Exploratory Socio-Spatial Distribution of Overweight and Obesity among Primary School Girls in Jeddah Governorate, KSA

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Abstract: Background: Obesity in general and childhood obesity in specific are becoming an increasingly challenging burden worldwide, it is estimated that 10% of the world's school-age children are being overweight and one quarter of them are obese. Despite its hazardous effects on health, factors associated with obesity from the perspective of medical geography are not adequately studied. Objectives: To estimate the prevalence of obesity among primary school female students and to identify demographic associated tendencies based on geographic distribution. Methods: This cross-sectional study surveyed healthy female school students (grades 4th, 5th and 6th) during 2011. Four governmental schools representing different socioeconomic levels in Jeddah Governorate, Kingdom of Saudi Arabia were selected, from which eight hundred students were included. A pre-designed validated questionnaire was used for data collection. Weights and heights were measured, and the body mass index (BMI) was calculated. Students were categorized into overweight, obese and normal according to BMI by age scale adopted by CDC for girls (2-19 years).Results: A total of 788 students participated in the study with a response rate of 98.5%. Sixty seven students (8.5%) were categorized as either overweight (49, 6.2%) or obese (18, 2.3%). The proportion of overweight and obesity was significantly increasing towards older ages; it ranged between 5.6% at nine years old girls to 17.2 at age thirteen. The prevalence was significantly higher among students living in villas; own private cars and whom fathers are jobless. Geographically, the prevalence was significantly higher among students residing in Al Morjan district in the north west of Jeddah which is known as being predominantly of high socioeconomic level.

1. Introduction

The worldwide prevalence of childhood obesity has increased greatly during the past three decades.[1] It has been estimated that 10% of the world's school-going children being overweight and one quarter of them are obese.[2;3] In 2010, 43 million children (35 million in developing countries) were estimated to be overweight and obese; 92 million were at risk of overweight.[4]

The immediate causes of obesity are excess energy intake, combined with lack of physical activity. It is useful to consider demographics and economics as factors underlying the nutrition transition.[26] Urban populations have generally a better access to energy-dense foods such as sugar and fatty products. They are also exposed to the increasing mediatized commercial communication (publicity, marketing) and to an evolution towards a sedentary way of life due to mechanization of transport, technicality of work and modification of leisure (television, cinema).[27]

In a national survey in Saudi Arabia, **El-Mouzan** reported that the prevalence of overweight, obesity, and severe obesity in school-age children (5-12 years) was 19.6%, 7.9% and 1.5%, respectively.[5]

Childhood obesity can adversely affect nearly every organ system and often results in serious wide variety of comorbid conditions and complications, including hypertension, dyslipidemia, insulin resistance/diabetes, fatty liver disease, psychosocial complications,[6] polycystic ovary disorder, and disordered breathing during sleep.[7]

In Saudi Arabia, although the national prevalence of overweight and obesity has been reported in adults [8] and more recently in children,[5] information on regional variation in the prevalence of nutritional disorders including overweight and obesity is scanty. National prevalence data are often used for the surveillance of overweight and obesity and for the design of preventive programs, regional variations are equally important to define priorities.[9]Moreover, factors associated with the occurrence of obesity have not been well investigated, which in turn relatively affect the impact of any programs to prevent obesity in this region.[10] Additionally, it had been cited that reports on the prevalence of overweight and obesity were limited mainly to male school children.[5] Accordingly, surveillance of prevalence of overweight and obesity starting at an early age is important for management and prevention.

Furthermore, studies focusing on the interaction between socio-economic characteristics, geographic domain and obesity are not adequate. Therefore, the current study incorporates the socio-spatial variations of obesity and to identify lifestyles and dietary practices contributing to obesity and its socio-spatial distribution. We hypothesized that obesity is subjected

to socio-spatial variations due to an unequal distribution of its causes in heterogeneous population. The purpose of this study was to: (i) determine the prevalence of obesity in the primary schools' female students; (ii) analyze the socio-spatial variations of obesity among the study group and (iii) identify lifestyles and dietary practices contributing to obesity and its socio-spatial distribution.

2. Material and subjects
Study area:
This study was conducted in Jeddah Governorate, located on the west coast of the Kingdom of Saudi Arabia with population of 3,000,000 in an urban area of 1,765 km^2 which lie between (39°. 15′ ; 40°. 35′E), and (22°. 5′; 20°. 30′N), it is considered as one of the most active commercial cities and the main seaport of the Kingdom.

Population of the study
There are 222 governmental primary schools for girls, serving about 160,000 students from grade one to grade six.
The current study targeted students at higher grades (4th,5th and 6th) as they are more capable to understand and respond to the questionnaire. Their estimated total number accounted for 70,000.

Sampling
Based on the assumption that the prevalence of obesity among primary school female students is about 14.5%, and adopting confidence interval of $\pm$2.5 % and power of 80%, the calculated sample size accounted 759 which was approximated to 800 students to compensate for expected non response.
Multistage sampling was pursued to select the study sample as following:
First stage: Putting into consideration that the socioeconomic status might play a role in potentiating overweight and obesity, therefore sampling was made on the ground of categorizing Jeddah governorate into four main regions with predominantly distinct socioeconomic levels namely: very high, high, medium and low levels.
One districtl was selected by simple random sampling from each region as follows:
Al Morgan district representing very high socioeconomic level; Al Azizia for high; Prince Abdul Majeed district as medium and Al Baghdadia as low socioeconomic level district.
Second stage: One school was selected by simple random sampling from each district.
Third stage: Students were selected by systematic random sampling from the assigned schools using the lists of students available at the students' affairs as a matrix for assignment.

Tools of the study
Calculating and interpreting BMI of the children

1. First, accurate height and weight of the students were measured using standardized scale.
2. BMI was calculated for each student by dividing weight in Kilogram by squared height meters.
3. According to CDC, BMI for children and teens is both age-and sex-specific due to remarkable changes in the amount of body fat at this age group and by gender, therefore, the BMI-for-age percentile was used for evaluating and categorizing body mass of the students.
4. The CDC BMI-for-age growth charts for girls (2-19 years) allowed translation of a BMI number into percentiles, and it was interpreted as following:

- Underweight, less than the 5th percentile
- Healthy weight, 5th percentile up to the 85th percentile
- Overweight, 85th to less than the 95th percentile
- Obese, equal to or greater than the 95th percentile

3. Results
Out of 721 primary school female students aged between 9 and 13 years, there were 67 (8.5%) who were categorized as either overweight (49, 6.2%) or obese (18, 2.3%). Although there were slight decreases in the prevalence of overweight and obesity on transition from 9th to 10th years of age, however there was significant stepwise consistent increase in the prevalence from 11th year of age onwards (p<0.05). The prevalence was significantly higher among students whom fathers are jobless 13(15.3%) than those whom fathers have jobs 54(7.7%). Meanwhile, it was found that owning a private car by the family is remarkably associated with significant increase in the prevalence of overweight and obesity among the students 66(9.4%) if compared to those who haven't 1(1.1%). The highest prevalence was recorded among students who are living in villas 31(15.3%), while the lowest was recorded among students who are living in apartments 31(5.8%) and these differences are statistically significant p<0.05 (Table 1).

Regarding the place of residence, it was remarked that the highest prevalence of overweight and obesity (15%) was reported among students living in Al Morjan district which is located in the north west of Jeddah Governorate (Table 2 and Figure 1), while the lowest prevalence was found among students living in Al Baghdadia (3.1%), and these differences are statistically significant (p<0.05).

On the other hand, although none of the students who go to school on foot suffer from overweight or obesity compared to 9% among those who used to go to school by private car, however, these differences are not statistically significant(p>0.05).

While 26.9% of the overweight or obese students indicated that they are taking snacks from home to eat them at the school, the percentage was higher among those with normal weight (38.7%). Meanwhile, it was

observed that the percentage of those who are consuming more than two fast food meals daily was higher among the overweight and obese children (13.4%) if compared to the normal weighted children (9.7%, p>0.05). However, this difference is not statistically significant (Table 3).

4. Discussion

Obesity is a complex condition which is influenced by a wide-range of genetic and non-genetic factors, with interactions between many of these.[1] Children living in the urban area with high socioeconomic status are significantly at risk for being overweight and obese.[11] The current study showed that 8.5% of the primary school girls (9-13 years) are either overweight or obese, although this percentage is close to the reported world wide figure (10%)[2;3], it is much lower than what was found by **El-Mouzan** who reported that prevalence of overweight, obesity, and severe obesity in Saudi school-age children (5-12 years) was 19.6%, 7.9% and 1.5%, respectively.[5] These differences could be attributed to un similarity of age grouping or not adequately nationally representative sampling. Another important explanation is the differences in the type of reference and cutoff used, as there are several reference data used to estimate obesity among school children, such as CDC, WHO, and IOTF references. Each reference gives a different prevalence of overweight and obesity.[10]

Our study showed that there are significant stepwise consistent increase in the prevalence of overweight and obesity among girls aged from 11th year of age onwards. These findings are consistent with what was found in similar studies where it was addressed that the observed high prevalence of overweight and obesity among girls in higher grades may be due to genetic factors and pubertal growth spurt.[12] The crucial importance of detecting overweight and obesity among this age group is derived from that fact that the combined influence of adult obesity-susceptibility variants depends on faster rates of weight gain appears to be confined to the first 11 y of life rather than continuing into later adolescence and adulthood. The persistence of this risk in adult life might be attributed to environmental factors.[13]

Urbanization had been identified as a potential factor enhancing development of obesity, because dwellers of these areas have easy access to energy dense cheap foods and less energy requirements in daily life.[9] Another issue that has to be considered is the heterogeneity in cities characterizing urbanization can make the situation even more complex. Therefore, it is important to understand the distribution of obesity in the population, as well as the distribution of the factors that influence it. In the present study it was remarked that the highest prevalence of overweight and obesity was reported among students living in Al Morjan district which is located in the north west of Jeddah Governorate and is ranked as high socio-economic , while the lowest prevalence was found among students living in Al Baghdadia which is considered as low socio-economic district.[14] This difference could be explained by the drastically different lifestyles led by these two districts, with the addition to the socioeconomic status; for the citizens living in the Northern part of Jeddah live in villas as it had been shown in the current study. Moreover, they also have easily accessible means of transport (personal cars) and machinery that reduce the effort level in their households. Also, there is a much less physical-extensive activity available which children could be involved in. Furthermore, it had been found that there is a directly proportional relationship between the times spent watching television and the risk of becoming obese in children in these areas.[15-17] These findings support what had been cited about the sedentary nature of the Saudi population. The overwhelming majority of men and women did not reach the recommended physical activity levels necessary for promoting health and preventing diseases. The high prevalence of inactivity among Saudis represents a major public health concern.[10]

Economic improvement over the last decades in most of the Eastern Mediterranean Region countries resulted in greater impact on diets that are characterized by being higher in fats especially saturated fat, cholesterol, and refined carbohydrates and low in polyunsaturated fatty acids and dietary fiber. This nutrition trend has complicated with a sedentary lifestyle and increased level of stress. Consequently, the prevalence of obesity and other noncommunicable diseases has risen steeply.[18;19] The nutrition transition in all high income countries in the region (Arab Gulf Countries), had been reported in several studies.[19;20]

On the other hand, in the central district of Jeddah, Al Baghdadia district, there seems to be a smaller percentage of obesity, as most of its inhabitants have a low average income rate.[15-17]

The low prevalence of overweight and obesity in this area does not necessarily mean better health than other districts but is most probably related to the higher prevalence of underweight, wasting and stunting.[21] **Lobstein *et al.*** pointed that there are many restrictions on using survey data for interpreting trends in obesity in children and adolescents. high prevalence of stunting as stunted children are more likely to be overweight in countries undergoing a rapid nutrition transition, differences may exist in the timing and patterns of adiposity rebound between populations in particular between populations in industrialized and in developing countries and measuring errors.[22]

In conclusion, these findings point to the fact that obesity is a prepupertal problem and calls for more consideration. The differences in the socio-spatial factors, such as age, household location and transport with private car, led to part of the between-districts differences in the prevalence of overweight and obesity among primary schools' Saudi girls. Furthermore, geographic factor might have contributed to this disparity as the area of residence is an independent risk factor. This supports the assumption that, in terms of health issues, cities are not homogeneous entities. There are 'districts' within the city that may hide important health disparities among city dwellers.[28]

Tailored health education programs accustomed for this age group especially those who are living in high socio-economic districts are essentially needed to diminish likelihood of developing overweight and obesity.

Table 1:- Prevalence of overweight and obesity according to demographic characteristics of the students

Characteristics	BMI categories				X^2	p
	Normal		Overweight or obese			
	No	%	No	%		
Age in years						
9 years	67	94.4%	4	5.6%	15.487	0.004
10 years	212	96.8%	7	3.2%		
11 years	266	89.9%	30	10.1%		
12 years	152	87.9%	21	12.1%		
13 years	24	82.8%	5	17.2%		
Work status of the father						
Has a job	649	92.3%	54	7.7%	5.649	0.017
Jobless	72	84.7%	13	15.3%		
Ownership of private car						
Yes	633	90.6%	66	9.4%	6.823	0.009
No	86	98.9%	1	1.1%		
Type of housing						
Villa	171	84.7%	31	15.3%	17.260	<0.001
Apartment	503	94.2%	31	5.8%		
Public house	45	90.0%	5	10.0%		

Table 2:- BMI categories according to place of residence and used methods for transportation of the students

	BMI categories				X^2	p
	Normal		Overweight or obese			
	No	%	No	%		
Districts						
Prince Abdul Majeed housings	185	92.5%	15	7.5%	18.351	<0.001
Al Baghdadia	187	96.9%	6	3.1%		
Al Azizia	179	91.8%	16	8.2%		
Al Morjan	170	85.0%	30	15.0%		
Methods of transportation						
Walking	36	100.0%	0	.0%	3.533	0.171
Public buses	97	91.5%	9	8.5%		
Private cares	588	91.0%	58	9.0%		

Table 3:- BMI categories according to habits of taking snacks to the school and consuming fast foods.

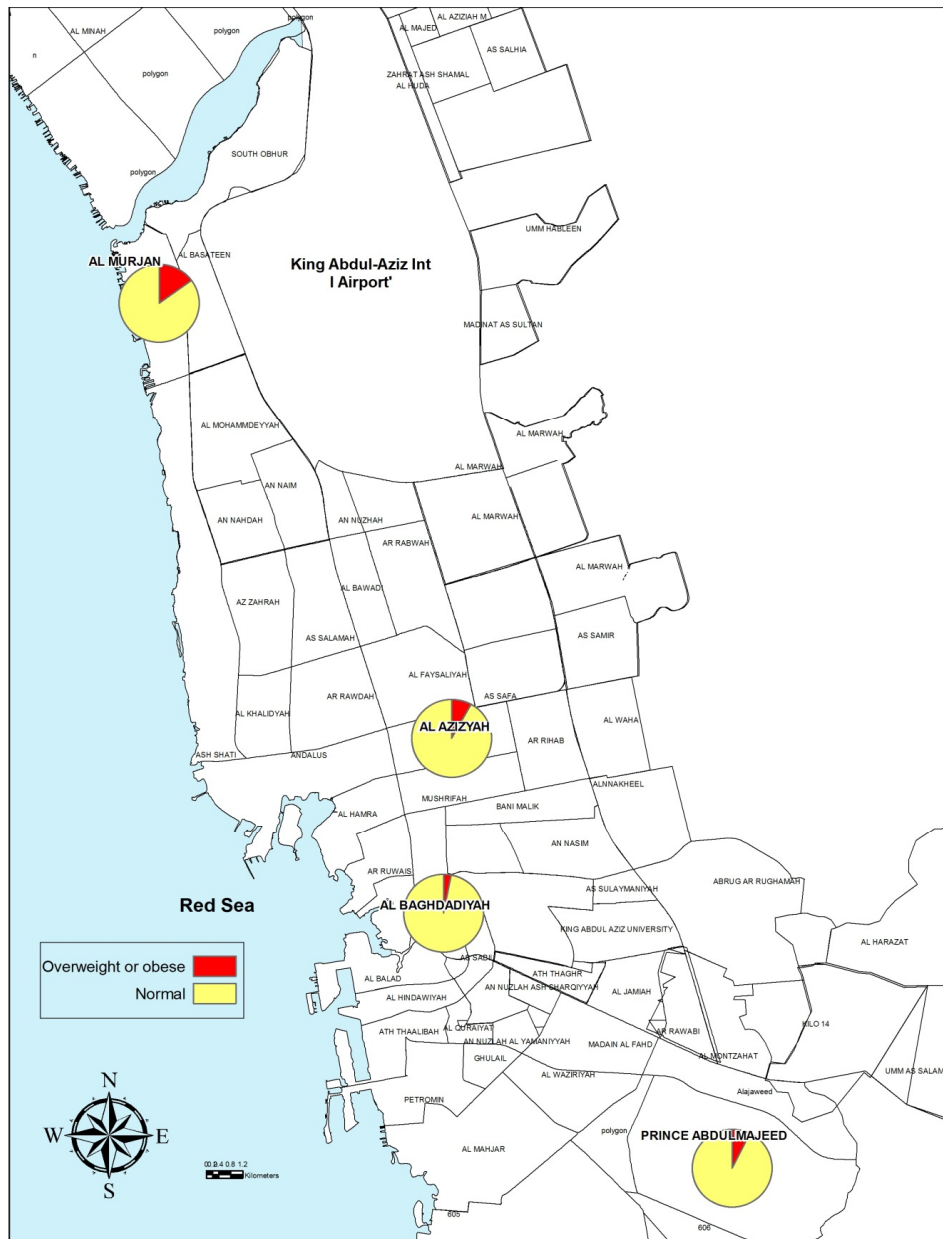|	BMI categories				X^2	p
	Normal		Overweight or obese			
	No	%	No	%		
Taking snacks to the school						
Yes	279	38.7%	18	26.9%	3.654	0.056
No	442	61.3%	49	73.1%		
Daily frequency of consuming fast foods						
None	49	6.8%	8	11.9%		
Once	465	64.5%	41	61.2%		
Twice	137	19.0%	9	13.4%	4.221	0.239
>Two times	70	9.7%	9	13.4%		

Figure 1: Distribution of overweight and obesity by selected districts in Jeddah Governorate

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