how their planned and implemented policies lead to inequality; this gives them a clue to adopt measures to correct their plans and policies. Since there are a few studies in this area and due to the lack of such study in Kermanshah, this study aimed to determine the relationship between the status of socioeconomic inequality and overweight/obesity in high school students and investigate factors associated to this condition in adolescents in the city of Kermanshah. It can present a clear picture of the burden of the disease on different socioeconomic groups in the community; the results can also be utilized to facilitate health planning and health economic investment.

2. Methods

In this cross-sectional study, the study population included all high school students in Kermanshah city who attended school in the academic year of 2015 - 2016 (comprising 39 - 40 thousand students). Kermanshah is located in the western Iran and the total population of the city is estimated to be 952,285. People of the city mostly speak Kurdish. Kermanshah has a moderate and mountainous climate and is one of the western agricultural core of Iran that produces grain, rice, vegetable, fruits, and oilseeds. However, Kermanshah is emerging as a fairly important industrial city.

Of a total of 157 non-governmental and public high schools in Kermanshah, 75 were girls' high schools and 82 were boys' high schools. Using Cochran formula and taking into account the overweight/obesity prevalence of 11% and precision of 0.0005, the initial sample size was calculated as 752 students. Then, the calculated number was multiplied by the impact of the sampling design (stratified cluster random sampling) with a moderate heterogeneity (design effect = 1.7); thus, the sample size increased to 1279 students. Finally, taking a missing rate of 12.5% into account, the final sample size was determined as 1440 students. After making coordination with the provincial education organization, the sample was selected via proportional stratified sampling. Accordingly, in proportion to the number of students by gender and educational areas, the samples were selected from the three educational zones which covered a total of 157 high schools. Then, using cluster sampling method, in proportion to the number of students, we randomly selected 25 high schools, including 12 girls' schools and 13 boys' schools (8 schools from zone 1, 4 schools from zone 2, and 13 schools from zone 3).

To collect the required data, we used a questionnaire including demographic data (age, sex, educational level, field of study, etc.), SES variables (parents' level of education and occupation, level of income, house area (square meter), number of rooms, possession of various means, type of heating and cooling equipment, internet access, number of hours of internet use, etc.), and nutritional status data (diet and meals, fast food consumption, and physical activity). The questions in socioeconomic and nutritional status were based on previous studies (conducted in this field) as well as those used in the population and housing census designed by the Statistical Center of Iran (3, 10, 13-19). All the questionnaires were self-administered and were given to eligible students (those who were student in one of the high schools in Kermanshah city with the lack of specific diseases) along with an informed consent to participate in the study. The questionnaires were distributed and collected until we reached the desired sample size.

Using a tape measure with a precision of 1 cm, the height of the participants was measured in an upright position against the wall, without shoes. Shoulder, heel, and buttocks of the participants were flat against the wall. Moreover, using a Seca analog mechanical scale model 220, the weight of each participant was measured without shoes with minimal clothing. The status of obesity was determined through calculating body mass index (BMI). BMI is the person's weight in kilograms divided by the square of height in meters. For children and teens, BMI is age-and-sex-specific and is often referred to as BMI-for-age. Since there are changes in weight and height with age, as well as their relation to body fatness, BMI levels among children and teens need to be expressed relative to other children of the same sex and age. These percentiles are calculated from the centers for disease control and prevention (CDC) growth charts, which were based on national survey data collected from 1963 - 65 to 1988-94 (20, 21).

2.1. Statistical Analysis

2.1.1. Socioeconomic Status

Using principal component analysis (PCA), every individual SES was determined based on the possession of

some assets (including durable goods such as refrigerators, freezers, mobile phones, washing machine, dishwasher, microwave, vacuum cleaner, computer, car, etc.), living place, and income level (income was excluded from final model of SES since most of the participants did not answer this question). Since the data in PCA are quantitative, in this study we used polychoric PCA. The SES was set as a five-rank variable ranging from the poorest to the richest (five rating groups: The poorest, Poor, Moderate, Rich, and The richest).

2.1.2. Socioeconomic Inequality

The concentration index (C index) and a concentration curve were used for the measurement of inequality. In addition, to obtain the concentration curve, the cumulative percentage of overweight/obesity was plotted on the y-axis against the cumulative percentage of the ratio of the poorest to the richest socioeconomic groups plotted on the x-axis. In addition to the C index, we used multinomial logistic regression to investigate the factors associated with obesity. The collected data were analyzed using Stata 11 software. The P value < 0.05 was considered statistically significant.

The ethics committee of Kermanshah University of Medical Sciences approved research project of this paper (Reg. No. 94061).

3. Results

The mean age of 1445 students participating in the study was 16.35 $\pm$ 0.84 years, ranging from 14 to 19 years. Of all, 51.63% (746 students) were female and the rest were male. Concerning the school type, 81.8% were public (state) schools. The majority of the participants were second-grade (year 2) high school students (55.29%). In addition, the majority of the students (53.01%) were studying natural sciences. Concerning the home ownership, 69.8% of the participants were the owner of their home (Table 1). Based on the results of PCA, there was nearly an identical frequency of people in different groups in terms of asset index.

3.1. Weight, BMI and Obesity Status

The median weight of the students was 61 kg (IQR = 17) with a range of 30 to 210 kg; it was 57 kg (IQR = 14) in females and 67.5 kg (IQR = 17) in males. In addition, the median of BMI was 20.54 kg/m^2 (IQR = 4.32) in females, 21.20 (IQR = 4.42) in males, and 20.76 kg/m^2 (IQR = 4.49) in all the participants. Of all, 74.97% had a normal BMI (Table 2). As the students reported, most of them did not use high-fat diet (72.03%) and their mean number of meals was 3.32 $\pm$ 0.91 times a day. Moreover, 51.91% of the students reported the consumption of fast food; the mean number of fast food consumption per month was higher in males than females (6.76 $\pm$ 5.99 versus 4.7 $\pm$ 4.05 a month). Furthermore, most of the students had physical activity (62.92%) with a mean frequency of 3.41 $\pm$ 1.82 times a week (Table 2).

3.2. Socioeconomic Inequality in Overweight/Obesity Based on the Asset Index and Mother's Education

The highest percentage of overweight/obesity in terms of SES classification was observed in the poor and the richest groups of girls (29.3%), in the poor group of boys (23.84%), and in the poor group of the entire participants (25.82%) (Figure 1). Concerning asset index, the C Index for overweight/obesity was 0.09 in girls (95% CI: -0.14 - 0.33), -0.02 in boys (95% CI: -0.14 - 0.09), and 0.01 in the entire participants (95% CI: -0.13 - 0.17); taking into account the confidence interval, it was not statistically significant in any of the mentioned groups (Figure 2). In addition, the C index for mother's education was -0.05 in girls (95% CI: -0.22 - 0.11), -0.02 in boys (95% CI: -0.28 - 0.24), and -0.04 in the entire participants (95% CI: -0.36 - 0.27), which was not statistically significant (Figure 3).

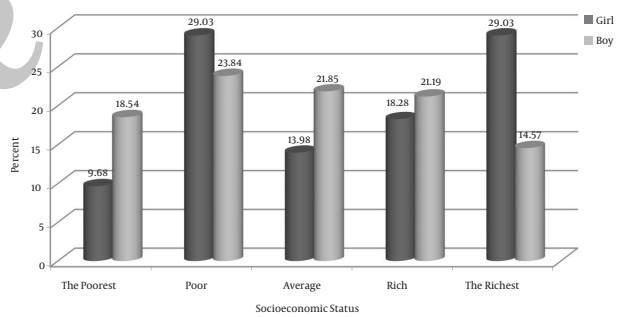

Figure 1. Frequency of Overweight/Obesity based on Asset Index by Gender in Adolescents, Kermanshah, Iran (2016)

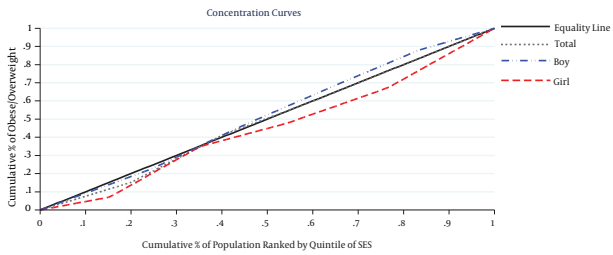

Figure 2. Concentration Curve of Overweight /Obesity Based on Asset Index by Gender in Adolescents, Kermanshah, Iran (2016)

Table 1. Demographic Variables, Socioeconomic Status, and Mother's Education by Gender in Adolescents, Kermanshah, Iran (2016)

Variables	Girl, No. (%)	Boy, No. (%)	Total, No. (%)
Education grade			
Year 2	473 (63.4)	326 (46.64)	799 (55.29)
Year 3	224 (30.03)	334 (47.78)	558 (38.62)
Year 4	49 (6.57)	39 (5.58)	88 (6.09)
Total	746 (100)	699 (100)	1445 (100)
Field of education			
Natural sciences	384 (51.47)	382 (54.65)	766 (53.01)
Humanities	206 (27.61)	57 (8.15)	263 (18.2)
Math and physics	22 (2.95)	141 (20.17)	163 (11.28)
Technical and vocational	134 (17.96)	90 (12.88)	224 (15.5)
Apprenticeship	0	29 (4.15)	29 (2.01)
Total	746 (100)	699 (100)	1445 (100)
School type			
Public	638 (85.52)	544 (77.83)	1182 (81.8)
Non-governmental/public bests	108 (14.48)	155 (22.17)	263 (18.2)
Total	746 (100)	699 (100)	1445 (100)
Home ownership			
Self-owned	502 (68.02)	501 (71.67)	1003 (69.8)
Mortgage	84 (11.38)	101 (14.45)	185 (12.87)
Rented	123 (16.67)	62 (8.87)	185 (12.87)
Other	29 (3.93)	35 (5.01)	64 (4.46)
Total	738 (100)	699 (100)	1437 (100)
SES			
The poorest	93 (15.58)	152 (24.24)	245 (20.02)
Poor	118 (19.77)	127 (20.26)	245 (20.02)
Moderate	115 (19.26)	130 (20.73)	245 (20.02)
Rich	132 (22.11)	113 (18.02)	245 (20.02)
The richest	139 (23.28)	105 (16.75)	244 (19.93)
Total	597 (100)	627 (100)	1224 (100)
Mother's education			
Illiterate	56 (7.57)	91 (13.15)	147 (10.27)
Under diploma	295 (39.86)	308 (44.51)	603 (42.11)
Diploma	255 (34.46)	188 (27.17)	443 (30.94)
Academic	134 (18.11)	105 (15.17)	239 (16.69)
Total	740 (100)	692 (100)	1432 (100)

3.3. The relationship between BMI and Other Variables

In multivariate analysis, we investigated the relationship between obesity and the variables including gender, use of high-fat diet, fast food consumption, physical activity, socioeconomic status, and mother's education level; based on the results of multinomial logistic regression, the odds of underweight in males was 2.23 times higher than that in females. In addition, the odds of over-

Table 2. BMI Groups, Diet Status, and Physical Activity by Gender in Adolescents, Kermanshah, Iran (2016)

Variables	Girl, No. (%)	Boy, No. (%)	Total, No. (%)	P Value[a]
BMI				< 0.001
Under weight	29 (3.91)	51 (7.36)	80 (5.58)	
Normal	598 (80.7)	477 (68.83)	1075 (74.97)	
Over weight	100 (13.5)	114 (16.45)	214 (14.92)	
Obese	14 (1.89)	51 (7.36)	65 (4.53)	
Total	741 (100)	693 (100)	1434 (100)	
Fatty diet				0.69
Yes	204 (27.53)	198 (28.45)	402 (27.97)	
No	537 (72.47)	498 (71.55)	1035 (72.03)	
Total	741 (100)	696 (100)	1437 (100)	
Fast food				0.06
Yes	369 (49.53)	379 (54.45)	748 (51.91)	
No	376 (50.47)	317 (45.55)	693 (48.09)	
Total	745 (100)	696 (100)	1441 (100)	
Physical activity				< 0.001
Yes	419 (56.24)	487 (70.07)	906 (62.92)	
No	326 (43.76)	208 (29.93)	534 (37.08)	
Total	745 (100)	695 (100)	1440 (100)	

[a] Based on chi-square test.

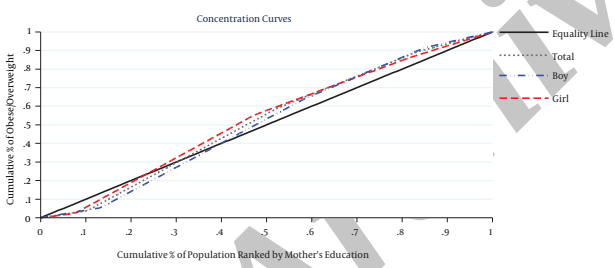

Figure 3. Concentration Curve of Overweight/Obesity Based on Mother's Education by Gender in Adolescents, Kermanshah, Iran (2016)

weight/obesity in males was 1.81 times higher than that in females; the odds of overweight/obesity in those consuming high-fat food was 1.61 times higher than that of students not consuming high-fat diet (Table 3).

4. Discussion

Based on the results, 19.45% of adolescents in age range of 14 to 19 years were overweight or obese which indicates the high prevalence of these conditions among adolescents; thus, it is expected for them to develop several diseases such as diabetes, hypertension, heart diseases, obstructive sleep apnea, venous thromboembolism, certain types of cancer, and metabolic syndrome in future (22). In fact the prevalence of overweight/obesity varies in different communities, for instance it is 2.2 in Sri Lanka (23), 5.7 in Pakistan and Australia (24, 25), 15.9 in Turkey and Sweden, 31.8 in America (20, 22, 26), 35.5 in Argentina (27), and 45.3 in Kuwait (28). Regardless of the method of measuring, the differences in the prevalence rates might be also due to the age of children and adolescents. Moreover, the increasing prevalence observed in different countries indicates that the problem is not only common in developed countries, but also has an increasing trend in developing and underdeveloped countries.

To design and implement effective interventions to control and manage obesity, it is necessary to understand the complex processes leading to this condition in a community and, as we know, one of the effective factors is socioeconomic status (12, 29). These factors may affect the amount of energy intake and expenditure, which in turn result in the accumulation of fat in the body. In this study, considering the asset index, there was no statistically significant difference between different socioeconomic levels in terms of overweight/obesity although considering

Table 3. The Relationship Between BMI Groups and Various Variables in Adolescents, Kermanshah, Iran (2016)

Variables	Underweight, OR (95% CI)	Normal, OR	Overweight/Obese, OR (95% CI)
Gender (boy)	2.23 (1.27 - 3.92)	1	1.81 (1.34 - 2.44)
Fatty diet (yes)	0.89 (0.48 - 1.67)	1	1.61 (1.18 - 2.18)
Fast food (yes)	0.77 (0.45 - 1.32)	1	1.12 (0.83 - 1.51)
Physical activity (yes)	0.89 (0.52 - 1.54)	1	0.92 (0.67 - 1.24)
SES[a] (rich and the richest compared to others)	0.59 (0.29 - 1.17)	1	0.87 (0.63 - 1.21)
Mother's education (under diploma compared to others)	0.63 (0.34 - 1.17)	1	1.25 (0.91 - 1.73)

[a] Based on Asset Index.

the SES the highest prevalence of obesity/overweight was observed in adolescents in the poor group. Given the socioeconomic status of people in Iran, which is a developing country, one may expect to observe a higher prevalence of overweight and obesity in the rich group of the community (12). Based on the results, although we observed a higher prevalence of overweight and obesity in the richest group of females, generally the prevalence was higher in those with lower SES. Monteiro et al. (2002) showed that obesity in developing countries is a health problem common in people with higher socioeconomic status (30). The results of studies showed that the burden of obesity/overweight in developed countries is higher in those with lower SES while in the developing countries it is higher in the more affluent groups of people (31-34). In developing countries, with increasing the level of gross national product (GNP), the burden of obesity shifts toward groups with lower socioeconomic status (35). Thus, it can be concluded that obesity/overweight in Kermanshah are being shifted to those with low SES. This issue must be considered by health policy makers who are responsible for health intervention and resource allocation. Similar to developed countries, in developing and underdeveloped countries, people and groups with lower SES have a worse health condition, as compared with their more affluent counterparts (36). Increasing the burden of overweight and obesity on this group not only results in the above-mentioned problems, but also can complicate their final health outcome.

In addition to the presence of inequality, the trend of inequality over time is of great importance. Studies on children and adolescents in countries like US and Great Britain show that socioeconomic inequalities in obesity/overweight do not decrease and in some cases, it is on the rise (13, 37-39). However, the results of this study showed that overweight and obesity in children whose mothers had a degree below high school diploma was 1.25 times more prevalent than that in children whose mothers had higher education levels. Nonetheless, considering the asset index, the results of multinomial logistic regression model did not show any significant difference. On the other hand, a study in Isfahan, Iran, showed that overweight and obesity was more prevalent in adolescents whose mothers had low education level (low socioeconomic status) (40). In addition, in a study in the United States, there was a significant relationship between girls BMI and parents' education level (41). A study in China showed that father's education level could be associated with students' BMI (42). In this study, we did not observe a significant relationship; it can be largely attributed to the multifactorial and complex nature of the relationship between obesity and other influencing factors.

In this study, gender was one of the most influencing factors that affected adolescents' BMI; accordingly, underweight and overweight/obesity were more prevalent in boys than in girls (OR = 1.81 and 2.23, respectively). In many studies, there are also some reports on sex differences in the prevalence of overweight/obesity (42, 43). Overall, it is supposed that girls and boys are different in terms of body composition, weight gain patterns, hormonal biology, and sensitivity to social, ethnic, genetic, and environmental factors (44).

In this study, many participants reported they did not consume high-fat food and they had physical activity during the week, but they still reported high consumption of fast food. In addition, the odds ratio of obesity/overweight in those who consumed high-fat food was 1.61 more than those not consuming high-fat foods. The tendency to consume fast foods, especially among adolescents, may increase energy consumption and, consequently, increase the risk of overweight and obesity (45). However, in this study, we did not find any relationship between fast food consumption and overweight/obesity. Overweight and obesity might have a relationship with fast food and western dietary pattern versus traditional dishes; such a relationship might differ between different communities. For

instance, in a study in Bahrain, it was found that the traditional foods in this country contain higher levels of fat and energy (46). In a study in Iran, the three groups of healthy foods, western foods, and traditional Iranian foods were compared; according to the results, a dietary pattern with a high intake of fruits, vegetables, poultry, and whole grains was associated with lower risk of general and abdominal obesity (47). Hence, a number of healthy food products in both traditional and Western foods is of great importance.

Although the focus of our study was on socioeconomic inequality in overweight/obesity, in terms of factor affecting this condition, only a small number of variables were investigated. In fact, a series of factors such as race, family size, peer and friends influence, and training/advertisement by mass media may be associated with obesity/overweight and must be investigated. For the purpose of this study, we only included urban students which might be different from those living in rural areas in terms of obesity/overweight and pattern of inequality. In fact, someone expects to see lower SES in rural area. Therefore, our study has limited power for further generalization of our results to the whole community in Kermanshah district.

4.1. Conclusion

Although there was no socioeconomic inequality in the prevalence of overweight/obesity in Kermanshah (probably similar to other parts of Iran), this condition was more prevalent in adolescents with lower SES; this indicates the shift of the problem to the poorer groups of the community. As people with low SES has their own specific types of deprivation, it is necessary to consider this issue in healthcare programs. Predominance of boys and the use of high-fat foods are the factors affecting overweight/obesity and therefore need to be considered in all health policy interventions in future.

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Footnotes

Authors' Contribution: Neda Izadi, contribution to study concept and design, acquisition, analysis and interpretation of data, drafting of the manuscript; Sayed-Saeed Hashemi-Nazari, contribution to analysis and interpretation of data; Elaheh Rafiee, contribution to study concept, design, and analysis; Azam Malekifar: contribution to drafting of the manuscript; Farid Najafi, contribution to study design, acquisition, analysis and interpretation of data, drafting of the manuscript

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