Progressive Changes in Overweight and Obesity during the Early Years of Schooling among Children in a Central Region of Saudi Arabia

Al-Mohaimeed A[1,*], Ismail MS[2], Dandash K[1], Ahmed SM[2], AlHarbi MH[1]

[1]Family and Community Medicine Department, College of Medicine, Qassim University, Mailing Address: College of Medicine Qassim University, Saudi Arabia , P.O. Box 6655 , Buraidah, 51452, KSA
[2]Food Science & Human Nutrition Department, College of Agriculture and Veterinary, Qassim University, P.O.Box 6622, Buraidah, 51452, KSA

Abstract   Childhood overweight and obesity have become a global public health problem. This study aims to determine the prevalence of these health conditions in children studying in government schools in the two cities of Buraidah and Unaizah of the Qassim Region, Saudi Arabia. The   key question that we examined was whether the children enter the school as overweight or become overweight after entering the school. Using a cross-sectional, observational study design, a random sample of 874 school children between 6– to 10 years was enrolled in 2010/2011. A structured questionnaire was used for collecting data. Weight and height were measured, and the body mass index (BMI) was categorized. Based on the World Health Organization (WHO) definition, the overall prevalence of overweight and obesity was 12.8% and 10.1%, respectively. Girls had a higher prevalence of overweight (18.4%) and obesity (15.6%) than boys. Overweight tendency increased dramatically from 7.6% in Grade 1 to 19% in Grade 4. Similarly, obesity also increased progressively after entering the school. Our study suggests that overweight and obesity are mostly acquired after entering the school. Public health program are, therefore, required to promote a healthy lifestyle from the early years of schooling.

Keywords   Childhood, Overweight, Obesity, BMI, Saudi Arabia

1. Introduction

Studies from different parts of the globe indicate a high prevalence of overweight and obesity among children in both developed and developing countries. Saudi Arabia ranks 29 on the 2007 list of countries with fat individuals with 68.3% of its citizens being overweight and obese.[1] Of the 13 provinces that constitute Saudi Arabia, Qassim ranks the third with a high prevalence of obesity (26.5%) ranging between 11.7-33.9%.[2]

Overweight and obesity are defined as abnormal or excessive fat accumulation in the body that may impair health. Obesity is a complex and incompletely understood condition. It is not just an individual's problem but a public health issue and therefore must be tackled accordingly.[3] Globally, obesity is the fifth leading cause of death.[4] Childhood obesity is a global problem. Its prevalence continues to increase at an alarming rate. It has become one of the most serious public health challenges of the 21st

century.[5] Globally, 10% of school-aged children, between 5 and 17 years, are overweight or obese, and the situation is getting worse.[6]

A review of data on childhood obesity for Saudi Arabia shows interesting variations. The results of the national household screening on diabetes mellitus (1994 to 1998) revealed overweight and obesity as 13.6% among males and 17.8 % among females in 6-12 years children.[7] The recent work on the 2005 reference national based data of 19317 healthy children and adolescents from 5 to 18 years showed an overall prevalence of overweight, obesity and severe obesity as 23.1%, 9.3% and 2%, respectively with a total of 34.3 %. These studies also showed that children between 6-13 years of age in the Qassim region have higher prevalence of overweight and obesity than the similar group in South Western and Northern regions.[8, 9]

Childhood overweight and obesity are strongly associated with the risk of developing high cholesterol, hypertension, respiratory ailments, orthopaedic problems, depression and type 2 diabetes.[10] Overweight and obesity are affected by various genetic, behavioural, and environmental factors.[11] Examination of these factors is therefore crucial for providing insights into preventive actions.[12] The management of overweight and obesity in children should

not be delayed until adulthood because then it becomes ever more difficult to achieve lasting weight reduction. Adiposity measurement methods are variable. Body mass index (BMI) is simple anthropometric measure and has been a valuable tool for monitoring trends in obesity.[13-18]

The aim of this study is to assess the prevalence of overweight and obesity among young school children of 6-10 years in two big cities of Qassim, Saudi Arabia. We purposefully selected the capital city which constitutes 50% of Qassim's population. The other was selected randomly from the remaining ten cities. The reason for selecting 6-10 year cohort was to observe and better understand the progression process of overweight and obesity against the background of their entry into an 'external environment of exposure to food' outside their homes. The age group of over 10 years was not selected to avoid effects of hormonal changes on BMI that could result from menarche.[19] A key question that we examined was whether the children enter the school system as overweight or become overweight after entering the school. To address this issue we explored if the prevalence of overweight and obesity increased with age or remained the same from the early ages as the children entered the school system.

2. Methodology

This was a cross-sectional study carried out in the Qassim region and data were collected using a multi-staged survey sampling method. We targeted students between 6-10 years studying in the first four years of the public sector primary schools.. A review of the global studies reports the prevalence rates of overweight, including obesity, to vary between 23% to 46.0%[20]. For calculating our sample size, we applied a conservative approach of using 50% as the prevalence rate of overweight, which would give the largest required sample. At 95% confidence level, with 5% margin-of-error, a design effect of 2.0 for clustered data at the school level and 12% non-response rate, we estimated the sample size requirement of 874. Hence, the study targeted to interview 874 students.

As the first step the capital city, Buraidah, which makes nearly 50% of the population of Qassim was selected. Unaizah was the other city randomly selected of the ten main cities of Qassim..

The second stage was of random selection of targeted schools. From a current list of primary schools in the two cities, and according to proportional allocation, 30 schools from Buraidah and 4 from Unaizah were randomly selected to represent nearly 10% of total targeted schools.

In the third stage an ordered list of classes of the targeted fourth graders in the selected schools was used to represent the sampling frame. As the average number of students per class was around 25, a total of 40 classes were included to reach the required sample size. Ten classes from each grade were randomly selected. All students in the class (cluster) were invited to participate. Thus the study covered 874

students who were present in the selected classes at the time of data collection. The selected students fulfilled the inclusion criteria of being native Saudis; registered in the primary national schools; age 6-10 years and permanent residents of Qassim. Using the school health records we excluded physically disabled children, i.e. those having any chronic disease or any psychiatric or an immune-compromised disorder. The survey was conducted between February and June 2011.

3. Data Collection Tools and Techniques

After a brief orientation, selected school children were subjected to the following:

3.1. Anthropometric Measurements

All measurements were carried out outside the class room. The students were measured bare feet and with light clothes. The weight was measured using a portable commercial balance (Seca, Germany) with an accuracy of ±100 g. The students stood erect and without touching anything. The recorded weight was approximated to the nearest 0.5 kg (Jellify, 1989). The height was measured using a portable stadiometer. The students stood on the platform with feet parallel and the back of the head, back; buttocks, calves and heels touching the upright surface. The standing body height was measured to the nearest 0.5 cm.[22] The scales were recalibrated after each measurement.

1) BMI was calculated as 'body weight in kilograms/height in meters, squared. We applied the cut-off points of overweight: >+1SD (equivalent to BMI 25 kg/m2 at 19 years), Obesity: >+2SD (equivalent to BMI 30 kg/m2 at 19 years), Thinness: <-2SD and Severe thinness: <-3SD which are recommended by WHO[23] in identifying the age and gender-specific cut-off points for the BMI with the age ranging from 5 to 19 years for the diagnosis of overweight and obesity among the subjects. BMI indirectly assesses the amount of body fat.[15] We used the standard WHO definition for the sake of comparability of the results to studies in other regions and comparable countries.

3.2. Questionnaire Construction

It included the following items:

a. Sociodemographic data: These were collected using a parental form and included the following items: Name of the school; class level; socioeconomic data; parental age, education, and occupational status; current residence, and family size.

b. Medical history: This included health status of the student, and his/her past history of surgeries, medical conditions and any previous use of medicines. It also included family history of general health and obesity.

Finally, all questions were reviewed by a group of five experts in the field, and modified according to their recommendations.

3.3. Pilot

The questionnaire was piloted on a small sample of the students to identify the areas in need of improvements.

3.4. Administration of the Questionnaire

This was done by handing the questionnaire over to the students attached with a covering letter as mentioned above, students then had to bring the filled out questionnaire back to the school's social worker.

3.5. Data Management and Data Processing

Statistical Package Social Science; SPSS version 17 software (SPSS Inc. Chicago, Illinois, USA) was used for data entry and processing. Exploratory data analyses were performed for examining the quality of data and distribution of the variables. Inferential data analyses were conducted using the appropriate statistical tests of significance. We reported the prevalence rates and 95% confidence intervals of overweight and obesity. A significance level of 0.05 was used for assessing the statistical differences between subgroups. Differentials in overweight and obesity were examined for socio-demographic variables. Multivariable logistic regression models were used to identify the major determinants of overweight or obesity, adjusted for other confounding covariates.

3.6. Ethical Considerations

The Regional Education Directorate and School Health Authorities, along with the teaching and administrative staff of schools, were taken onboard about the study objectives and methods. Before commencing interviews and measurements, the students were given a brief orientation. The study protocol was approved by the Research Committee of Qassim University.

4. Results

Our sample consisted of 874 students (boys and girls). Boys represented 70.7 % (n=618) and girls the rest of 29.3% (n= 256). The mean age of boys was 8.2 ± 1.28 SD with a range of 6-10 years and for girls it was 8.7 ± 1.14 SD with a range 7-10 years. The response rate for the first set of data collection was 100% and to the second 92.0% (804 out of 874 students).[Table 1]

Table 2 shows the summary measures of height, weight and BMI. Girls showed a highly significant difference from boys in both weight and height (P value=0.001). The mean of BMI of boys was 16 ± 2.6 with a range 12.1 to 31.1, and that of girls was 17.9 ± 4.3 with a range 8.4 to 41.3 as they showed a highly statistically significant difference than boys (P=0.001).

The detailed distribution of overweight and obesity as per International Classification of WHO based on BMI is shown in Fig. 1. Overweight and obesity were observed in 12.8 % (112 students) and 10.1% (88 students) of the

students, respectively whilst the majority of the sample was within the normal range. It is also important to note that 10.1 % (n=88) students had either severe thinness or ordinary thinness, indicating a sizeable proportion of malnutrition among Saudi Arabian children.

The differentials in overweight, obesity and underweight by demographic and socio-economic characteristics were shown in Table 3. Only 7.6% of the children were overweight in the first grade, while 19.2% of them were so in the 4th grade. Similarly 8.6% of them were obese in the first grade while 12.8 of them were so in the 4th grade.

Table 1. The description of sample characteristics

Variable	Frequency	Percent
Age 6 7 8 9 10	95 192 179 180 228	10.9 22.0 20.5 20.6 26.1
Gender Boys Girls	618 256	70.7 29.3
Residency Buraidah Unaizah	801 73	91.6 8.4
Grades 1st grade 2nd grade 3rd grade 4th grade Missing	175 158 157 174 210	20 18.1 18 19.9 24
Father's work - Working -Not working	573 221	65.5 25.2
Mothers' work -Working -Housewife	126 678	14.4 77.6
Father's education -None -primary -secondary/high	47 230 325	5.4 26.3 37.2
Mother's education -None -Primary -Secondary/high	70 259 279	8.0 29.6 31.9
Relative parents Yes No	348 258	39.8 29.5
Family size Less than 6 6 or more	148 437	16.9 50.0
Socioeconomic status -Low -High	474 118	54.2 13.5
Total	874	100

Table 2. The summary of anthropometric measurements of school children by gender

	Sex	N	Mean	95%CI		Range
				Upper	lower	
Height (cm)	Boys	618	124.0485	123.364	124.733	106.0 – 148.0
	Girls	256	131.2813	129.9573	132.6052	101.0-153.0
Weight (kg)	Boys	618	24.9547	24.41157	25.49774	15.4- 58.3
	Girls	256	31.4105	30.13006	32.69103	14.0- 64.0
BMI (kg/m2)	Boys	618	15.9869	15.77493	16.19896	12.1- 31.1
	Girls	256	17.8733	17.33641	18.41019	8.4-41.3

Table 3. Students' BMI classes by demographic profile

| BMI classes Variables	Obese	Over-weight	Normal	Thiness	P value
	%	%	%	%	
Gender					
-Girls	16.6	18.4	49.6	16.4	<0.001
-Boys	7.8	10.5	74.3	7.4	
Age groups					
-6-8	9.5	11.5	67.2	11.8	<0.001
-9-10	10.6	14.1	66.9	8.3	
Grade					
-1st grade	8.6	7.6	75.6	8.2	
-2nd grade	8.6	10.7	60.9	19.8	<0.001
-3rd grade	10.9	16.4	65.6	7.1	
-4th grade	12.8	19.2	62.1	5.9	
Residence					
-Unaizah	10.1	12.9	66.4	10.6	0.390
- Buraidah	9.6	12.3	74.0	4.1	
Father's work					
- Working	7.7	13.6	67.4	11.3	0.507
-Not working	10.9	13.6	63.8	11.8	
Mothers' work					
-Working	14.3	20.6	59.5	5.9	0.775
-Housewife	9.4	12.1	66.8	11.7	
Father's education					
-None	12.8	8.5	76.6	2.1	0.431
-primary	8.3	12.2	66.5	13.0	
-secondary/high	10.5	14.8	64.9	9.8	
Mother's education					
-None	7.1	5.7	82.6	4.3	0.061
-Primary	7.7	12.4	67.6	12.4	
-Secondary/high	12.9	16.5	60.9	9.7	
Relative parents					
Yes	12.1	14.9	62.1	10.9	0.311
No	6.6	11.2	72.1	10.1	
Family size					
Less than 6	13.5	17.6	60.1	8.8	0.433
6 or more	8.7	12.4	68.2	10.8	
Socioeconomic status					
-Low	9.7	12.7	67.9	9.7	0.017
-High	11.9	18.6	56.8	12.7	
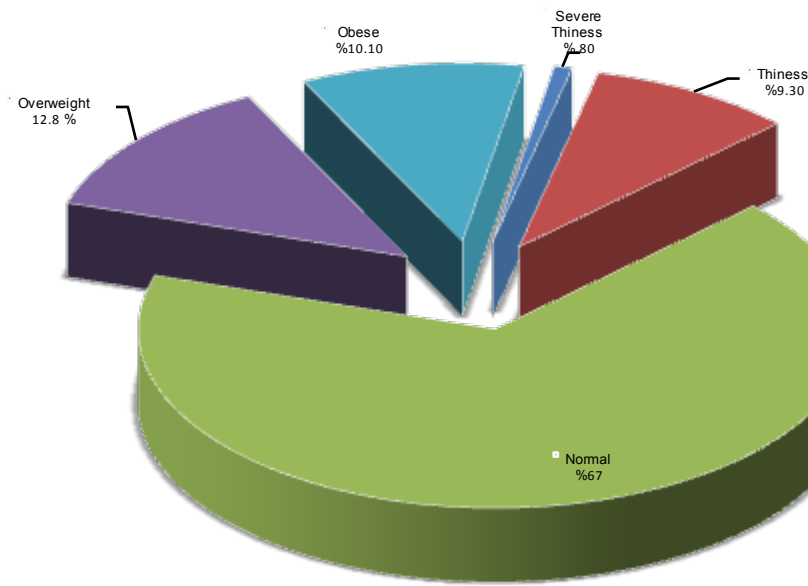
Figure 1. Distribution of children according to WHO's classification of overweight and obesity based on BMI

Table 4. Results of multiple logistic regression for overweight and obesity among children

| Variables	Adjusted Odds Ratio (AOR)	95% CI	P-value.
Boys (Ref.)	1.00		0.011
Girls	1.72	1.13 – 2.61	
Grade			
-1st grade (Ref.)	1.00		
-2nd grade	1.26	0.71 – 2.24	0.423
-3rd grade	1.51	0.85 – 2.67	0.163
-4th grade	2.27	1.31 – 3.95	0.004
Residence:			
Buraidah (Ref.)	1.00		
Unaizah	0.95	0.44 – 2.05	0.889
Father Working			
No (Ref.)	1.00		
Yes	1.08	0.54 – 2.17	0.830
Mother Working			
No (Ref.)	1.00		
Yes	0.98	0.67 – 1.44	0.912
Father's education:			
None, primary or preparatory (Ref.)	1.00		
Secondary and above	1.20	0.80 – 1.81	0.381
Mother's education:			
None, primary or preparatory (Ref.)	1.00		
Secondary and above	1.26	0.85 – 1.88	0.249
Consanguineous Parents (related to each other by blood):			
No (Ref.)	1.00		
Yes	1.25	0.84 – 1.84	0.278
Family size:			
Less than 6 (Ref.)	1.00		
6 or more	1.17	0.73 – 1.86	0.519
Socioeconomic status:			
Low (Ref.)	1.00		
Moderate	0.87	0.45 – 1.70	0.689
High	1.19	0.56 – 2.54	0.648
Very high	3.31	0.58 – 18.77	0.176
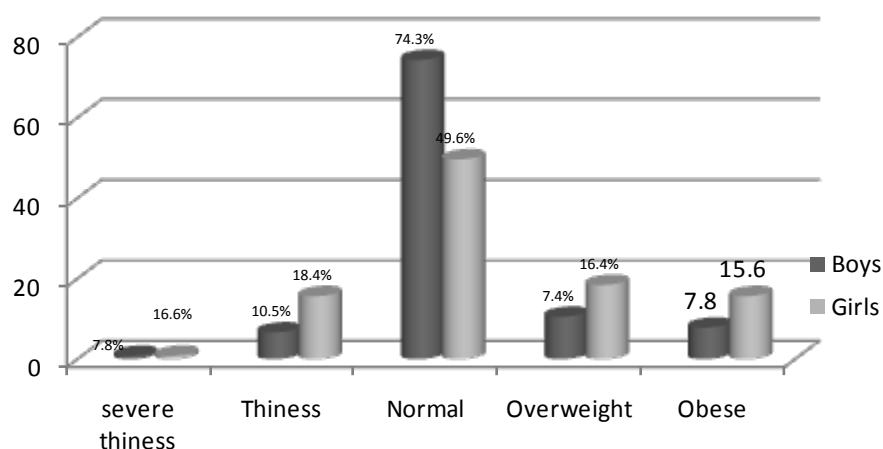
Figure 2.   The differentials in overweight and obesity by gender

Girls showed higher percentages of overweight (16.4 %) and obesity (15.6 %) than boys (7.4 % and 7.8 % respectively). Percentages of boys with normal BMI (74.3%) was higher than girls (49.6 %).[Fig.2]

Table 4 shows the results of multiple logistic regression for overweight and obesity among children by the key variables of interest. The results suggested gender and grade levels as the two significant major determinants of overweight and obesity. Age was highly correlated with the grade level of the students and was not included in the model. Being a female student was a significant risk factor for overweight and obesity (adjusted OR=1.72; 95% CI: 1.13-2.61). The odds of obesity and overweight increased progressively with grade level, and by 4th grade level, their odds was almost 2.3 times higher than the 1st grade students (OR 2.27; 95% CI: 1.31-3.95). Other variables were statistically not significant in the model.

5. Discussion

Childhood obesity has become one of the most serious public health challenges of the 21st century.[5] The results of our study support this contention by demonstrating the emergence of a highly increasing prevalence of overweight and obesity among school children. It showed that overweight and obesity affected about half of our sample. It is in line with the global trends; in the USA, the problem more than tripled in the past thirty years.[24] Positive economic growth and the associated affluence, urbanization, modern amenities, fast food culture and lack of physical activity could be the main variables responsible for the emergence of obesity in the Saudi population. This premise is supported by Popkins[25] who attributed the increase rates

of overweight and obesity in developing countries to radical and rapid changes in life-style.

Another notable feature was that results of our study exceeded the increase recorded in overweight and obesity rates in similar age groups in the gulf region, e.g. Kuwait (37.0 %), Qatar (23.3 %) and UAE (26.4 %)[26, 27, 28], countries that have undergone similar economic upturn. This aspect supports our hypothesis that advancing time has had an amplifying effect on these two factors, which is a great cause for concern and needs to be checked through effective and immediate public health interventions. However, Iran appears to be an exception to this general trend but only in terms of severity of the problem. Iran showed much lower rates of obesity and overweight[29], perhaps, due to the sanctions and embargoes adversely affecting the Iranian economy.

Additionally, our study results also exceeded the reported rates in the two main previous national studies in 2002 (31.4%) and 2005 (34.3%).[7, 8] These variations in the rates in the gulf region could be attributed to the lack of consistency and agreement among different studies on the classification of obesity in children, in addition to differences in study designs and sampling methods. The difficulty and limitations in comparisons of prevalence of overweight and obesity among children have already been indicated in WHO's report[3] and by Story et al.[30] This study used the WHO's definition and classification of obesity.[22] The study design was cross-sectional with a randomly selected cluster sample suited to achieve its objectives. Nonetheless, all studies have categorically recorded increasing trends in rates of obesity and overweight.

Childhood obesity is not caused by one factor alone; rather it results from the interplay of multiple factors.

Regarding the factors associated with occurrence of overweight and obesity in the elementary school-aged children, the problem appears to affect girls more than boys. Results of logistic regression revealed the predominance of being a girl as a risk factor for occurrence of the problem at this age. In the gulf region the predominance of the problem of obesity among girls appeared in Bahrain and UAE as well.[27, 31, 32] In contrast, more boys were overweight and obese than girls in Qatar. [26]

Preponderance of sedentary lifestyle as a result of affluence has reduced physical activity in the gulf region. Young school students spend more time in front of computers, TV and with iPods, iPads and tablets at the expense of physical activities. Similarly, girls spend most of their out-of-school time at home with hardly any physical activity making them prone to becoming overweight and obese. These observations have also been recorded in European countries. Swedish researchers attributed the problem of overweight or obesity in young girls, who were affected more than boys of the comparable age, to the time spent in front of televisions and computers that tended to reduce the physical activity.[33] Girls, therefore, increasingly demonstrate a sedentary behavior pattern than boys of their age group.[34]

The examination of the relationship of overweight and obesity with age in our study showed a positive trend, progressively increasing with age after the children joined the school. These finding could be due to the exposure of children to an external environment where their diet habits changed or they were exposed to more fatty diets. These results are supported by the study of Al Isa[28] among Kuwaiti children of the same age group. Another study conducted in Jeddah, Saudi Arabia showed a prevalence of obesity of 10.8 among preschool children.[35] Furthermore, there was a statistically significant association of advancing grade years, and overweight and obesity rates. This was an additional indicator supporting the progression of the problem with the increasing age. However, there are studies with contradictory findings as well. Booth et al,[36] in Australia reported no relationship between school grade and fatness. To the contrary, the youngest age cluster (6 year old) values were unusual in our study. The rates of overweight and obesity by both measures were higher than older age clusters (7th and 8th clusters). This could be a negative indicator highlighting the susceptibility of the younger generations to the problem of obesity.

Interestingly, we found out that parents' employment and level of education was associated with adiposity. Students whose mothers were employed and had a relatively higher level of education showed a tendency towards overweight and obesity. However, in logistic regression modelling, this role lost its weight, which probably makes this finding incidental. In the Saudi population the highly educated working women have to face competing demands of work and family. In this situation providing home cooked healthy meals to children is difficult, who invariably resort to junk food, therefore, exposing themselves to the risk of overweight and obesity. The connection between mothers' work, earnings and the occurrence of overweight and obesity in children has been reported in a number of studies.[37, 38, 39, 40]

Our results indicated that family size has a bearing on the occurrence of overweight and obesity. The smaller sized families showed a significant increase in the percentages of overweight and obesity than larger families, therefore, showing an inverse relationship between the size of the family and obesity/overweight. Although our results showed a significant association of small sized families with the problem of obesity, it lost its significance in logistic regression modelling. This could be attributed to the link between the small sized family with a higher socioeconomic status that is associated with high rates of overweight and obesity. These results agreed with Padez's cross sectional study of Portuguese children of 7 to 9.5 years that reported that being a single child was significantly associated with overweight and obesity. The same trend was seen regarding the number of siblings in the family and the order of birth; children from big families and those born later presenting a lower risk of being overweight or obese.[41] However, household size and income are negatively related to the child's weight but the relationship is weak.[31]

Socioeconomic status (SES) of the family was yet another factor that impinged on obesity and overweight. Our study results indicated that overweight/obesity was significantly higher among the students belonging to the higher socioeconomic group, thus, establishing a positive relationship between the socioeconomic status of the family and obesity. Families with a higher disposable income tend to spend more on food and life comforts without really visualizing their health consequences. Similar results have been reported by a global study that compared prevalence of overweight and obesity in school-aged youth from 34 countries and reported particularly high prevalence in affluent countries of North America, the UK, and South-western Europe.[42] In India, the prevalence of obesity and overweight increased significantly with the increasing income.[43] A similar picture was seen in Egypt, where the prevalence of obesity among high SES adolescents was more than double than that among low SES groups.[44] However, a different trend has also been observed. Over the last three decades, the prevalence of overweight and obesity was greater in lower-middle- and low-income countries than in upper-middle and high-income countries, with rates of obesity doubling over the three decades between 1980 and 2008.[45] Surveys of school children from poor families report higher intake of fat, lower intake of complex carbohydrates and lower intake of some micronutrients.[46, 47]

6. Limitations of this Study

Our study had some limitations. Our sample did not include private schools and schools from rural areas. Data

collection was done at two levels; firstly, by direct measurement of the student obesity indices at the school and getting the socio-demographic background information by a self- reported questionnaire from students' parents. This procedure raised the non-response rate of the questionnaire part. It created incongruity between the numbers of the two variables. Moreover, self- reported data had a likelihood of biasness and inaccuracy, especially in data related to income and parents' educational level. Moreover, this study is based on cross-sectional data and the temporal changes in weight could not be determined to assess progression to overweight at an individual level.

7. Conclusions

The results of our study demonstrated the emergence of an increasing prevalence of overweight and obesity among Saudi school children resulting from radical and rapid changes in life-style owing to economic growth. Smaller size of the family and higher socoi-economic status contributed more to the development of these conditions. Interestingly, overweight and obesity were mostly acquired after entering the school. The problem increased progressively with the increasing age due to the exposure of students to the 'external food environment' as against home-cooked meals. It emphasizes the urgent need of effective interventions to offset the problem from the early years after entering the school. Results also suggested the presence of the problem of underweight among few children which should be further investigated and addressed.

Conflict of Interests

The authors declare that they have no conflict of interests.

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