

Research Article

The Prevalence of Obesity Among High School Female Students in Makkah City

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ABSTRACT

Background: Mother-child relationships are built on the foundation of their interactions through-out the postnatal period. If it compromised in premature infants will results in substantial maternal anxiety and/or depression. We investigated the degree of maternal anxiety during retinopathy of prematurity (ROP) examinations..

Methods: This cross-sectional study was conducted among mothers who visited the Maternity and Children, Al-Habib Hospital and Qassim University Hospital. The mothers completed a self-completion survey. The survey included questions about the child's appearance at examination, socio-demographic characteristics, the child's condition from the treating consultant, and maternal anxiety using a Visual Analogue Scale. .

Results: Of 481 mothers, 33.7% were aged over 35 years, and 40.5% were bachelor's degree holders. Approximately 44.5% mothers attended ROP clinical examinations for the first time. Approximately 69.2%, 25.8%, and 3.1% reported severe, moderate, and mild anxiety, respectively. Increasing age was more associated with the risk for severe anxiety. However, mothers who received complete information.

Conclusion: Mothers who attended ROP examinations demonstrated severe anxiety. Increasing age was the independent risk factor, whereas receiving complete information about their child's condition was the protective factor. Psychological support is beneficial for mothers experiencing a high degree of anxiety during ROP examinations..

1. INTRODUCTION

Childhood obesity is a serious global issue, as its prevalence continues to escalate at alarming rates (Caballero, 2004; Cloutier et al., 2018). Childhood obesity is defined as a BMI equal to or greater than the 95th percentile for gender and age (Tsoi et al., 2022). Approximately 30% of children in the United States are classified as overweight or obese (Estrada et al., 2014; Tsoi et al., 2022). Locally, Saudi Arabia has witnessed a substantial increase in the prevalence of overweight or obese children over the past two decades (Aljassim & Jradi, 2021). This escalating healthcare crisis has both short and long-term detrimental effects on well-being (Lee, 2009). In younger age groups, childhood obesity increases the risk of developing chronic diseases later in life such as type 2 diabetes mellitus, hypertension, obstructive sleep apnea, osteoarthritis, coronary heart disease, stroke, and certain cancers (Daniels, 2009; Lee, 2009).

Promoting general health requires a well-balanced diet rich in natural, fresh foods and meals high in vitamins and minerals (Cena & Calder, 2020). Many social and environmental factors influence healthy eating behaviors (Kabir et al, 2018). Eating behavior is characterized by the customary decisions and actions people make regarding their food intake, encompassing the types of foods they select, how they prepare them, and their portion size (Hernandez, et al., 2016; Story et al., 2002).

In Saudi Arabia, the trajectory of eating patterns has changed significantly in the last few decades due to a rapid rise in socioeconomic status. These changes have impacted individuals of all ages, especially children (Mahfouz et al., 2008). Previous studies have shown that Saudi diets now feature fewer fruits and vegetables and more animal products and processed foods (Adam et al., 2014; Al-Hazzaa et al., 2011). Before COVID pandemic, Before the COVID-19 pandemic, the Saudi Min-

istry of Health reported that 20.2% of the adult Saudi population and 9.3% of schoolchildren were clas-sified as obese (AlEnazi et al., 2023; Salem et al., 2022).

A cross-sectional study conducted in Saudi Arabia iden-tified significant correlations between BMI and factors such as breakfast frequency, physical activity, and sed-entary behav-iors, particularly the use of smart devices and video gaming (Said & Shaab, 2022). However, this study relied on self-reported data from parents regard-ing their child’s anthropo-metric measurements and die-tary habits, which may intro-duce bias in assessing the child’s BMI. This study examines the prevalence of childhood obesity and its association with dietary hab-its, physical activity patterns and quality of life among female high school students in Makkah, Saudi Arabia.

2. MATERIALS AND METHODS

This descriptive cross-sectional study was conducted in Mak-kah City, Saudi Arabia, from January to March 2024, targeting female high school students. Ethical approval was obtained from the Biomedical Research Ethics Committee of Umm AL-Qura University (HAPO-02-K-012-2023-11-1861). In-formed consent was taken from all participants before they completed the study questionnaire. The inclusion criteria were as follows: providing consent, being female, and being a high school student. Students residing in other cities or those older than 18 years were excluded. Participants were recruited using a snowball sampling technique.

Anthropometric measurements, including weight, height, and body fat percentage (assessed using Tanita bioelectrical im-pedance analysis), were conducted by the study investi-gator, utilizing the same scale for all participants. Sociodemograph-ic data, dietary habits, physical activity patterns and quality of life were collected via an online questionnaire (Kolotkin & Crosby, 2002; Syed et al., 2020), which was adapted and translated into Arabic by a language expert

Descriptive analysis was conducted to summarize the demog-raphic characteristics of the study participants. Subsequent-ly, inferential analyses, such as the Mann-Whitney U Test, were employed to examine associations. Linear and Binary Logis-tic Regression was used to identify possible predictors. Statistical significance was established at a p-value of 0.05. All statistical analyses were performed using IBM SPSS Soft-ware, version 29.0.0. and Prism software v. 10.3.0.

3. RESULTS

Demographic characteristics of the study partici-pants

A total of 258 high school female students from Mak-kah, Saudi Arabia, were enrolled in this study. The mean age of participants was 16.46 ± 1.1 years. Almost, all (99.6%) had reached puberty, with a mean age at menarche of 12.3 ± 1.4 years. Most participants (70.9%) reported regular men-strual cycles (Table 1). With regard to weight status, 16.0% were underweight (BMI > 5th percentile), 62.6% had a healthy weight (BMI 5th - 85th percentile), 10.5% were overweight (BMI 85th - 95th percentile) and 10.9% were obese (BMI \leq 95th percentile) (Figure1).

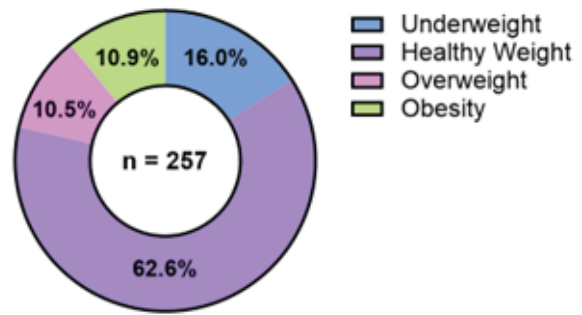


Figure 1. Distribution of the participants according to their BMI categories

The mean BMI was 21.6 ± 5.3 kg/m², ranging from 13.8 to 43.7 kg/m² (Table 1). Of note, 13.5% (n=35) of the partici-pants reported having at least one chronic condi-tion. Anemia was the most common (n=18) followed by Asthma (n=11), Polycystic Ovary Syndrome (n=5), hy-pothyroidism (n=2), and hypertension (n=1).

Table 1: - Sociodemographic, other parameters of par-ticipants with their status of exercise

		Fre-quency (n=258)	Per-cent
Age	Years 15≤	55	21.3
	Years 16	86	33.3
	Years 17	60	23.3
	Years 18	57	22.1
	Mean (SD)	(1.05)	16.46
	Range	13-18	
Weight (kg)	Mean (SD)	(13.7)	54.1
	Range	34.4-110.4	
Height (cm)	Mean (SD)	(5.8)	158.1
	Range	139-175	
BMI	Underweight	41	16.0
	Normal	161	62.6
	Overweight	27	10.5
	Obese	28	10.9
	Mean (SD)	(5.3)	21.6
	Range	13.8-43.7	
Body Fat Percentages	Mean (SD)	(11.0)	21.5
	Range	5-52.3	
Educational Status	High school	258	100.0
Reached Puberty (Menstrual Cycle Started)	No	1	4.
	Yes	257	99.6
Age at Menarche (Years)	Mean (SD)	(1.3)	12.3
	Range	6-16	
Regular Menstrual Cycle	No	75	29.1
	Yes	183	70.9
Chronic Diseases	No	221	85.7
	Yes	37	14.3

Physical Activity Levels

Physical activity levels were relatively low, with 41.1% of

participants reporting no exercise, and 27.9% exercising 1–2 days per week. Aerobic exercise was the most common type (34.9%), and 29.5% of participants engaged in physical activity for 10–30 minutes per day (Table 2). Binary logistic regression analysis was also conducted to identify exercise-related predictors associated with overweight/obesity among participants. The results showed no significant association between exercise-related predictors (exercise frequency, type of exercise, duration of exercise sessions) and overweight/obesity.

Table 2: Physical Activity Levels

Status of Physical Exercise		Frequency	Percentage
How many days do you exercise per week	Never	106	41.1
	Days 1-2	72	27.9
	Days 3-5	53	20.5
	Daily	27	10.5
Type of Exercise You Perform	Don't Practice	143	55.4
	Aerobic Exercise	90	34.9
	Resistance Exercise	25	9.7
If you exercise, for how much time during the day	Mins/Day 5-10	41	15.9
	Mins/Day 10-30	76	29.5
	Mins/Day 30<	43	16.7

Dietary habits of the participants

The majority of participants (70.5%) reported daily consumption of animal protein, such as chicken, eggs, and red meat. Milk and dairy products, as well as sweets and chocolates, were also frequently consumed, with daily consumption rates of 50.4% and 45%, respectively. Vegetable intake, while present, was less substantial with daily consumption rates of 35%. Green leafy vegetables and potato chips were commonly consumed 2-6 times per week. Legumes, Soft drinks and fast foods were predominantly consumed once per week. Whole grains (oats) and seafood exhibited significantly lower consumption rates, with approximately 40% of participants reporting no intake of these food items (Figure 2).

Figure 2: Dietary Habits of participants

Binary logistic regression analysis was done to identify dietary predictors associated with overweight/obesity among participants. Sweets/chocolate consumption showed a significant association ($p = .024$), indicating that higher intake was associated with increased odds of overweight/obesity.

Impact of Overweight/Obesity on Physical Health

The majority reported never experiencing difficulty picking things up from the ground ($n=210, 81.4%$), getting out of a chair ($n=232, 89.9%$), using stairs ($n=191, 74.0%$), moving around ($n=230, 89.1%$), experiencing shortness of breath with little effort ($n=111, 43.0%$), or experiencing ankle and lower limb swelling

at the end of the day ($n=201, 77.9%$). However, a considerable proportion expressed concern about their health, with 63.6% ($n=165$) reporting being sometimes to always worried (Table 3).

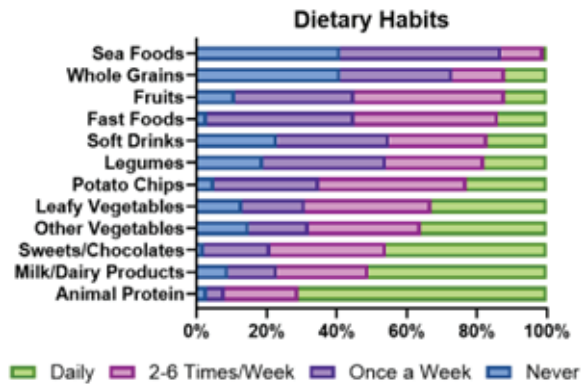


Figure 3: Relationship between the BMI percentile and Total body fat. a) There is a significant positive correlation between BMI percentile and total body fat ($r^2 = 0.45, p < 0.001$). b) There was a significant difference in total body fat among the different BMI groups. $*** > 0.001, **** > 0.0001$.

Table 3: Effect of Overweight/Obesity on Physical Health of Participants

	Never	Response of Participants				
		Rarely	Sometimes	Mostly	Always	Other
I find it difficult to pick things up from the ground	N	210	23	17	5	3
	%	81.4	8.9	6.6	1.9	1.2
I find it difficult to get out of my chair	N	232	11	8	6	1
	%	89.9	4.3	3.1	2.3	0.4
I have Difficulty using Stairs	N	191	24	24	9	10
	%	74.0	9.3	9.3	3.5	3.9
Trouble moving Around	N	230	7	16	3	2
	%	89.1	2.7	6.2	1.2	0.8
SOB with Little Efforts	N	111	42	50	22	33
	%	43.0	16.3	19.4	8.5	12.8
Lower Limb Swollen at the End of the Day	N	201	22	26	2	7
	%	77.9	8.5	10.1	0.8	2.7
Worried about my Health	N	75	19	66	33	65
	%	29.1	7.4	25.6	12.8	25.2

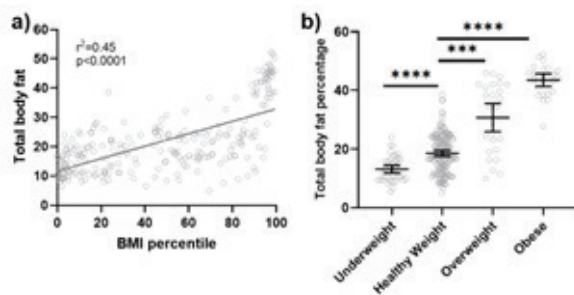
The median total body fat percentages across different BMI categories were as follows: 12.3% for underweight, 18.3% for healthy weight, 34.4% for overweight, and 45% for obese participants. There was a significant difference between these groups (Figure 3). Additionally, a highly significant positive correlation was found between BMI percentile and total body fat ($r^2 = 0.45, p < 0.001$) (Figure 3). Obese students experienced an earlier age of menarche compared to those with a healthy weight (12.5 years vs. 11.85 years, $p = 0.016$). However, the correlation between age at menarche and BMI percentile was weak ($r^2 = 0.02, p = 0.049$).

4. DISCUSSION

Overweight and obesity prevalence in our study was found to

be 10.5% and 10.9%, respectively, which aligns with global trends indicating a rise in adolescent overweight/obesity (de Onis et al., 2010). In Saudi Arabia, a large-scale study involving 351,195 children and adolescents identified an overweight or obesity prevalence of 11.2% (AlEnazi et al., 2023). Another study in the Eastern Province of Saudi Arabia found a higher prevalence of overweight or obesity prevalence at 25% among high school students, more closely aligning with our findings. Furthermore, multiple risk factors have been linked to childhood obesity in Saudi Arabia such as decreased physical inactivity, consumption of fructose-rich beverages, high salt intake, increased TV viewing, use of smart devices, and inadequate sleep duration (Albaker et al., 2022).

Our study provides insights into the dietary habits of female high school students in Makkah. While consumption of fruits, vegetables, and whole grains was relatively high, frequent intake of fast foods, sweets/chocolates, and soft drinks



was also observed. Of note, we found a significant negative association between sweets/chocolate consumption and overweight/obesity, suggesting a potential protective effect. This contrasts with prior literature that did not associate a high intake of sweets and sugary beverages with an increased risk of overweight/obesity (Murphy et al., 2013; O'Neil et al., 2011)..

Additionally, our study revealed that a substantial number of participants reported a lack of exercise, indicating a sedentary lifestyle among female high school students in Makkah. This finding is consistent with previous reports showing a high prevalence of physical inactivity (>50%) among both adults and adolescents in Saudi Arabia (Al-Hazzaa, 2004, 2006). Among those who engaged in physical activity, aerobic exercise was the most common, with many participants exercising for 10-30 minutes per day. However, none of the exercise-related variables in our study showed significant associations with overweight/obesity. This suggests that factors beyond exercise frequency, type, and duration may be more critical in determining weight status among adolescents. Alternatively, our smaller sample size may have limited the ability to detect smaller correlations. Previous studies have demonstrated that reducing sedentary behavior can lead to weight loss in obese children (Al-Hazzaa, 2006; Epstein et al., 1995).

Regarding the association between puberty and obesity, our study found a small but significant correlation between age at menarche and BMI percentile, particularly at the higher end of BMI. The obese group experienced menarche slightly earlier than the healthy weight group. This finding aligns with prior research indicating that increased adiposity in girls is associated with an earlier onset of puberty and menarche (Huang et al., 2020; Oh et al., 2012) Not surprisingly, our study also found a strong correlation between BMI and total

body fat per-centage, with the obese group having an average total body fat percentage of 45%, compared to 18% in the healthy weight group. Finally, the prevalence of chronic diseases among our participants was low, with anemia, asthma, and polycystic ovary syndrome (PCOS) being the most common conditions. Previous epidemiological studies have linked obesity to PCOS among young females, a relationship further supported by recent genetic studies (Barber et al., 2019).

Several limitations should be considered when interpreting the findings of our study. First, the cross-sectional design restricts the ability to establish causal relationship. Second, the self-reported nature of dietary and exercise data may introduce recall bias or measurement error. Lastly, our study sample consisted of female high school students from a specific geographical region, limiting the generalizability of the study findings.

5. CONCLUSION AND RECOMMENDATION

The prevalence of overweight and obesity was relatively high among female high school students in Makkah. Obesity was linked to higher total body fat and earlier menarche. No significant correlation was found between dietary habits or physical activity and obesity, except for increased sweets and chocolate consumption, though larger studies are needed to verify these findings.

AUTHOR CONTRIBUTION

Conception: Binhussein M. and Khojah A; methodology: Alsaadi N, Alghamdi M; Data Collection: Gheliwi H, Alamri E, Alsaadi N, Alghamdi M, Alsulami A ; Data analysis: Bukhari A, Khojah A; Writing: Gheliwi H, Alamri E, Alsaadi N, Alghamdi M, Alsulami A, Mesh R, Bukhari A, Binhussein M, Khojah A; visualization, Bukhari A, Khojah A; supervision, Binhussein M, Khojah A. All authors have read and agreed to the published version of the manuscript.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Informed consent was taken from all participants before they completed the study questionnaire. The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Bio-medical Research Ethics Committee of Umm AL-Qura University (HAPO-02-K-012-2023-11-1861).

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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