



Association of Physical Activity with Obesity Trends in School Children of Madinah Al Munawwarrah-A Cross-Sectional Study

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Abstract

Background: Obesity is one of the three gravest threats to human health globally. There was no study on association of obesity with physical activity of children of the 2nd holiest city of Muslims Al Madinah Al Munawwarrah which is located on North West of Saudi Arabia.

Objectives: This study aimed to

- Evaluate the prevalence of overweight and obesity in school children.
- To study association of physical activity and obesity.

Methods: Participants were healthy school boys and girls aged 5 - 18 years. Study design was cross-sectional. A total of 6000 school children, consisting of 3000 boys and 3000 girls from twenty (20) schools were enrolled. School selection was done by random stratification with the help of Ministry of education. Data were collected between April - December 2017. Height and weight of children were measured to calculate percentiles for BMI-for-age and -sex according to the 2000 Centers for Disease Control and Prevention (CDC) growth charts, Overweight and obesity was defined as BMI-for-age/sex $\geq 85^{\text{th}}$ and $\geq 95^{\text{th}}$ percentile respectively.

Results: The overall prevalence of obesity was 14.7% (n = 588). Obesity Prevalence in boys was 16% (n = 347) and in girls was 14% (n = 241). The overall prevalence of overweight was 15.4% (n = 616). The Prevalence in boys was 16% (n = 366) and in girls was 14% (n = 250). There was negative correlation between Physical activity and Body Mass Index. This relationship is also highly significant. (P -Value < .0005)

Conclusions: Overweight and obesity in school children in Al Madinah Al Munawwarrah is similar to global prevalence. Physical activity is a major risk factor for obesity in school children. Physical activity programs should be seriously implemented at education levels in every school of AlMadinah Al Munawarah to control this epidemic with coordination of Ministry of education and Ministry of health.

Keywords: Obesity; Physical Activity; School Children

Background

Childhood obesity have reached epidemic level and the prevalence of overweight in preschool and school-aged children has ris-

en 3 - 4 times [1,2]. Childhood obesity is on increase in Saudi Arabia as well. Many studies in different regions of the kingdom pointed upward trends of obesity in both genders. Exercise and physical

activity is of low priority in families and children across the kingdom. Obesity among adolescents is a public health problem in all regions of Saudi Arabia [3]. Economic development in Saudi Arabia over the last 30 years has influenced the quality and the quantity of food intake and predisposed people to various health problems due to a sedentary life [4,5].

A recent study in the Aseer region revealed an overall prevalence of obesity and overweight among adolescent boys (approximately 16%) [6]. Close examination of adolescent obesity studies, with attention to potential gender differences, reveals that such differences are common, both before and during puberty [7,8]. El Mouzan reported the prevalence of overweight and obesity among children aged between 5 and 18 years using the data from the Saudi references 2005 [9]. The prevalence of overweight was found to be 23.1%, obesity was found to be 9.3% and severe obesity was 2%. El Mouzan also reported the prevalence of overweight and obesity among 0 - 5 year old children [10,11].

It is well known that physical activity plays a leading role in preventing overweight and obesity. However, physical activity measurements is difficult to interpret and evaluate [12]. A tremendous lifestyle change over the last decades has been seen in Saudi Arabia. Sedentary lifestyle was prevalent especially among Saudi children and youth. A number of recent school-based interventions directed towards increasing physical activity and decreasing sedentary behavior have shown encouraging results. On balance, increasing physical activity in children is an attractive and non-restrictive approach to obesity prevention. The adoption of this approach requires the support and involvement of many community sectors other than health [13,14].

Many studies were done in eastern, central and southern region but no study was carried out in western region and the Holy city of AlMadinah AlMunawarah at present time. Therefore, based on published data on children obesity, Clinical Nutrition department of newly built Prince Muhammad bin Abdul Aziz Hospital Al Madinah Al Munawwarah, Ministry of National Guard Health Affairs, as part of its outreach community program embarked upon this study project with aims and objectives mentioned below.

Objectives of the Study

The study was carried out with following objectives:

- To assess the nutritional status of school students
- To evaluate the presence of obesity and risk factors.

Methodology and Statistical Analysis

Study area/setting:

Prince Muhammad Bin Abdulaziz Hospital -National Guard Health Affairs, Clinical Nutrition department research staff will develop the study project; carry out data collection and analysis in the 2nd Holy Most city in the Muslim world AlMadinah AlMunawarah west of Kingdom of Saudi Arabia.

Study subjects

Inclusion criteria: Healthy school boys and girls aged 05 - 18 years.

Exclusion criteria: Any student with diagnosed medical problem such as diabetes mellitus type I etc.

Study design: Cross-sectional stratified study.

Sample size: 6000 (10% of overall population).

Sampling technique

Randomization

Prince Muhammad Bin Abdulaziz Hospital-National Guard Health Affairs, Clinical Nutrition department research staff carried out data collection and analysis in the 2nd Holy Most city in the Muslim world AlMadinah AlMunawarah west of Kingdom of Saudi Arabia in collaboration with Ministry of Education in Madinah Al Munawarah between the period April 2017 until December 2017 excluding the summer vacations (from end of May till the end of Sep 2017).

Inclusion Criteria was the healthy school boys and girls aged 05 - 18 years whereas any student with diagnosed medical problem such as Diabetes Mellitus Type I was excluded. It was a cross-sectional stratified study. Total sample size was 6000, which further divided into 3000 boys and 3000 girls (10% of overall population of school students). Twenty (20) schools were selected randomly out of total 110 schools with the help of Ministry of education.

Methods, instruments and measurements

A pre structured self-administered questionnaire was used to collect the data on demographics, anthropometrics, dietary and physical lifestyle of the children. An informed consent was filled either by parent or guardian or school administration. Dietary intake was recorded by Food Frequency Questionnaire (FFQ).

The body mass index (BMI) was calculated as Kg/m², which was also used as a measure of obesity because it correlates well with

adiposity [15]. Anthropological measures of weight and height were taken following the interview. All subjects were measured when they were barefoot and wear only light clothes. Weight was measured by standardized calibrated scales to the nearest 0.1 kg and height was taken to the nearest 0.1 cm using the standardized wall-mounted height boards with a sliding head piece. The calculated BMI was classified into four categories according to age: Acute Malnutrition (< 5th percentile), normal weight (05th ≤ 85th percentile), overweight (85th ≤ 95th percentile), and obese (> 95th percentile) [16]. as per American Society for Parenteral and enteral Nutrition (ASPEN) Pediatric Nutrition (Published in 2002).

Data analysis

Data was coded and analyzed using IBM 2014 Statistical Package for the Social Sciences (SPSS). Descriptive statistics was used to determine mean, frequencies and standard deviations. Univariate, bivariate and multivariate analysis were done at 5% level of significance. Correlation analysis was done between Nutritional intake of food groups and individual food item in order to find out the risk factors for obesity in our sample. All the analysis was also done separately for the male and female students.

Results

Demographics

A total of 3987 school children responded on self-administered questionnaire which was initially distributed to 6000 children. 3000 were girls and 3000 were boys. The response rate was recorded as 67%. Out of total 3987 children, 2222 (56%) were boys and 1765 (44%) were girls who responded with fully or partially filled questionnaire.

All above means and standard deviations are in the table 1.

Age category based demographics

When total of 2222 sample of boys was grouped into three categories, the boys in Category-I (5 - 8 years) were 32 (1%), Category-II (9 - 13 years) were 636 (29%) and Category-III (14 - 18 years) were 1554 (70%) of total boys sample. Whereas out of total 1765 girls, the girls in Category-I (5 - 8 years) were 110 (6%), Category-II (9 - 13 years) were 624 (35%) and Category-III (14 - 18 years) were 1031 (58%) (Table 1).

Means

Age

The demographics showed that the overall mean age for the whole sample was 14 years (SD ± 2.54). Mean age for boys was

14.4 years (SD ± 2.27) and girls was 13.88 years (SD ± 2.81). The overall mean age (both boys and girls included) in Category-I (5 - 8 years) was 7.71 (SD ± 0.63), category-II (9 - 13 years) was 11.82 (SD ± 1.31) and Category-III (14 - 18 years) was 15.68 (SD ± 1.35).

All above means and standard deviations are in the table 2.

Physical measurements

Such as weight, height, body mass index (BMI).

Weight: The overall weight was 50.3 (SD ± 17.6). Mean boys weight was 52.53 (SD ± 18.26) kg. Mean weight for girls was 47.54 (SD ± 16.48) kg.

Height: The overall height was 1.54 (SD ± 0.12) meters. Mean height for boys was 1.57 (SD ± 0.13) meters. Mean height for girls was 1.50 (SD ± 0.11) meters.

Body mass index: The overall mean Body Mass Index (BMI) was 20.7 (SD ± 5.84) kg/m². Mean Body Mass Index (BMI) for boys was 20.78 (SD ± 6.03) kg/m² and mean Body Mass Index (BMI) for girls was 20.64 (SD ± 5.5) kg/m².

For boys: The mean BMI in Category-I (5 - 8 years) was 16.08 (SD ± 2.75), category-II (9 - 13 years) was 18.95 (SD ± 4.56) and Category-III (14 - 18 years) was 21.62 (SD ± 6.38).

For girls: The mean BMI in Category-I (5-8 years) was 14.94 (SD ± 2.59), category-II (9-13 years) was 19.25 (SD ± 4.86) and Category-III (14-18 years) was 22.10 (SD ± 5.65).

All above means and standard deviations are in the table 2.

Nutritional status of school children

Nutritional status classification was done based on the BMI percentile into three main levels:

- Obese
- Overweight
- Acute malnutrition.

Obesity

The overall prevalence of obesity recorded in our sample was 14.7% (n = 588). Obesity prevalence in boys was 16% (n = 347) and in girls was 14% (n = 241).

For boys: The obesity prevalence in Category-I (5 - 8 years) was 9% (n = 3), category-II (9 - 13 years) was 14% (n = 86) and Category-III (14 - 18 years) was 17% (n = 258).

For girls: The obesity prevalence in Category- I (5 - 8 years) was 6% (n = 7), category-II (9 - 13 years) was 14% (n = 85) and Category-III (14 - 18 years) was 14% (n = 149).

Overweight

The overall prevalence of overweight was also similar to obesity as 15.4% (n = 616). The Prevalence in boys was 16% (n = 366) and in girls was 14% (n = 250).

For boys: The prevalence of overweight in Category- I (5 - 8 years) was 13% (n = 4), category-II (9 - 13 years) was 18% (n = 117) and Category-III (14 - 18 years) was 16% (n = 245).

For girls: The prevalence of overweight in Category- I (5 - 8 years) was 9% (n = 10), category-II (9 - 13 years) was 14% (n = 88) and Category-III (14 - 18 years) was 15% (n = 152).

Correlation between body mass index and physical activity

There was negative correlation was found between physical activity and body mass index as shown in below table. This relationship is also highly significant (P -Value < .0005).

Variable	By Variable	Correlation	Lower 95%	Upper 95%
How much physical activity	BMI	-0.0747	-0.1162	-0.0330
Physical activity	BMI	-0.0574	-0.0989	-0.0157
Physical activity	how much physical activity	0.8435	0.8310	0.8551

Table a

Significance of correlation between physical activity and body mass index

	BMI	How much physical activity	Physical activity
BMI	<.0001	0.0005	0.0070
How much physical activity	0.0005	<.0001	<.0001
Physical activity	0.0070	<.0001	<.0001

Table b

Variab les	Mean	SD (±)	Upper 95% Mean	Lower 95% mean
Overall	14.18	2.54	14.26	14.10
Gender				
Male	14.4	2.27	14.5	14.3
Female	13.88	2.8	14.61	13.7
Age Category	Male: Female	Male: Female	Male: Female	Male: Female
5-8 (I)	8.06: 7.60	0.80: 0.54	8.35: 7.71	7.77: 7.50
9-13(II)	11.82: 11.83	1.29: 1.33	11.92 11.93	11.72: 11.72
14-18(III)	15.60: 15.80	1.31: 1.40	15.67 15.88	15.54: 15.77
Weight	52.53: 47.54	18.26: 16.48	53.29 48.3	51.77: 46.77
Height	1.57: 1.50	0.13: 0.11	1.58: 1.50	1.56: 1.49
Body mass index (BMI)	20.7	5.84	20.9	20.54
Male	20.78	6.03	21.03	20.52
Female	20.64	5.5	20.91	20.38

Table 1: Overall school children demographics in the holy city of Madinah Al Munawwarah.

Variab les	Numbers (N)	Percentage (%)
Gender (%)		
Male	2222	55.7
Female	1765	44.3
Age Category	Male: Female	Male: Female
5-8	32: 110	1: 6
9-13	636: 624	29: 35
14-18	1554: 1031	70: 58

Table 2: School children demographics in the holy city of Madinah Al Munawwarah.

Nutritional status (NS)	Numbers (N)	Percentage (%)
Acute Malnutrition (0)	755	19%
Normal (1)	2026	51%
Overweight (2)	616	15.4%
Obese (3)	588	14.7%

Table 3: Overall nutritional status in the holy city of Madinah Al Munawwarah.

Age	Acute Malnutrition (%)	Overweight (%)	Obesity (%)
	Male: Female	Male: Female	Male: Female
All Ages	529 (24%): 226 (13%)	366 (16%): 250 (14%)	347 (16%): 241 (14%)
5-8 (I)	08 (25%): 45 (41%)	04 (13%): 04 (13%)	03 (9%): 07 (06%)
9-13 (II)	149 (23%): 79 (13%)	117 (18%): 117 (18%)	86 (14%): 85 (14%)
14-18 (III)	372 (24%): 102 (10%)	245 (16%): 245 (16%)	258 (17%): 149 (14%)

Table 4: Nutritional status by age category in the holy city of Madinah Al Munawwarah.

Body mass index is negatively correlated with physical activity. This means no or low physical activity has a connection with increasing obesity.

Foods	Frequency	Numbers Percentages (%)	
		Male Female	Male: Female
Eating while watching TV	Yes	1711: 1384	78: 79
Screen hours	1 - 3 hour /d	618: 517	28: 29
	> 3 hours /d	522: 431	24: 25

Table 5: Screen time patterns school children in the holy city of Madinah Al Munawwarah.

Overwhelming majority of the students watch TV during eating.

Daily physical activity of school children in Madinah AlMunawwarah

Out of total 3987 students 3960 filled the questions on physical activity. Our data showed of 1732 (44%) of all student have no daily physical activity. Whereas 2228 (56%) students do physical activity at different levels. Based on gender, 779 (35%) of male students were physically inactive and 1422 (65%) were active at different levels of physical activity. While on female side, 953 (54%) were inactive and 806 (46%) were doing physical activity of various intensity.

Different levels of daily physical activity included were

- Less than 20 minutes
- 20 - 60 minutes
- Above 60 minutes.

Our results showed that 1727 (44%) of students irrespective of age were sedentary with no activity at all. 753 (19%) were doing activity for less than 20 minutes. Those doing activity from 20 - 60 minutes were 858 (22%). 614 (15%) student were doing intense activity for more than 60 minutes a day. Levels of daily physical activity were also analyzed for gender. The results showed 776 (35%) of males and 951 (54%) of females respectively were doing no daily physical activity. 358 (16%) of males and 395 (22%) of females respectively were doing daily physical activity for less than 20 minutes a day. 554 (25%) of males and 304 (17%) of females respectively were doing daily physical activity for less than 20 minutes. 506 (23%) of males and 107 (06%) of females respectively were doing daily physical activity for 20 - 60 minutes a day.

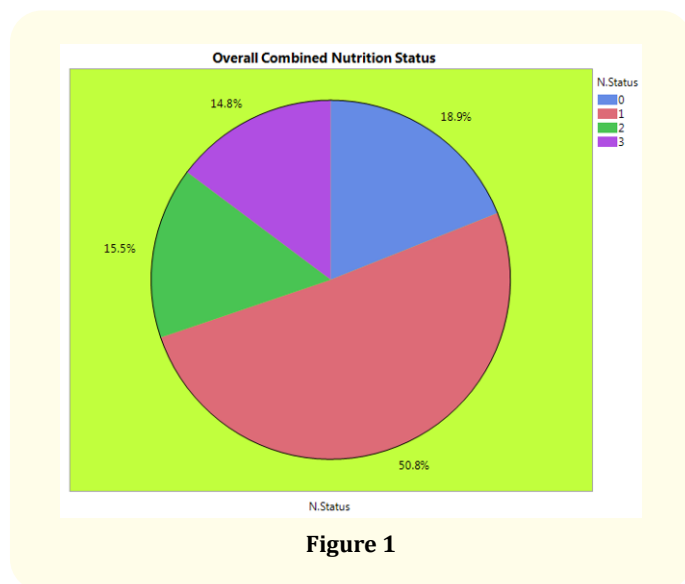


Figure 1

Variable	Number (N)	Percentage (%)
	No: Yes	No: Yes
Doing any Physical Activity	1732: 2228	44%: 56%
Male	779: 1422	35%: 65%
Female	953: 806	54%: 46%

Table 6: Physical lifestyle of school children in the Holy city of Madinah Al Munawwarah.

Variable	Number (N)	Percentage (%)
No Activity	1727	44%
Less than 20 minutes	753	19%
20-60 minutes	858	22%
Above 60 minutes	614	15%

Table 7: Overall amount of physical activity of school children in the holy city of Madinah Al Munawwarah.

Variables	Numbers(N)	Percentage (%)
Gender (%)		
Male	2222	55.7%
Female	1765	44.3%
Types of Activity	Male: Female	Male: Female
No Activity	776: 951	35%: 54%
Less than 20 minutes	358: 395	16%: 22%
20-60 minutes	554: 304	25%: 17%
Above 60 minutes	506: 107	23%: 06%

Table 8: Overall physical activity of school children in the holy city of Madinah Al Munawwarah.

More than a third of male and more than a half of female students are sedentary.

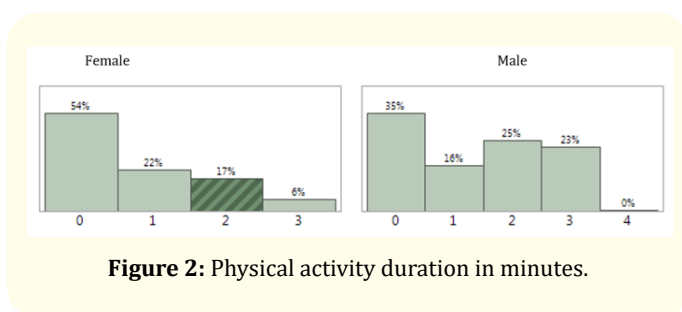


Figure 2: Physical activity duration in minutes.

Discussion

The present study is the first in Madinah to investigate Nutritional status and lifestyle of school children at primary, elementary and secondary levels. It showed a bleak picture as far as the Nutritional indicators on obesity and overweight are concerned. Results showed that the BMI for students in this study was quite high than mentioned in many other studies. Body Mass Index (BMI) was negatively correlated with physical activity. This correlation was highly significant (P-Value < .0005). This means when BMI was low children were more active and vice versa. Thus, BMI was strongly connected with Physical activity in our school children population.

Obesity and overweight is on the rise as in the other region of the kingdom. As reported earlier [6,16] the prevalence of overweight (from 11.69% to 23.1%) and obesity (from 6.3% to 11.3%) for school-age children in Saudi Arabia. The same pattern prevails here in Madinah as we found around 15% prevalence of obesity and a little above 15% overweight in school children. Total combine percentage of overweight and obese exceeds 30%, which is quite alarming. In Saudi Arabia. Amin., *et al.* documented that the association between the prevalence of obesity and eating outside the home was highly significant (p < 0.001) in primary school children (6 - 11 years old). They found that obesity rates increased to about 53% with the increased frequency of eating outside the home more than 5 times a week [17]. This is enough to put our heads down to face impending health Dietary patterns are hugely tilted on the side of Obesogenic tendencies on one side.

Daily physical activity

As BMI, Physical activity was negatively correlated with body mass index (BMI). This correlation was highly significant (P-Value < .0005). This means no or low physical activity was strongly connected with increasing obesity in our school children population. Physical activity was recorded at minimal levels in our school children. Our study results show that 44% of overall students are sedentary. Only 37% of students are doing physical activity for more than 20 minutes daily. Physical inactivity is more prevalent in girls (54%) as compared to boys (35%). This explains the fast increasing of overweight and obesity amongst females.

It is well known that physical activity plays a leading role in preventing overweight and obesity. However, physical activity measurements is difficult to interpret and evaluate [12]. A tremen-

dous lifestyle change over the last decades has been seen in Saudi Arabia. Sedentary lifestyle was prevalent especially among Saudi children and youth. For example, among 2,908 Saudi school students from grades 10, 11 and 12, data were collected during October and November 2009, revealing 60% of children and more than 70% of adolescents do not engaged in sufficient physical activity [16]. Based on the result from the Youth Risk Behavior Surveillance Survey, compared to US youth who participate in physical activity, only 18.4% engaged in physical activity to meet the guidelines [18]. In a recent study done by Al-Hazzaa., *et al.* in Saudi Arabia, among 2,906 adolescents (1,400 males and 1,506 females), about 50% of the males and more than 75% of the females did not meet the recommendation of 60 minutes of daily moderate-intensity physical activity. In addition, results showed that overweight/obesity were significantly and inversely associated with vigorous physical activity levels. Moreover, physical activity patterns were found to be significantly higher among females [19].

Screen time

There was above half of the students (52%) who consumed 1-3 hours daily spend on TV and other electronic gadgets thus taking away potential time for physical activity. Those who watch TV while eating is overwhelming was as high as 78% in boys and 79% in girls. Screen time is one of the factors influencing physical activity. These possible factors contributing to screen time's effect on overweight/obesity rates include: decreasing time available to engage in physical activity and therefore decreasing energy expenditure, increasing the consumption of food while watching TV (primary unhealthy food), and increasing exposure to advertisement on purchasing and consumption of such food. For example, in western countries, much research has documented a positive relationship between time spent viewing TV and obesity rates among children and youth due to decrease in time available for physical activity [20].

In general, daily activity questions show that majority of urban teens watched more TV, had more computers and played more video games, came to school with a driver, spent more hour driving a car, were more physically active and had less sleep compared to rural students. Eating out at fast food restaurants was higher among urban than rural. The food frequency questionnaire showed that fruits, vegetables, breads, and cereals consumption for rural teens lower than urban, whereas protein and milk or dairy intakes was higher among rural compared to urban. Results of this research indicate the need for prevention based healthy lifestyle programming

is Saudi high schools. The extremely dry climate and hot weather in Saudi Arabia, coupled with the desertification and lack of forestation and vegetation generally forces people to stay indoors which leads to reduced physical exercise time and encourages a sedentary lifestyle [21].

Therefore, with some other cultural restrictions, Enas and Hana recently documented that the number of steps taken among the female population is substantially lower than the widely promoted target of 10,000 steps per day.

Physical activity is an accepted strategy in the treatment of established obesity (tertiary prevention). A number of recent school-based interventions directed towards increasing physical activity and decreasing sedentary behavior have shown encouraging results. On balance, increasing physical activity in children is an attractive and non-restrictive approach to obesity prevention. The adoption of this approach requires the support and involvement of many community sectors other than health [13,14].

There is a need for a national program in the country to prevent and control obesity among children and adolescents. Such program should be part of a national plan to prevent diet-related chronic diseases. An obesity control program should incorporate the following: dietary management of obesity; promotion of physical activity; health education campaigns; training courses for health workers; drawing up of regulations and legislation to control advertising of prescription drugs and equipment that claim to reduce obesity; and consideration of possibility of providing girls and boys facilities for practicing physical activity and exercise in schools as well as the community [22].

Conclusion

We conclude that sedentary lifestyle in school children is contributing to the exponential increase in obesity in Madinah and consequently the risk of non-communicable disease is likely to rise in in at a faster pace.

Future Research Ideas

More research needed on innovative ideas to promote physical activity, monitoring and evaluation of school environment towards health practices. How can one apply the best practices to schools at national level? These are important potential research questions to be answered in the near future.

Recommendations

- Consistent physical health programs.
- Start reward program and reward best school in diet and physical health.
- Reward best teachers in the class and reward the best parent.
- Design and implement BMI measurement program in all schools.

Author Contributions

Dr. Atta ur Rehman Khan designed the methodology, amalgamated and cleaned the data, carried out the analysis and was the primary writer of the research report. Co-authors Mr. Meshal Al Malki has helped in coordination with Ministry of Education, participation in laborious task of such a large data collection and Data Entry, review and approval of the manuscript.

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Conflict of Interest

Authors report no conflict of interest for this study.

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