

REVIEW ON THE PREVALENCE OF OBESITY AMONG PRIMARY SCHOOL CHILDREN USING BODY MASS INDEX BMI

Saba Talib Wahhab

University of Al-Iraqia College of Medicine Departement of Pharmacology, Baghdad,Iraq

Raghad Abdulsalam Khaleel

University of Al-Iraqia College of Medicine Departement of Pharmacology, Baghdad,Iraq

<https://doi.org/10.5281/zenodo.20691198>

Abstract

Background and objective:

Obesity in children is a growing health concern with serious medical and psychological implications. The objective of this study is to investigate the prevalence of childhood obesity, identify contributing factors, and propose effective interventions to reduce its occurrence

Methods:

A random sample of 250 primary school students was selected for the study. Data was collected through surveys, anthropometric measurements (height, weight, BMI), and parental questionnaires evaluating lifestyle factors such as diet, physical activity, and chronic health conditions.

Results:

- **Gender Distribution:** 47.2% male, 52.8% female.
- **Age Range:** 6-12 years.
- **Weight & Height:** Categorized into different BMI ranges.
- **Health Findings:** 21% of children had health issues.
- **Dietary Habits:** 52% consumed at least one fast-food meal daily.
- 81.4% ate snacks between meals.
- 45.4% ate sweets twice a day.
- 45.8% consumed fruits/vegetables only once daily.
- **Physical Activity:** 30.4% engaged in <30 minutes of daily activity.
- **Lifestyle Impact:** High consumption of unhealthy foods and low physical activity correlated with obesity.

Conclusion:

The study highlights poor dietary habits and insufficient physical activity as key contributors to childhood obesity. Despite 60% of parents being aware of healthy lifestyles, their children's habits do not reflect this awareness. Increased education and structured interventions are needed to address these issues.

Discussion:

- **Dietary Patterns:** Frequent consumption of fast food, sweets, and lack of fruits/vegetables contribute to obesity.
- **Physical Inactivity:** Sedentary lifestyles exacerbate weight gain.
- **Parental Role:** Awareness does not always translate into action.
- **Health Implications:** Obesity-related conditions such as diabetes, respiratory, and digestive disorders were prevalent.
- **Intervention Needs:** Schools and families must adopt healthier eating habits and encourage more physical activity.

Keywords: Obesity, Childhood Obesity, Diet, Physical Activity, Fast Food, Sedentary Lifestyle, BMI, Chronic Diseases, Parental Awareness, Public Health. Let me know if you need any modifications or additional details!

1- Introduction, Background and Defention

The term obesity refers to an excess of fat. Because of the unavailability and high cost of techniques that directly measure body fat, body mass index (BMI), derived from the body weight and height, has emerged as the accepted clinical standard measure of overweight and obesity for children 2 years and older. Body mass index is calculated by dividing the body weight in kilograms by the height in meters squared. In general, BMI provides a decent estimate of adiposity in the healthy pediatric population. However, BMI may underestimate adiposity in a significant percentage of children, such as those with decreased muscle mass because of low body fat, and somewhat overestimate fatness in children who are short or have relatively high muscle mass. As such, BMI should be regarded as a proxy for adiposity, and when applying it

in clinical and research contexts, its advantages and disadvantages should be taken into account. Weight for length is the recognised indicator of overweight and obesity in children under the age of two. While skinfold thickness is useful as a predictor of adiposity, waist circumference and the waist-to-hip ratio can be utilised to evaluate abdominal obesity. The standards for the absolute level of BMI in children change with age and sex since children's height and weight are always fluctuating due to natural growth and development.

2- Epidemiology Of Obesity In Childhood

The current obesity and overweight rates among children and adolescents in the United States are approximately one-third. One With increasing age, the prevalence of overweight or obesity rises: 8.4% of pre-school-aged children (ages 2–5), 17.7% of school-aged children (ages 6–11), and 20.5% of adolescents (ages

12–19) suffer from overweight or obesity, and 22.8% of preschool-aged children (ages 2–5), 34.2% of school-aged children, and 34.5% of adolescents suffer from these conditions. Globally, there were millions of obese children in 2015. According to data from the World Obesity Federation, the trend is still on the rise,

with an estimated 158 million children and adolescents between the ages of 5 and 19 becoming obese in 2020, 206 million in 2025, and 254 million in 2030. There is growing recognition that the epidemiological burden of childhood obesity has resulted in additional costs for society and individuals.

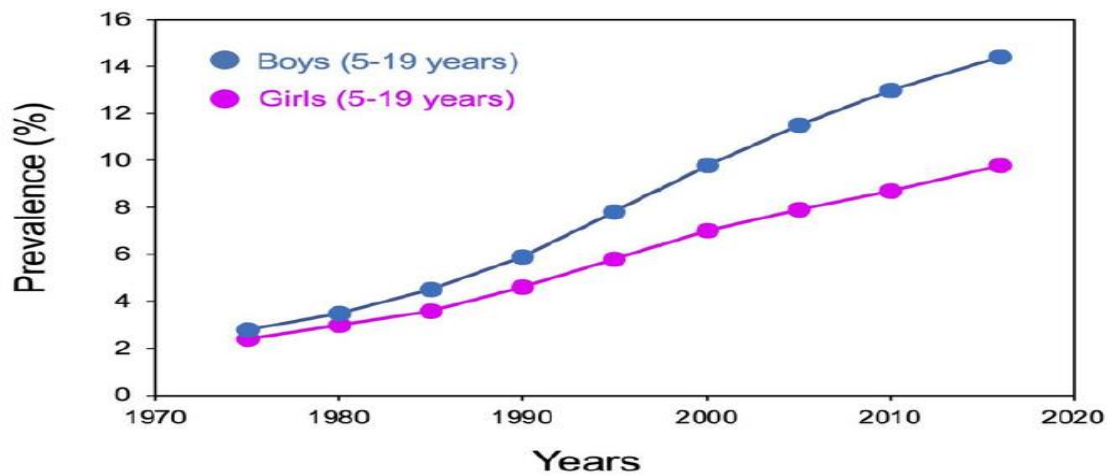


Figure 1. Increase in the prevalence of obesity among Canadian children over the past 40 years. From NCD Risk Factor Collaboration (2017).

Obesity raises the risk of early puberty in children, irregular menstruation in teenage girls, sleep disorders like obstructive sleep apnea (OSA), and cardiovascular risk factors like type 2 diabetes, prediabetes, high cholesterol, hypertension, non-alcoholic fatty liver disease, and metabolic syndrome.

overweight is usually determined by BODY MASS INDEX(BMI), which is a relationship of the the

person's weight to his height BMI is computed by taking the body weight in kilograms and dividing it by the square of the height in meters $BODY\ MASS\ INDEX(BMI) = \frac{weight\ (kg)}{height(m)^2}$ BMI does not measure the body fat but relates well with the degree of obesity Table

Table 1.

the categories of obesity as pronounced by the who.

Classification	B.M.I (kg/m ²)	Risk of co-morbidities
Underweight	<18.50	Low
Normal	18.50–24.99	Average
Overweight	≥25.00	
Preobese	25.00–29.99	Increased
Class 1 obesity	30.00–34.99	Moderate
Class 2 obesity	35.00–39.99	Severe
Class 3 / morbid obesity	≥40.00	Very severe

3- Risk Factors Of Childhood Obesity

It is well known that obesity development is multifactorial and correlates with the child's developmental process, even though the problem of relatively disproportionate energy intake from diets and energy consumption by the body for daily usage can be attributed to the incidence of obesity in general.

3.1 Nutrition and Diet

According to reports, people who consume at least one fast food item and more than two carbonated soft drinks per day are significantly more likely to be overweight or develop obesity. This is because meals and beverages have a high energy content, which leads to a positive energy balance.

3.2 Socioeconomic Factors

Low socioeconomic level, low parental education, non-parental carers, a reduced frequency of fruit consumption, short sleep duration, and parental obesity are

further socioeconomic factors that contribute to childhood obesity.

3.3 Comorbidities and Healthcare System-Related Factors

Regarding related medical illnesses, children with comorbidities, including autistic spectrum disorders, as well as those who struggle with sleep and affective issues, were shown to be overweight.

3.4 Maternal-Related Factors

Higher pre-pregnancy BMI has been linked to childhood obesity, according to research. The BMI of parents has also been shown to have a significant impact on the body weight of their offspring. Intrauterine life is a critical time for the development of childhood obesity since it is believed that fetal growth contributes to the development of lean body mass later in life. In a similar vein, children who are tiny for gestational age are more likely to gain body fat, especially around the

abdomen .According to a study that looked at the relationship between birth weight and childhood obesity and overweight, people who were heavier at birth had a higher chance of becoming overweight or obese later in life.

3.5 Physical Activity

Another danger that is directly linked to dietary intake is the frequency of physical exercise in youngsters. The positive energy balance, which is generally acknowledged as the primary cause of the prevalence of obesity, is directly linked to a lack of physical activity and unhealthy eating habits

3.6 Sleep Duration and Quality

increased risk of childhood obesity is accompanied by short sleeping durations ,especially in children less than 6 and 6–10 years old. Additionally, decreased sleep timing was associated with adverse dietary intake behavior such as a decrease in the intake of fruits .

4- Etiology Of Childhood Obesity

Childhood obesity is the consequence of an interaction among a complex set of factors that are related to the environment, genetics ,and ecological effects such as the family, community, and school.

4.1 Environmental Factors

The causes of childhood disorders are very complicated .Maladaptive coping mechanisms like eating to numb unpleasant feelings, appetite upregulation, and low-grade inflammation are some of the ways that psychosocial and emotional strain contributes to children gaining too much weight.

4.2 Factors related to genetics

Between 30 and 50 percent of the variation in adiposity seems to be due to hereditary factors .Several single gene abnormalities and obesity-related disorders have been identified, despite the fact that polygenetic obesity is by far the most prevalent.

4.3 Endocrine Conditions

Less than 1% of obese children and adolescents have endocrine reasons of weight gain.^{56,57} The majority of kids who gain weight due to endocrine issues have hypogonadism , small stature, and/or poor linear growth.

4.4 Medications

Several medications can contribute to weight gain such as glucocorticoids, antipsychotics drugs including Risperidone and olanzapine, and antiepileptic drugs.

4.5 Hypothalamic Obesity

Patients may have symptoms of increased intracranial pressure such as headache and vomiting. Weight gain may also be seen in patients after cranial trauma or inflammatory disease affecting the hypothalamus.

5- CLINICAL COMORBIDITIES OF OBESITY IN CHILDREN

5.1 Growth and Puberty

Children's growth and pubertal development may be impacted by excessive weight gain. For both boys and girls, childhood obesity can result in advanced bone age and a prepubertal acceleration of linear growth velocity.

5.3 Other Comorbidities

Compared to teenagers, children with OSA experience fewer detrimental effects in terms of cardiovascular stress and metabolic syndrome .In children and adolescents, obesity is a risk factor for obstructive sleep apnea (OSA) in and of itself.

5.2 Sleep Disorders

A broad range of liver abnormalities, including nonalcoholic fatty liver disease (NAFLD) , the leading cause of liver disease in children , are associated with obesity .Steatosis , or increased liver fat without inflammation, and NASH(non –alcoholic steatohepatitis), or increased liver fat with inflammation and hepatic damage, are both included in NAFLD.

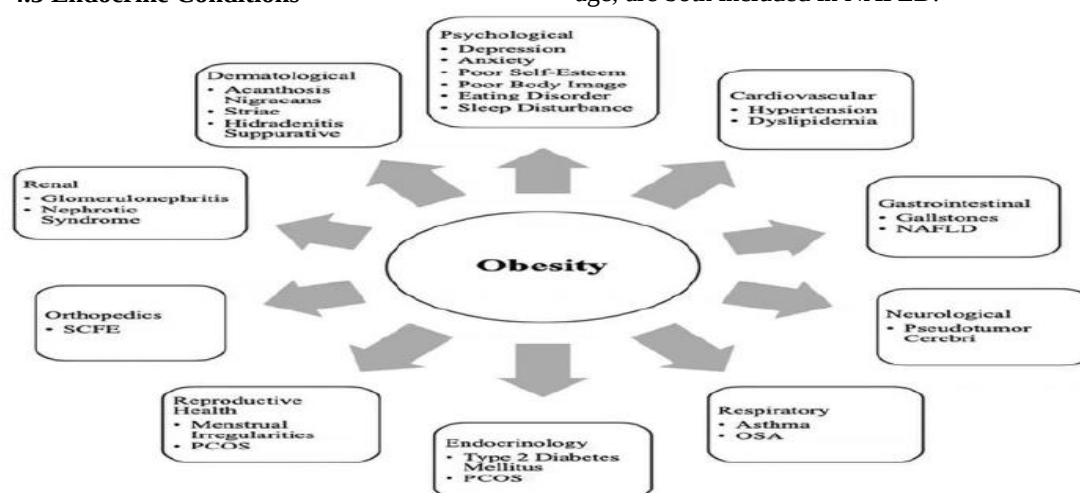


Figure 2 Obesity related comorbidities in children and adolescents. a, NAFLD, Non-Alcoholic Fatty Liver Disease; SCFE, Slipped Capital Femoral Epiphysis ;PCOS, Polycystic Ovary Syndrome; OSA, Obstructive Sleep Apnea.

6- Aim of the Study

The aim of this study is to assess the prevalence of obesity among primary school children, identify key contributing factors such as dietary habits, physical activity levels, and lifestyle choices, and evaluate the impact of obesity on children's health. Additionally, the

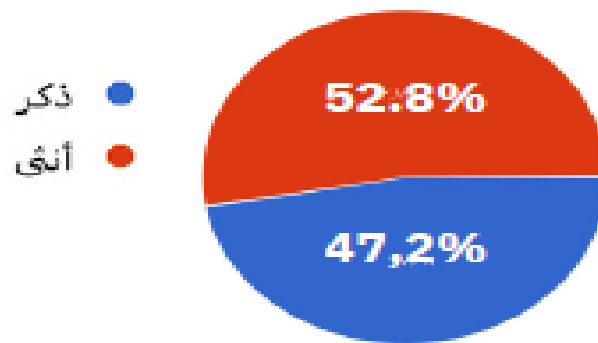
study seeks to raise awareness among parents and educators and propose effective preventive measures to reduce childhood obesity and its associated health risks.

7-Method of Study

-this study was conducted in a duration of two months (from beginning of November to January

in2025).the study design was cross sectional In this research, for data collection, we visit a primary schools in aladhamyia to ask the children questions about their lifestyle that could be the cause of high prevalence of obesity in school age children .The sample size was 250 collected from children with age(6-12) years old. A ran-

dom sample of 250 primary school students was selected for the research study. After analyzing the results, we found the following: The percentage of **male** students participating in the survey was **47.2%**. The percentage of **female** students participating in the survey was **52.8%** .



The children's ages ranged from 6 to 12 years:

- 11.3% were 6 years old
- 13% were 10 years old
- 15.4% were 7 years old
- 19.4% were 9 years old
- 13% were 11 years old
- 13% were 8 years old
- 15% were 12 years old

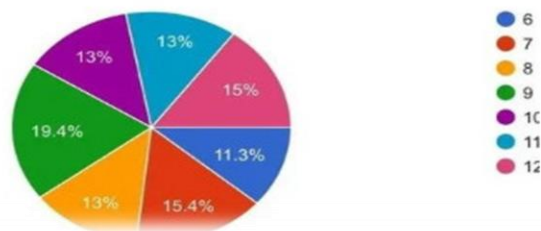


Figure 3. Age of children involved in study .

The children's weight ranged from 20 kg to 60 kg:

Figure 4. of children involved in study.

The children's height ranged from 120 cm to 160 cm:

- 25.6% were 120-130 cm tall
- 32.8% were 130-140 cm tall
- 30.8% were 140-150 cm tall
- 8.8% were 150-160 cm tall
- 2% were above 160 cm tall

- 24.8% weighed between 20-30 kg
- 30.8% weighed between 30-40 kg
- 23.6% weighed between 40-50 kg
- 14.4% weighed between 50-60 kg
- 6.4% weighed more than 60 kg

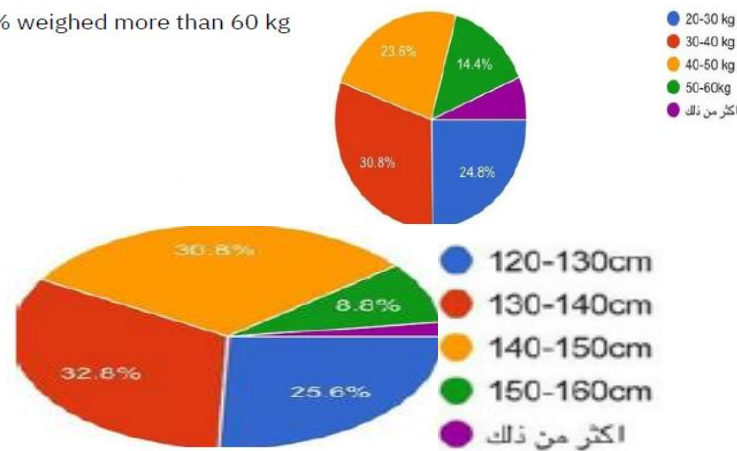


Figure 5. The height of children involved in study.

The percentage of children who suffered from illnesses was 21%.

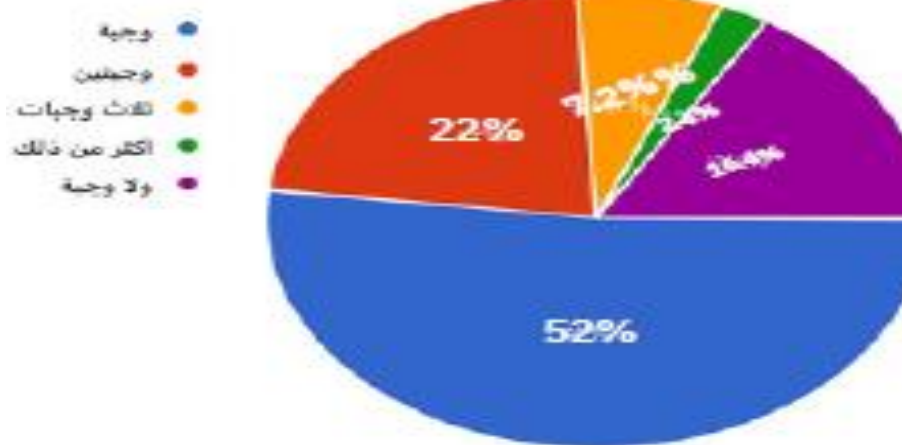
The percentage of parents who were aware of a healthy lifestyle was 60%.

8- Result of the study

Questions we asked to evaluate the lifestyle of the child's :-

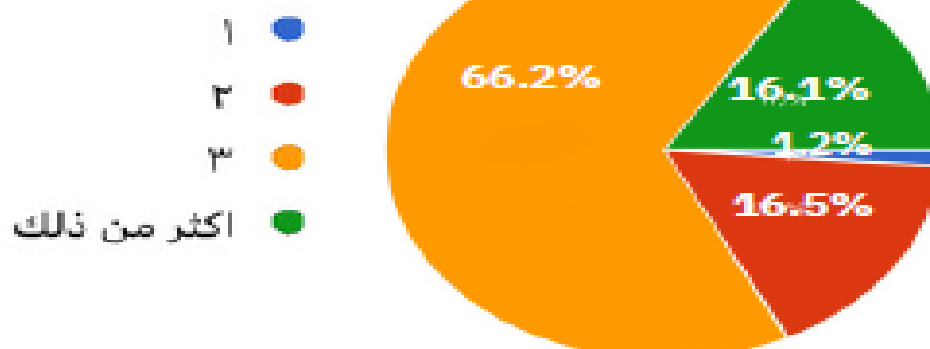
1- (How many fast-food meals does the child consume daily?)

- 52% of children consume one fast-food meal daily.
- 22% consume two meals.
- 16.4% do not consume any fast-food meals.
- 7.2% consume three meals.
- 2.4% consume more than three meals.



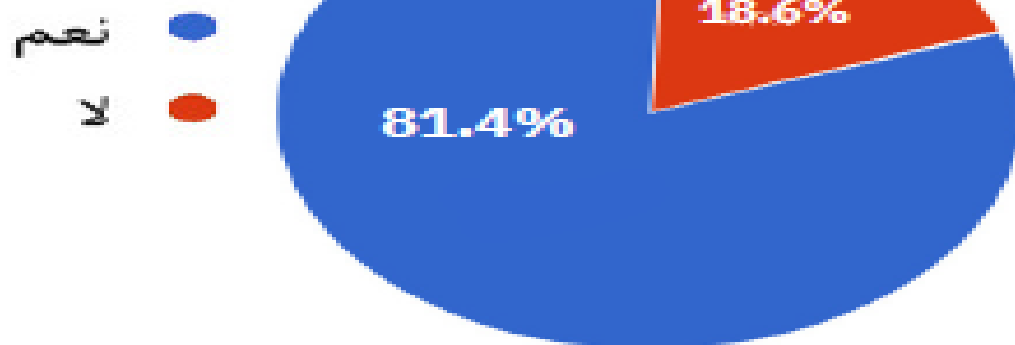
2- (How many meals the child eats daily?)

- 66.2% eats three meals daily, while 16.5% eats two meals. 16.1% eats more than three meals. only 1.2% eats one meal daily.



3- (Does the child consume snacks between main meals?)

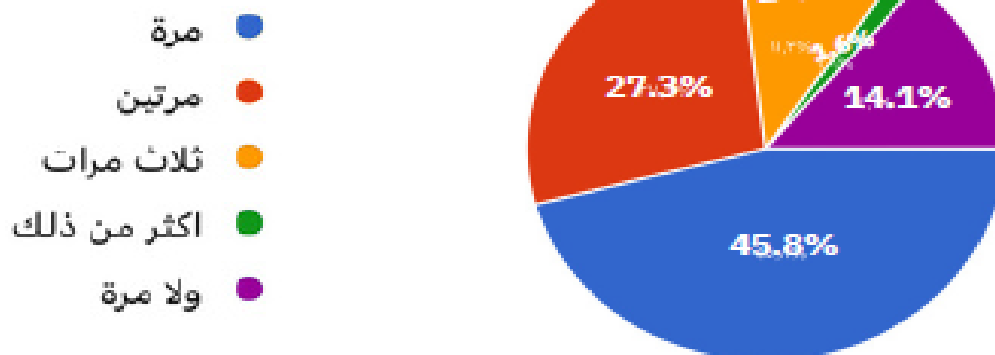
○ 81.4% of children consume snacks between meals. 18.6% do not consume snacks.



4- (How much the child consume Fruits and Vegetables)

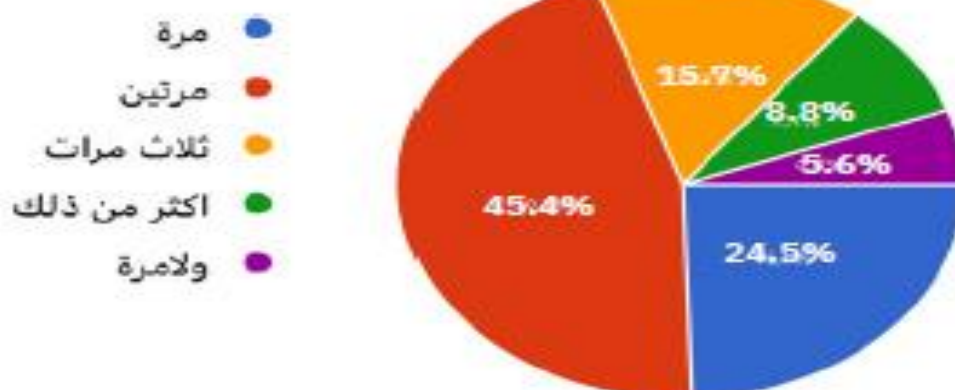
○ 45.8% of children consume fruits and vegetables once a day, while 27.3% consume them

twice daily. Only 11.2% eat them three times or more, 1.6% consume more than three times a day, 14.1% never consume them.



5- (How many times the child consume Sweets in the day?)

○ 45.4% of children eat sweets twice a day, while 24.5% consume them once. 15.7% eat sweets three times or more, whereas only 8.8% consume them more than three times a day 5.6% not consume

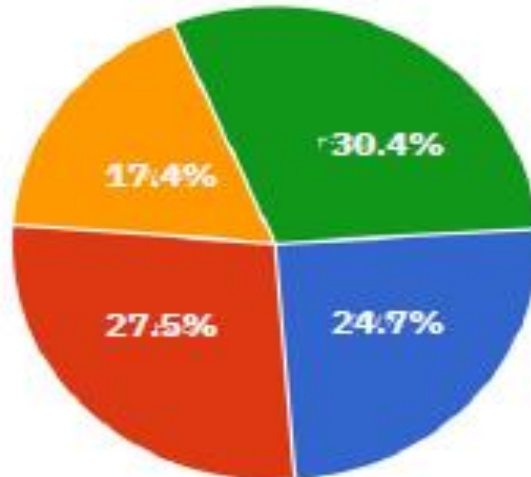


6- (How many times the child spent doing physical activity?)

○ 30.4% of children spend less than 30 minutes on physical activity, and 17.4% spend more than an

hour. 27.5% are active for an hour, while 24.7% engage for only half an hour.

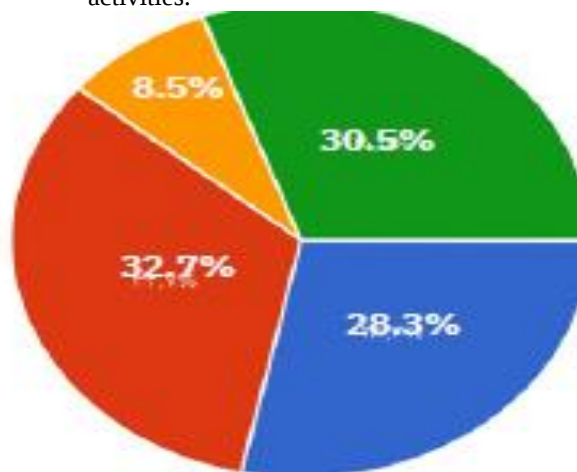
● نصف ساعة
 ● ساعة
 ● اكثر من ذلك
 ● اقل من ذلك



7- (What are the activities that the child did?)

○ 28.3% playing football.
 ○ 32.7% running.
 ○ 8.5% swimming, and
 ○ 30.5% doing other activities.

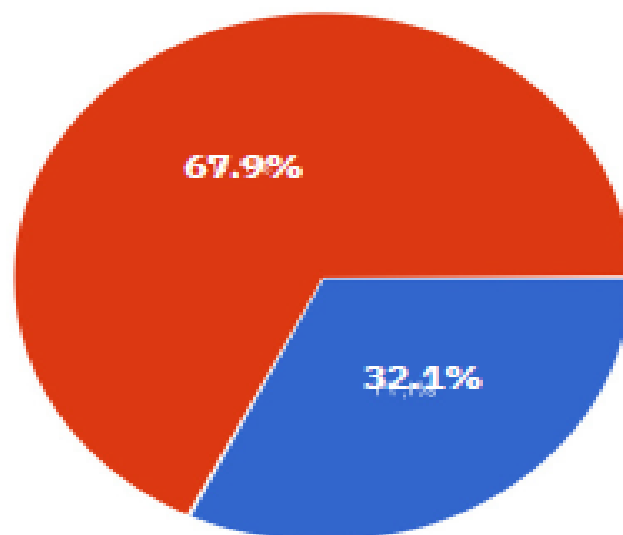
● كرة القدم
 ● الركض
 ● السباحة
 ● غير ذلك



8- (Did the child eat when he felt angry or depressed?)

○ The answer was yes for 32.1% of children and
 No for 67.9% of children.

● نعم
 ● لا



9- (What chronic diseases does the child suffer from?):

○ 63.3% of children do not suffer from chronic diseases.

○ 14.4% suffer from gastrointestinal diseases.
 ○ 13.7% suffer from respiratory diseases.
 ○ 8.6% suffer from diabetes.

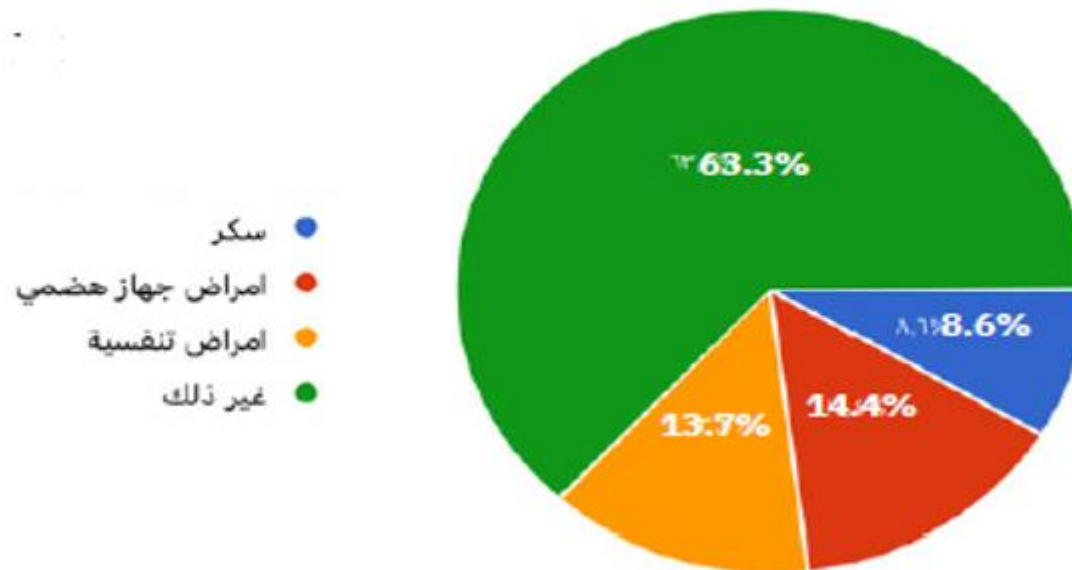


Table 2 :

The percentage variable among a sample in school aged children

variable	Percentage variable
Fast food intake	
one meal	52%
Two meals	22%
Three meals	7.2%
More than three meals	2.4%
Not consume any meal	16.4%
Meals that the child consume daily	
1	1.2%
2	16.5%
3	66.2%
More than 3	16.1%
snacks between main meals	
No	18.6%
Yes	81.4%
consume of Fruits and Vegetables	
1	45.8%
2	27.3%
3	11.2%
More than	1.6%
Never consume	14.1%
Consume of Sweets in the day	
1	24.5%
2	45.4%
3	15.7%
More than 3	8.8%
Never consume	5.6%
Time doing physical activities	
1/2 hour	24.7%
An hour	27.5%
More than that	17.4%
Less than that	30.4%
type of activities	
Football	28.3%
Running	32.7%
Swimming	8.5%
another	30.5%
Emotional eating (with depression and anger)	

No	32.1%
Yas	67.9%
Chronic diseases	
DM	8.6%
GIT	14.4%
Respiratory	13.7%
others	63.3%

Table 3:

Percentage of obesity correlated to BMI for each age group and gender.

character	Total N=250%	Underweight N=19%	Normal N=123%	Overweight N=89%	Obesity N=19%
Age					
6	N=29 11.6%	N=1 5.26%	N=24 19.51%	N=4 4.49%	non
7	N=38 15.4%	non	N=28 22.76%	N=10 11.24%	non
8	N=32 12.8%	N=7 36.84%	N=12 9.76%	N=9 10.11%	N=4 21.05%
9	N=48 19.4%	non	N=17 13.82%	N=26 29.21%	N=5 26.31%
10	N=32 12.8%	N=4 21.05%	N=13 10.57%	N=13 14.61%	N=2 10.53%
11	N=34 13%	N=2 10.53%	N=10 8.13%	N=16 17.98%	N=6 31.58%
12	N=37 15%	N=5 26.32%	N=19 15.45%	N=11 12.36%	N=2 10.53%
gender					
male	N=118 47.2%	N=8 42.1%	N=64 49.6%	N=35 39.3%	N=11 57.8%
female	N=132 52.8%	N=11 57.9%	N=60 50.4%	N=54 60.7%	N=8 42.2%

According to the previous table :

This table provides a breakdown of BMI categories (underweight, normal, overweight, and obesity) among children grouped by age and gender. Key observations and comments are as follows:

1- General Trends Across Age Groups:

▪ **Underweight:** The proportion of underweight children varies across age groups. The highest percentage is observed in 8-year-olds (36.84%) and 12-year-olds (26.32%), suggesting a nutritional or health concern in these age brackets.

▪ **Normal BMI:** Most children fall into the "normal BMI" category, particularly in younger age groups like 6-year-olds (19.51%) and 7-year-olds (22.76%). However, the proportion decreases slightly in older age groups.

▪ **Overweight:** The percentage of overweight children increases steadily with age, peaking at 9 years old (29.21%) and remaining significant in older age groups.

▪ **Obesity:** Obesity is most prevalent in 9-year-olds (26.31%) and 11-year-olds (31.58%), indicating a concerning trend in these age groups.

2- Gender Differences:**▪ Males:**

• - The majority of boys fall in the normal BMI category (49.6%), but they have a higher proportion of obesity (57.8%) compared to girls (42.2%).

• Overweight males make up 39.3%, while underweight males account for 42.1% of the underweight population.

▪ Females:

• - More females are classified as "normal BMI" (50.4%) compared to males.

• Overweight females make up 60.7%, a significantly higher proportion than males. - Underweight females are 57.9% of the underweight population, suggesting a higher prevalence of under nutrition among girls.

3- Age-Specific Observations :

▪ **6-Year-Olds:** This age group has no cases of obesity and the lowest proportion of overweight children (4.49%). Most children fall into the normal BMI range (19.51%).

▪ **8-Year-Olds:** There is a spike in underweight children (36.84%) and a relatively high proportion of obesity (21.05%), indicating potential disparities in health or nutrition within this group.

▪ **-9Year-Olds:** This group sees the highest percentage of overweight children (29.21%) and a significant proportion of obesity (26.31%).

▪ **10 - Year - Olds:** This group has (14,61%) overweight and the obesity (10.53%).

▪ **11-Year-Olds:** This group has the highest obesity rate (31.58%), which is alarming and may warrant targeted interventions.

▪ **12-Year-Olds:** While obesity decreases slightly (10.53%), the underweight proportion remains relatively high (26.32%).

4- Key Concerns:

▪ The prevalence of obesity in certain age groups (9 and 11 years old) is concerning and may indicate lifestyle or dietary issues specific to these age ranges.

▪ The high proportion of underweight children in some groups (e.g., 8 and 12 years old) suggests a need to address under nutrition alongside obesity.

▪ Gender-related differences in obesity and underweight prevalence highlight the need for gender-sensitive health interventions.

9- Conclusion:

▪ Obesity among primary school children based on various factors such as eating habits, awareness of healthy lifestyles, and the prevalence of chronic diseases among children.

▪ Fast-food consumption among children, which could be associated with weight gain.

▪ Snack consumption can either be healthy or unhealthy, depending on the type of snacks, which affects overall weight and health.

▪ Excessive sugar intake is strongly associated with childhood obesity due to high calorie consumption and poor satiety control.

▪ Imbalance between energy intake and expenditure.

▪ Limited physical activity contributes to weight gain and obesity due to an.

▪ Low intake of fruits and vegetables is linked to poor dietary habits and increased obesity risk due to a lack of essential nutrients and fiber.

▪ This indicates a need to increase awareness of the importance of healthy living among children and their parents.

▪ Regular intake of sweets (especially more than twice daily) contributes to excessive calorie intake, leading to weight gain.

▪ High sugar consumption is associated insulin resistance, increasing the risk of obesity and type 2 diabetes.

▪ Frequent consumption of fast food is linked to high fat and calorie intake, which promotes obesity.

▪ Processed fast food often lacks essential nutrients, contributing to poor dietary habits and metabolic disorders.

▪ Eating due to stress or sadness (rather than hunger) can result in overeating, especially of unhealthy foods.

▪ Children with metabolic disorders (such as diabetes) or digestive issues may have altered eating habits that contribute to weight fluctuations.

▪ Obesity itself increases the risk of respiratory problems and digestive disorders, creating cycle of poor health.

Table 4 .

Variables that effects on childhood obesity

Variables Findings	Variables Findings	Variables Findings
Age	6-12 years old	Obesity risks increased with age
Height	120-160 cm	Growth factors may affected with obesity
Weight	20-60 Kg	Higher weight associated with increased BMI and obesity
BMI	Range from 12.8 - 26.6	Higher BMI Linked with overweight and obesity
Fruit and vegetable intake	45.8% once/day , 27.3%twice/day , 14.1 never	Low intake linked to poor diet and weight gain
Sweet Consumption	%45.4twice/day ,15.7% three/day	High sugar intake increases calorie consumption and obesity
Fast Food Consumption	52% once/day , 22% twice/day	High calorie intake contribute to obesity
Physical Activity	30.4 less than 30 min , 27.5% one hour	Low activity leads to energy imbalance and weight gain
Screen Time	High usage	Less physical activity contributing to obesity
Emotional eating	32.1% eat due stress	Stress-related overeating leads to weight gain
Parental Awareness	60% aware of healthy lifestyle	Awareness does not always translate into action good habits
Chronic Diseases	21% have illnesses	Obesity increase risk of diabetes, digestive and respiratory issues

10- Discussion:

The study results highlight significant trends in childhood obesity among primary school children, emphasizing key lifestyle factors such as diet, physical activity, and parental awareness. These findings provide valuable insights into the causes and potential interventions for childhood obesity.

10.1 Gender and Age Distribution

The study sample consisted of 250 children, with 47.2% males and 52.8% females, aged between 6 to 12 years. The results showed that obesity prevalence increased with age, indicating that as children grow older, they are more likely to develop weight-related issues. This could be attributed to increased independence in food choices and reduced physical activity over time.

10.2 Dietary Habits and Their Role in Obesity

The most striking findings was the high consumption of unhealthy foods: • 52% of children consumed at least one fast-food meal daily.

- 45.4% ate sweets twice a day, while 24.5% ate sweets once daily.

- Only 45.8% consumed fruits and vegetables once a day, and 14.1% never consumed them.

These dietary patterns indicate a reliance on high-calorie, low-nutrient foods, which contribute significantly to obesity. The limited intake of fruits and vegetables suggests a lack of essential nutrients and fiber, which are crucial for maintaining a balanced diet and preventing excessive weight gain.

10.3 Physical Activity Levels

The study found that many children engaged in limited physical activity: • 30.4% of children exercised for less than 30 minutes a day.

- Only 17.4% engaged in physical activity for more than an hour.

This indicates a sedentary lifestyle, which is a major contributing factor to obesity. Increased screen time, reduced outdoor play, and a preference for passive activities, such as watching TV or playing video games, contribute to a positive energy balance, where calorie intake exceeds expenditure, leading to weight gain.

10.4 Chronic Health Conditions Linked to Obesity

Among the children studied:

- 21% had health issues, including diabetes (8.6%), respiratory diseases (13.7%), and digestive disorders (14.4%).

- Obese children were more likely to have metabolic conditions, such as insulin resistance and high cholesterol.

These findings confirm that childhood obesity is not just a weight issue but a serious health concern with long-term consequences. Obesity increases the risk of developing chronic diseases, which can persist into adulthood and lead to severe health complications.

10.5 Parental Awareness and Its Effect on Children's Lifestyle

Despite 60% of parents being aware of healthy lifestyle choices, their children continued to follow unhealthy eating habits and sedentary lifestyles. This suggests a gap between awareness and action. Many parents may struggle to implement healthier practices due to time constraints, financial limitations, or lack of enforcement at home. These findings highlight the need for a holistic approach that addresses both diet and physical activity to effectively reduce obesity rates among children.

9- Recommendations

Based on the study findings, the following recommendations are proposed to address childhood obesity effectively:

9.1 Promote Healthy Eating Habits

- Encourage children to consume a balanced diet rich in fruits, vegetables, whole grains, and lean proteins.

- Reduce the intake of fast food, sugary snacks, and carbonated drinks.

- Educate parents and children about the importance of proper nutrition through school programs and community initiatives.

- Implement school meal programs that provide nutritious, well-balanced meals.

9.2 Increase Physical Activity

- Ensure that children engage in at least 60 minutes of physical activity daily through sports, outdoor play, or structured exercise programs.

- Schools should incorporate more physical education sessions and active learning strategies.

- Parents should encourage outdoor activities, reduce screen time, and promote active play at home.

9.3 Reduce Sedentary Behavior

- Limit screen time (TV, video games, mobile devices) to no more than two hours per day for children.

- Encourage interactive and educational activities that involve movement.

- Create public parks and playgrounds to promote physical engagement in the community.

9.4 others

- Schools should integrate health education programs that focus on nutrition, physical activity, and obesity prevention.

- Recognize and manage emotional eating behaviors by providing psychological support and counseling for children struggling with obesity-related stress or low self-esteem.

References:

- 1- Ogden CL, Carroll MD, Kit BK, Flegal KM. *Prevalence of childhood and adult obesity in the United States*, 2011-2012. *JAMA*. 2014;311(8):806-814.
- 2- Dietz WH, Robinson TN. *Clinical practice: overweight children and adolescents*. *N Engl J Med*. 2005;352(20):2100-2109.
- 3- Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, and Bhadoria. AS. *Childhood obesity: causes and consequences*. *J Family Med Prim Care*.(2015) 4:187-92.
- 4- Brown CL, Halvorson EE, Cohen GM, Lazorick S, Skelton JA. *Addressing childhood obesity: opportunities for prevention*. *Pediatr Clin North Am*.(2015) 62:1241-61.
- 5- Rinninella E, Raoul P, Cintoni M, Franceschi F, Miggiaro GAD, Gasbarrini A, et al. *What is the healthy gut microbiota composition? a changing ecosystem across age, environment, diet, and diseases*. *Microorganisms*. (2019) 7:14.
- 6- Ahmad A., Zulaily N., Shahril M.R., Wafa S.W., Amin R.M., Piernas C., Ahmed A. *Obesity determinants among Malaysian 12-year old school adolescents: Findings from the HAT study*. *BMC Pediatr*. 2021;21:418.
- 7- Janssen I., Katzmarzyk P., Boyce W.F., King M.A., Pickett W. *Overweight and obesity in Canadian adolescents and their associations with dietary habits and physical activity patterns*. *J. Adolesc. Health*. 2004;35:360-367.
- 8- Edwin Thanarajah S., Tittgemeyer M. *Food reward and gut-brain signalling*. *Neuroforum*. 2020;26:1-9.

- 9- Parekh N., Deierlein A.L. **Health behaviours during the coronavirus disease 2019 pandemic: Implications for obesity.** *Public Health Nutr.* 2020;23:3121–3125.
- 10- Hill A.P., Zuckerman K.E., Fombonne E. **Obesity and Autism.** *Pediatrics.* 2015;136:1051–1061.
- 11- Puhl R.M., Liu S. **A national survey of public views about the classification of obesity as a disease.** *Obesity.* 2015;23:1288–1295.
- 12- Dantas R.R., da Silva G.A.P. **The role of the obesogenic environment and parental lifestyles in infant feeding behavior.** *Rev. Paul. Pediatr.* 2019;37:363.
- 13- Yang Z., Li Y., Dong B., Gao D., Wen B., Ma J. **Relationship between parental overweight and obesity and childhood metabolic syndrome in their offspring: Result from a cross-sectional analysis of parent-offspring trios in China.** *BMJ Open.* 2020;10:e03633.
- 14- Adair L.S. **Child and adolescent obesity: Epidemiology and developmental perspectives.** *Physiol. Beh av.* 2008;94:8–16.
- 15- Noorwali E., Potter G., Ford H., Mulla U., Murphy D., Wark P., Frost G., Hardie L., Cade J. **Sleep timing and vegetable intakes in UK adults: A cross-sectional study.** *Proc. Nutr. Soc.* 2018;77.
- 16- Incledon E., Wake M., Hay M. **Psychological predictors of adiposity: systematic review of longitudinal studies.** *Int J PediatrObes.* 2011;6(2-2):e1-e11.
- 17- Hemmingsson E. **A new model of the role of psychological and emotional distress in promoting obesity: conceptual review with implications for treatment and prevention.** *ObesRev.* 2014;15(9):769-779.