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“Evaluation of the Prevalence and Sociodemographic Factors Associated with Overweight and Obesity among high school female adolescents in the Dammam and Khobar area in Eastern Province, Saudi Arabia”

Author name: Dr. Shatha Zuhair Alzuhair
Consultant Family medicine
Master Public health

Co-author name: Dr.Ali Rashid Alsubaie
PhD Public health

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Abstract

Background and objectives: Being overweight or obese increases the risk of chronic diseases, reduces individual satisfaction, and incurs costs to the health care system. This study seeks to determine the prevalence of overweight or obesity and obesity-related factors in female adolescent students in Dammam and Khobar, Saudi Arabia.

Methods: The study utilized a cross-sectional quantitative survey (n=374) conducted in Dammam and Khobar. The survey targeted 15-18-year-old female studentsin the 10th, 11th, and 12th grades. The chi-square test was employed to examine the impact of categorical factors on adiposity

Results: Of the 374 students who took the field test, 239 (63.9%) went to public schools, and 135 (36.1%) went to private schools. The study found that 26.8% of the participants were overweight or obese, 78% among them from public schools and 22 % from privateschools. The results showed that parents' education level and type of school were associated with adolescent weight, while other factors significantly increased the chanceof being overweight or obese student, such as students living with a single career parent (p-value of 0.003; OR = 1.737; 95% CI: 1.803–17.904) and lower financial levels (p-value of 0.021;OR = 1.006; 95% CI 1.162–6.441). In contrast, students who walked to or used school services had a decreased chance of being overweight or obese (p-value of 0.001; OR = 2.064;95% CI: 0.037–0.297). **Conclusion**: The study found that many of Saudi adolescent girls in research area are overweight or obese, which emphasizing the need for societal and individual health-conscious school policies.

Keywords

Adolescents, BMI, Overweight, Obesity, School Health, Students, Saudi Arabia

الملخص

الخلفية والأهداف: إن زيادة الوزن أو السمنة تزيد من خطر الإصابة بالأمراض المزمنة، وانخفاض الرضا الشخصي، والتكاليف التي يتحملها نظام الرعاية الصحية .تسعى هذه الدراسة إلى تحديد مدى انتشار زيادة الوزن والسمنة والعوامل المرتبطة بالسمنة لدى الطالبات المراهقات في الدمام والخبر بالمملكة العربية السعودية.

الطرق: استخدمت الدراسة مسحًا كميًا مقطعيًا (ن = 374) أجري في الدمام والخبر. واستهدف المسح الطالبات في سن 15-18 عامًا في الصفوف العاشر والحادي عشر والثاني عشر. تم استخدام اختبار مربع كاي لفحص تأثير العوامل التصنيفية على السمنة.

النتائج: من بين 374 طالبًا أجروا الاختبار الميداني، وجد 239 (63.9٪) من المدارس الحكومية، و135 (36.1٪) من المدارس الخاصة. وجدت الدراسة أن 26.8٪ من المشاركين يعانون من زيادة لبوزن لو السمنة، 78٪ منهم من المدارس الحكومية و22٪ من المدارس الخاصة. أظهرت النتائج أن مستوى تعليم الوالدين ونوع المدرسة مرتبطان بوزن الطالبات المراهقات، في حين أن عوامل أخرى زادت بشكل كبير من فرصة أن تكون الطالبة بوزن زائد او سمنة، مثل الطلبة الذين يعيشون مع أحد الاباء (قيمة 1.737 = OR ;0.003 p؛ 95٪ CI: 17-904.1.803)، أولئك الذين لديهم مستويات مالية قليله (قيمة 1.006 = OR ;0.021 p؛ 95٪ CI 1.162-6.441). في المقابل، كان لدى الطالبات الذين يستخدمون الخدمة المدرسية او المشي فرصة منخفضة في أن يكونوا زيادة وزن او سمنة (قيمة p اقل من 0.001; OR = 2.064; 95٪CI : 0.037-0.297) .**النتيجة:** وجدت الدراسة أن العديد من الفتيات السعوديات في منطقة الدراسة يعانين من زيادة وزن او سمنة ولديهن العديد من السلوكيات الغذائية الغير الصحية ويؤكدن على الحاجة إلى سياسات مدرسية مجتمعية وفردية واعية بالصحة.

الكلمات المفتاحية

المراهقون، مؤشر كتلة الجسم، زيادة الوزن، السمنة، صحة المدرسة، الطلاب، المملكة العربية السعودية.

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Body mass index (BMI)
Overweight or obesity (OW/OB)
Socio-economic circumstances (SEC)
Socio-demographic factors (SDF)
World Health Organization (WHO)

CH.1 – INTRODUCTION

1.1 Background

Obesity is a significant public health concern that affects both developed and developing countries. The increasing prevalence of overweight individuals can be attributed to various factors, including poor lifestyle habits, lack of regular exercise, andgenetics (Kumari et al., 2022). Saudi Arabia has one of the highest rates of OW/OB individuals globally. It is estimated that almost one-third of the country's population is either OW/OB (Alhumud, 2020).

Obesity, a condition characterized by prolonged overweight, can significantly impair health by increasing the risk of acquiring severe health consequences such as cardiovascular disease, cancer, or diabetes. The health consequences of these hazards canbe unpredictable, potentially resulting in irreversible harm to an individual's well-being and even mortality (Bray et al., 2017; Bendor et al., 2020; Keramat et al., 2021). This poses a challenge not just for emerging nations aspiring to replicate the economic successof large economies but also for significant economies themselves. In 2022, the World Health Organization (WHO) reported that around 2.5 billion people and 390 million teensand children are either OW/OB (Obesity & Overweight, 2024). The rapid surge in obesityrates might be delayed by the collective impact of poor exercise habits, dietary patterns, and genetic predisposition (Alhumud, 2020).

Saudi Arabia has one of the world's highest heaviness rates, with its population being the most overweight internationally, according to the latest figures (Althumiri et al., 2021).The Ministry of Health of Saudi Arabia trains healthcare workers to identify early indicators and symptoms of medical conditions. Statistics indicate that the obesity rate among the Saudi population is 35%, which is equivalent to nearly one-third of the population (Alsulami et al., 2023).

According to research conducted by the Global Obesity Association (Jatoi et al., 2022), 22% of Saudi Arabian kids between the ages of five and 19 are considered overweight. This age range is the main target of the present study. Al-Hazzaa (2018) discovered that between 30 and 38.4% of individuals suffered from a combination of diabetes, coronary artery disease, or cancer and that 75.2% of adults were overweight. Asa result, non-communicable diseases have developed because healthcare systems in SaudiArabia have undergone necessary modifications to match modern lifestyles.

Adolescent girls in Saudi Arabia have a significantly high prevalence of excess body fat due to the limited availability of social gathering places, sports programs, and suboptimal dietary habits. Adolescent females are more likely to adopt harmful food habits compared to teenage boys, and these tendencies may arise well before puberty (Neumark-Sztainer et al., 2011; Purkiewicz et al., 2021). In addition, fixation on societaland culturally idealized body types can exacerbate the problem (Alhumud, 2020).

Two potential consequences that may ensue are diminished self-esteem and the development of an eating disorder. However, another aspect to consider is the factors contributing to human obesity. Currently, it is critical to determine the roots of the high prevalence of overweight high school females in Dammam and Khobar.

A significant population of adolescents and high school pupils resides in the eastern region of the Saudi Arabian province. Many adolescent Saudi Arabian women areobese or overweight. In the Eastern Province of the country, particularly in the major

cities of Dammam and Khobar, there is a dire need for long-term high schools (Alhumud,2020).

In this study, we will analyze social and cultural factors. The objective is to identify the factors contributing to the high prevalence of OW/OB among female studentsin secondary schools in Dammam and Khobar, Eastern Province, Saudi Arabia. Based onthe findings, schools should determine the necessary resources to help female students lose weight on campus. The results of this study can assist policymakers and healthcare professionals in developing targeted weight loss programs that are effective in this demographic.

1.2 Context

This research was conducted in the eastern Saudi Arabian cities of Dammam and Khobar. Because of their substantial populations, these urban centers amalgamate elements of both ancient and contemporary cultures. Public and private institutions catering to pupils of every age group and socioeconomic status are present in this region (Alhumud, 2020). The primary research inquiry is :What was the prevalence of secondary female OW/OB within the study's sample, taking into consideration socioeconomic circumstances (SEC) in the study area?

1.3 Significance and Definitions of Key Terms

Diabetes, heart disease, and high cholesterol levels are some issues that may resultwhen one is OW/OB. To find a person's body mass index (BMI), their body mass is measured in kilos and squared. OW/OB can be detected with its help. Anyone with a BMI over 30 is regarded as obese, while individuals whose BMI is 25–29.9 are categorized asoverweight. Obesity is a critical issue in the community since

it is linked to several chronic medical conditions, including heart disease, stroke, diabetes, and cancer (Alqasem et al., 2020). Anxiety and depressive disorders can arise as a consequence of an overall decrease in quality of life (Fernandes et al., 2023).

1.4 Aims and Objectives

This research aims to examine the prevalence of OW/OB among female studentteenagers in the cities of Dammam and Khobar, Saudi Arabia.

CH.2 – LITERATURE REVIEW

2.1 Background

Obesity is a worldwide health concern due to its accelerated increase in developedand developing nations (Kumari et al., 2022). The possibility of developing type 2 diabetes, cardiovascular disease, and various malignancies in adulthood is elevated in adolescents who are obese (Keramat et al., 2021). Inactivity, genetics, inadequate nutrition, and hormonal changes associated with puberty are all contributors to adolescentobesity (Alhumud, 2020). Additionally, mood disorders, depression, and social isolationare associated with it (Kansra et al., 2021).

Educational institutions could serve as convincing environments to promotehealthy behaviors and address the escalating prevalence of obesity among adolescents (Hammad & Berry, 2017). Additionally, physical activity programs, school health services, and nutrition initiatives may help reduce adolescent obesity (Alqasem et al., 2020). Furthermore, knowledge of the causes of obesity among high school girls and effective school-based health services may lead to more targeted treatments.

2.2 Prevalence of Obesity

Obesity is a universal concern that affects people of all ages and genders, and it continues to be a growing issue in modern society (Tiwari & Balasundaram, 2023). “Global, regional, and national prevalence of OW/OB in children and adults from 1980 to 2013: An analysis addressing various aspects of the healthcare workforce,” termed “acomprehensive assessment,” was published in the medical magazine *The Lancet* on May28, 2014. A multi-national group, accompanied by Institute for Health Metrics and Evaluation “Systematic Analysis” from the University of Washington, is led by the Global Burden of Diseases Study (Ng et al., 2014). Studies by the Global Burden of Diseases have shown that more than one-third of the world’s population is either OW/OB. In the Middle East, obesity—which was on the decline for 30 years—has once again become a high-incidence health condition. This increase in obesity rates is mainly related to the young population in countries such as Bahrain, Egypt, Saudi Arabia, Oman, and Kuwait (Ng et al., 2014).

The percentage of overweight children and adolescents has increased by almost 50% in the last two decades (Lifshitz, 2011). Furthermore, 75-80% of adolescents with obesity are likely to continue experiencing obesity into adulthood (Lifshitz, 2011).

Over the past 33 years, the rate of overweight adolescents in the Middle Eastern region has nearly doubled, with the highest rate reported in 2013. More than one in 10 girls with the BMI classification of obese is presented with a value of 22%; in boys, thispercentage is 24% (Ng et al., 2014). Unfortunately, today, many kids and teenagers are classified as obese all around the world (Kansra et al., 2021).

According to a 2022 report by the World Health Organization, over 390 million children and teenagers between the ages of five and 19 were either OW/OB (Obesity & Overweight, 2024). Another study was based on statistical data from more than 20,000 boys’ and girls’ schools. The study revealed that 25.7% of teenage students wereclassified as OW/OB, as reported by Albaker et al. (2022).

In light of the current situation, there is a growing concern about the potential risein illness and mortality rates, mainly due to diseases like cardiovascular diseases, which are already the leading cause of death in Saudi Arabia. Despite this, Vision 2030, the Kingdom's strategic plan for economic development and national growth, prioritizes healthcare transformation and includes initiatives to address the primary risk factors of non-communicable diseases (NCDs) such as obesity (AlEnazi et al., 2023).

In 2017, Saudi Arabia launched the RASHAKA Program to raise awareness abouthealthy lifestyle choices for school-aged children, parents, and teachers (Eid et al., 2017).Additionally, the National Center for Disease Prevention and Control (WEQAYA)established the Obesity Control and Prevention Strategy of 2030 to improve health outcomes related to obesity (AlEnazi et al., 2023).

A recent study was conducted on 351,195 children and adolescents aged 2–19. The study revealed that around 20% of these children were either overweight (11.2%) orobese (9.4%). The study also found that among females aged 14–19 years, the prevalenceof OW/OB was 7.9% and 10.8%, respectively. The study identified the Central and Eastern regions as having the highest prevalence of obesity among Saudis, with a rate of9.9% for both areas (Alenazi et al., 2023).

2.3 Risk Factors

Teenager obesity was found to lead to many interrelated predisposing conditions.The genotypic profile influences the amount of adiposity in the body. Scientific researchhas shown that genetics can be responsible for 40% to 70% of obesity cases. Genetics canaffect how much body fat accumulates, how much food is consumed, and how the body uses energy. However, adolescent obesity is not solely determined by genetics. Other factors also play a role in the development of obesity in children and teenagers. When these factors are combined with genetic predisposition, they can determine the prevalenceof obesity in this population.

Adolescent obesity is significantly affected by environmental factors such as changes in lifestyle, urbanization, and globalization, as stated by Mohdher et al. in 2019(Mohdher et al., 2019). These external pressures can lead to discrimination and racism. Additionally, the shift in diets towards foods high in fat, sugar, and salt, highlighted by Hammad and Berry in 2017, is also a contributing factor (Hammad & Berry, 2017). Moreover, the intake of fast food and processed food has contributed to adolescent obesity levels. Inadequate provision of safe recreation facilities, torrid weather, and the overuse of technology jointly or in isolation all lead to a sedentary lifestyle, which is prevalent among Saudi teenagers (Mohdher et al., 2019).

Most teens' most common forms of electronic devices include mobile phones, computers, and video games. A healthy diet is a critical factor in adolescent weight issues and obesity. Another factor that contributes to teen obesity is a poor diet, which puts a child at risk of not only severe health problems but also adverse social and psychological effects.

Adolescent obesity is also associated with unhealthy eating habits. In Saudi Arabia, high-fat, sugary, and salty Western diets have replaced vegetable, fruit, and grain- based meals. Adolescents in Saudi Arabia consume more sugar-sweetened drinks than ever before, contributing to a rise in overall calorie consumption and weight gain (Alsubaie, 2010). During puberty, teenagers often consume large amounts of unhealthy foods, such as fast food and sugary drinks, which are high in calories (Alasqah et al., 2021).

Obesity among children is more likely if parents are obese themselves or if the child has other risk factors such as individual and environmental factors (Hammad & Berry, 2017; Nogueira-de-Almeida et al., 2024). Adolescent obesity is principally associated with family history, as demonstrated by Mohdher et al. (2019). However, there is a range of factors that lead to obesity in Saudi female teens. Some contributing factors are attributed to a sedentary lifestyle, culture, ignorance of proper nutrition, lack of exercise, and consumption of calorie-dense foods, (Alfulayw et al., 2022).

CH.3 – RESEARCH METHODOLOGY

3.1 Research Design

The study used A cross-sectional quantitative study was conducted using questionnaires among female high school students in Dammam and Khobar, Saudi Arabia. The participants were in the 10th, 11th, and 12th grades, the participants were randomly selected using cluster-stratified sampling, with six public and four private institutions chosen from the research region.

3.2 Study Setting

The study occurred in the Eastern Province, specifically in Dammam and Khobar,Saudi Arabia. These urban centers combine elements of ancient and contemporarycultures due to their substantial populations. The region has public and private schools catering to students of all ages and socioeconomic statuses (Alhumud, 2020). In the Eastern Province, particularly in the major cities of Dammam and Khobar, there is a pressing need for long-term high schools (Alhumud, 2020). Schools in the Dammam andkhober are divided into private (27%) and public (73%) institutions. There are 20,385 secondary-level female pupils enrolled in 98 (61%) institutions in Dammam, of which 79are public and 19 are private. The 63 schools in Khobar (39%) enroll 10,133 pupils (39
public, 24 private).

3.3 Participants and sampling

The population selected for sampling in this study survey is female adolescents attending public and private high schools in the Dammam and Khobar areas. It is important to note that due to political, religious, and cultural reasons, male adolescent students are separated in schools from female students. This cultural norm necessitates their exclusion from this study, although there is no doubt that their future role in community and family health is fundamental. Most students are usually aged between 15and 18, in the tenth, eleventh, and twelfth grades of their school years in Dammam and Khobar City, Saudi Arabia.

In order to calculate a sufficient sample size to ensure the representativeness of the study population, the highest available prevalence of overweight and obesity among KSA females aged 14–19

years (18.7%) in a study by Alenazi et al. (2023) was used. Thefollowing formula was used for sample size calculation:

$$(n) = Z1^2\text{-}\alpha/2\ Pq\ /d^2$$

Where n is the sample size, Z is the degree of confidence, P is the expected prevalence, and d is precision, which is the same as the effect size (Ziegel et al., 1994).

The estimated sample size should include 325 students from the total population in this age group (30,518) with a 98% confidence level and a 5% margin of error. An additional 15% of participants were included in the cluster sampling technique to adjust for sampling error, resulting in a final sample size of 374 female students.

In this study, we utilized a multistage, stratified sampling method to select 10th to 12th-grade female students from the Dammam and Alkhobar areas in the eastern province of Saudi Arabia. We obtained a list of all female secondary schools from the Eastern General Directorate of Education. The sampling method involved dividing the Dammam and Khobar areas by cities to ensure a representative sample and to prevent potential bias by excluding students from different areas.

In the first stage, we used a systematic random sampling procedure to select schools divided into public and private based on their population size. We selected ten schools, six from Dammam and four from Khobar. These included four public schools, two private schools from Dammam, and two public and two private schools from the Khobar area. The number of schools selected from each area was determined by the totalnumber and percentage of these schools in each area.

In the second stage, classes were chosen for each grade using a simple random sampling design. One class was randomly selected from each grade (grades 10, 11, and 12) in each secondary school. Therefore, we selected 18 classes in Dammam schools (13-15 students from each grade) and 12 classes in Khobar schools (10-12 students from eachgrade) by choosing every fifth student from the list of registered students at eacheducational level. A unique code was generated for every student and school, which wasprinted on the questionnaires. In order to protect privacy, the questionnaires did not include the names of the students or the schools.

3.4 Data Collection Methods

The quantitative data was collected through a class questionnaire after a brief orientation with the participants. The survey was conducted in Arabic to encourage maximum participation.

3.4.1 Instruments

Quantitative questionnaire:

Section 1: Contains demographic information on age, nationality, residence, income, parents' education, sleep duration, mode of transportation to school, and historyof chronic illness.

Section 2: The participants collected anthropometric data and BMI by measuringthe weight and height of a trained nurse. The weight was measured using a commercial scale (Seca, Germany) with an accuracy of ±100 g. Subjects were asked to remove their footwear and wear minimal clothing before being weighed. Standing body height was measured to the nearest 0.5 cm using a commercial stadiometer with relaxed shoulders, arms hanging freely, and without shoes. The scales were recalibrated after each measurement. All measurements were carried out outside the classroom individually afteran interview with a food frequency questionnaire.

We calculated the body mass index (BMI) using the formula 'body weight in kilograms/height in meters.' We used the cut-off points recommended by Cole et al 2007.to identify age and gender-specific thresholds for BMI. The age range for diagnosis of overweight and obesity was 1 to 18 years. Children at or above the 85th percentile were considered overweight, those at or above the 95th percentile were considered obese, andthose below the 85th percentile were considered to have a desirable or lean BMI.

Six students were interviewed, and they all agreed that the questionnaire items were clear, appropriate, and easy to answer. The students commented on the language and layout, and then the questionnaire was modified.

Ten students participated in the pilot study, and the response rate was very high. Many students stated that the questionnaire was lengthy but easy to read, understand, andcomplete and did not need to be modified. Only some linguistic modifications were madeto make sure everything about the questions was clear.

The questionnaire items were based on Advice from experienced researchers wasobtained and considered. The questions were translated from English to Arabic and backto English. The questions were pre-tested by interviewing six students and then by a pilotstudy.

A test-retest study was applied, and no significant differences were found in the participants' responses. Also, the questionnaire was reviewed by three expert consultantsseparately, with modifications made in light of their suggestions.

3.4.2 Ethics and Limitations

The Institutional Review Board approved the investigation. Each participant was duly apprised that their answers would remain anonymous and be utilized solely for scientific purposes. At any time, participants could discontinue their participation. IRB approval was granted for IRB-UGS-2022-03-502.

An official letter was obtained from the supervisors addressed to the Directorate of Education in eastern province, Director. The letter stated the study's importance and requested permission to conduct it. Subsequently, the letter was submitted to the ResearchCommittee at the Eastern General Directorate of Education, which authorized the review of the questionnaire items. The committee approved the questionnaire.

The limitations of this study include potential memory bias and the likelihood of participants. It is important to note that causality cannot be determined from cross- sectional data. Additionally, the fact that the participants were mature female adolescentsmay have introduced selection bias. Even when participants provide accurate self-reported measures, inaccurate evaluations and biased predictions for the future are still possible.

3.5 Statistical Analysis

Student information was inputted using SPSS. The data were subjected to statistical analysis. The limit of significance was 5% (p-value < 0.05). Descriptive and inferential statistics were employed in the data analysis process. Number of occurrences,and percentages were employed to characterize the attributes of the participants, the prevalence of obesity, dietary and weight behavior, knowledge, attitudes, skills, the impact of media and advertising, and school health services. We analyzed the relationshipbetween obesity and demographics, using inferential statistics such as chi-square tests and regression analyses. The chi-square test was employed to investigate the impact of categorical factors on adiposity. Predictors of obesity in participants can be identified by employing a multinomial regression analysis.

CH.4 – RESULTS

4.1. Students' Background Characteristics

Of the 374 students, 239 (63.9%) attended public schools, while 135 (36.1%) attended private schools, as shown in Table 1. Concurrently, students received evaluations for the 10th–12th grades. The highest percentage was in the 10th grade (n = 154; 41.2%), while 104 students (27.8%) were in the 11th grade, and 31.0% (116 students) were in the 12th. Ages ranged from 15 to 18 years, with a mean of 15.9 years, a standard deviation of 0.83, and a median of 16. Of the students, 150 (40.1%) were 15, 108 (28.9%) were 16, and 116 (31.0%) were 17 years or older. Moreover, 256 students, or 68.4%, were Saudi nationals. In contrast, 118 (31.6%) individuals were of a different nationality.

Table 1. Social and Demographic Characteristics of the Students

Demographic Information	Answer Category	*N* = 374	%
Type of school	Private	135	36.1%
	Public	239	63.9%
Grade	10th grade	154	41.2%
	11th grade	104	27.8%
	12th grade	116	31.0%
Age	15 years	150	40.1%
	16 years	108	28.9%
	17 years and above	116	31.0%
Nationality	Saudi	256	68.4%
	Non-Saudi	118	31.6%
Father's Education Level	Below university	114	30.5%

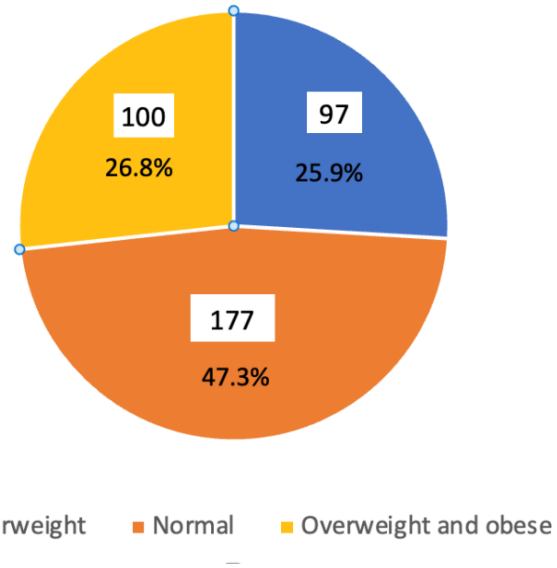
	University and above	260	69.5%
Mother's Education Level	Below university	171	45.7%
	University and above	203	54.3%
With whom do students live?	Single career	34	9.1%
	Both parents	340	90.9%
Financial Level	Less than middle	63	16.8%
	Middle and above	311	83.2%
Sleeping Hours	Less than 8 Hrs.	171	45.7%
	8 Hrs. or more	203	54.3%
Commuting to School	Private car	305	81.6%
	Other modes	69	18.4%
History of Chronic Disease	Yes	51	13.6%
	No	323	86.4%

According to the results, 260 fathers of students (69.5%) held a bachelor's degreeor higher, whereas 114 (30.5%) did not. Concurrently, 203 mothers (54.3%) of universitygraduates. Moreover, 171 individuals (45.7%) achieved degrees below the university level. As indicated by the results, 34 (9.1%) of pupils had a solitary occupation, while 340 (90.9%) lived with both parents. Sixty-three respondents (16.8%) belonged to the lower middle class, whereas 311 (83.2%) belonged to the middle and elite classes. Of thestudents in the sample, 171 (45.7%) slept for less than eight hours, while 203 (54.3%) slept for more than eight hours. Most of the students (305; 81.6%) commuted to school by private car, while only 69 (18.4%) used another mode of transportation. Furthermore,51 (13.6%) of the participants had a chronic illness, compared to 323 (86.4%) who did not.

4.2 BMI of the Students

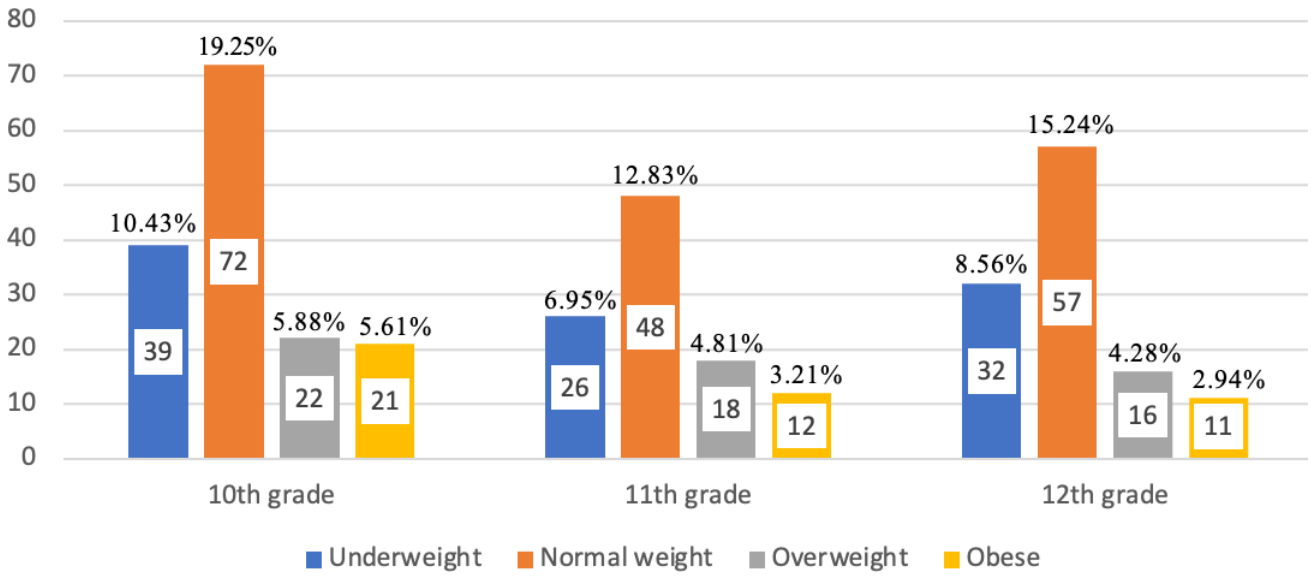
According to the findings, 25.9% of the students were underweight, while 177 (47.3%) were of average weight. A mere 100 individuals (26.8%) are classified as OW/OB weight. **(**Figure 2).

Figure 1. Student's Body Mass Indexes.



According to Figure 3, the 10th-grade students had the highest percentage of average weight, which was 19.25% (72), followed by the 11th grade with 12.83% (48), and the 12th grade with 15.24% (57). The percentage of obese students was the lowest inall grades, with 5.61% (21) in the 10th grade, 3.21% (12) in the 11th grade, and 2.94% (11) in the 12th grade. The percentage of overweight students in the 10th grade was 10.43% (39), in the 11th grade it was 6.95% (26), and in the 12th grade it was 8.56% (32). The final percentage of students who were classified as overweight was 5.88% (22) in the10th grade, 4.81% (18) in the 11th grade, and 4.28% (16) in the 12th grade. **(**Figure 3).

Figure 2. Cluster Bar Count of Students' Grades and BMIs



4.2 Associations: Chi-Square Tests

According to the Chi-square test results in Table 3, various socio demographic factors had a significant association with the students' BMI. The study revealed that 78%of OW/OB students were enrolled in public schools, while 22% attended private schools.In contrast, 58.8% of non-OW/OB students were in public schools, with 41.2% in privateschools (p-value < 0.001). Also, Fathers' education level was significantly associated withstudents' BMI status (p < 0.001), with 53% of OW/OB students having fathers who completed university education or lower, compared to 75.5% of non-OW/OB students. Meanwhile, there is a significant association (p-value < 0.001) between the education level of the mother and the students' BMI status. Among OW/OB students, 61% had mothers with education below the university level. In contrast, 59.9% of non-OW/OB students had mothers who had completed education beyond the university level.

The study also found that living conditions with parents were associated with students' BMI (p-value < 0.001), as 82% of OW/OB students and 94.2% of non-OW/OB students lived with both parents. Finally, the study found that commuting to school was another factor associated with students' BMI (p-value = 0.010), as OW/OB students weremore likely to use a private car, with 90% of them doing so. Moreover, 75% of OW/OB students belonged to families with financial levels above the middle; this result shows that financial level is another factor associated with students' BMI.

Table 3. Crosstabulation for OW/OB and non-OW/OB Students with Sociodemographic Factors

Demographical Factors	Category	Adolescent Overweight/Obesity		N = 374	p-value
		No n (%)	Yes n (%)		
Type of School	Private	113 (41.2%)	22 (22%)	135 (36.1%)	< 0.001
	Public	161 (58.8%)	78 (78%)	239 (63.9%)	
Grade	10th grade	111 (40.5%)	43 (43%)	154 (41.2%)	0.590
	11th grade	74 (27%)	30 (30%)	104 (27.8%)	
	12th grade	89 (32.5%)	27 (27%)	116 (31%)	
Age	15 years	114 (41.6%)	36 (36%)	150 (40.1%)	0.395
	16 years	74 (27%)	34 (34%)	108 (28.9%)	
	≥ 17 years	86 (31.4%)	30 (30%)	116 (31%)	
Nationality	Saudi	191 (69.7%)	65 (65%)	256 (68.4%)	0.382
	Non-Saudi	83 (30.3)	35 (35%)	118 (31.6%)	
Father Education Level	< university	67 (24.5%)	47 (47%)	114 (30.5%)	< 0.001
	≥ university	207 (75.5%)	53 (53%)	260 (69.5%)	
Mother Education Level	< university	110 (40.1%)	61 (61%)	171 (45.7%)	< 0.001
	≥ University	164 (59.9%)	39 (39%)	203 (54.3%)	
Student's Living Conditions	Single career	16 (5.8%)	18 (18%)	34 (9.1%)	< 0.001
	Both	258 (94.2%)	82 (82%)	340 (90.9%)	
Financial Level	< middle	38 (13.9%)	25 (25%)	63 (16.8%)	0.018
	≥ middle	236 (86.1%)	75 (75%)	311 (83.2%)	
Sleeping Hours	< 8 h	127 (46.4%)	44 (44%)	171 (45.7)	0.726
	≥ 8 h	147 (53.6%)	56 (56%)	203 (54.3%)	
Mode of Commuting to School	Other	59 (21.5%)	10 (10%)	69 (18.4%)	0.010
	Private car	215 (78.5%)	90 (90%)	305 (81.6%)	
History of Chronic Disease	Yes	34 (12.4%)	17 (17%)	51 (13.6%)	0.306
	No	240 (87.6%)	83 (83%)	323 (86.4%)	

*Using a 95% confidence interval, a p-value of 0.05 or less indicates a significant association.

4.3 Multinomial Regression

Table 4 shows the results of a multinomial logistic regression study. The influenceof characteristics statistically related to students' weight (Tables 3) was the focus of this study's examination. Among these factors were the students' parents' education level, the way they commuted to school, the financial level of their family, the sort of school they attended, and the students' living situations with their parents. The referencegroup did not consist of OW/OB students. The factors influencing students' weight revealed that only "students' living conditions" and "financial level" were considerably relevant, as was a particular form of transportation used to go to school.

Table 4. Logistic Regression Analysis of OW/OB and non-OW/OB Students withSocio demographic Factors and Weight Behavior

Questionnaire	Category Answer	Adjust OR (95% CI)	Significance
Type of schools	Private	–0.773 (0.186–1.143)	0.095
	Public	*Reference*	
Father's Education Level	< university	0.495 (0.716–3.758)	0.242
	≥ university	*Reference*	
Mother's Education Level	< university	0.176 (0.526–2.705)	0.674
	≥ university	*Reference*	
Student's Living Conditions	Single parent/other	1.737 (1.803–17.904)	**0.003**
	Both	*Reference*	
Financial Level	< middle	1.006 (1.162–6.441)	**0.021**
	≥ middle	*Reference*	
Mode of Commuting to School	Other	–2.064 (0.037–0.297)	**< 0.001**
	Private car	*Reference*	

*Reference group is non-OW/OB.
*Using a 95% confidence interval, a p-value of 0.05 or less indicated a significant association

The results show that compared to kids whose parents live together, those whoseparents live apart had a higher probability of becoming OW/OB. There is a p-value of 0.003 and an odds ratio of 1.737 (95% CI: 1.803–17.904). Additionally, students with a financial level below the middle are more likely to be OW/OB than those with a financiallevel above the middle. The odds ratio for this is 1.006, with a p-value of 0.021 (95% CI1.162–6.441).

Further factors influencing students' weight include the mode of transportation toschool. The results show that students who use school services or other transportation forms, such as walking, to go to school are less likely to become OW/OB than those whouse private cars. The p-value is less than 0.001, and the odds ratio is 2.064 (95% CI: 0.037–0.297).

CH.5 – DISCUSSION

5.1 Prevalence of Overweight and Obesity

According to this research, many Saudi Arabian adolescent girls are OW/OB as discovered that 15% of students are overweight. Of the 26.8% overweight and obese students, 11.8% are obese and need interventions to prevent complications. The results also indicate that a high percentage of 10th-grade students are obese, and the majority ofoverweight students are also in the 10th grade.

Literature research has shown that teenage girls are likely to become obese, as onein 10 girls with the BMI classification of obese is presented with a value of 22% (Ng et al., 2014). In developed countries, 19% of girls were overweight; according to a 2022 report by the WHO, over 390 million children and teenagers between the ages of five and19 were either OW/OB (Obesity & Overweight, 2024).

In various research studies, the prevalence of overweight and obesity varied acrossSaudi Arabia and neighboring countries. Some studies reported higher rates than our study, while others reported lower rates [(Collison et al.,2010; Majeed,2015; Khalaf et al.,2014; Alshammari et al.,2017; Al-Almaie,2005; Alkoly et al., 2011; Washi & Ageib,2010).

Al-Enazy et al.'s (2024) study revealed that the prevalence of overweight and obesity among female students was 12.4% and 20.9%, respectively (Al-Enazy et al., 2024).A recent study found that among females aged 14–19 years, the prevalence of overweight and obesity was 7.9% and 10.8%, respectively (Alenazi et al., 2023). Anotherstudy conducted at the eastern region of Saudi Arabia, it was observed that 11.8% of girlswere obese and 17.2% were overweight (Al-Almaie , 2005).

Over 20,000 students in the Eastern Province of Saudi Arabia were studied by Albaker et al. (2022). According to the results, a quarter of all high school pupils are overweight. This finding is much higher than the result of this study on the prevalence ofoverweight among high school students.

Alhusaain et al. surveyed Riyadh City, the Central Province. They reported a higher prevalence rate of obesity (15.7%) among school-age students (Al-Hussaini et al.,2019). According to Shanawaz et al. (2019), a survey conducted in Jazan (Southern Province) found that the prevalence of obesity and overweight was 12.4% and 10.1%, respectively (Shanawaz et al., 2019), which is almost similar to the results of our study. In contrast, a study carried out by Qamar Farshori et al. in 2015 found that 13% of female children were obese and 20% were overweight (Qamar Farshori et al., 2015).

Another study found that among urban Saudi female students, the prevalence of overweight and obesity was 20% and 11%, respectively (Al-Saeed et al., 2007). Al- Malki's research revealed a notable rise in the rates of both overweight and obesity amonggirls as they matured, reaching 30% and 19% respectively (Al-Malki et al., 2003). However, the prevalence of overweight in the present study was found to be lower than the estimated rate of 30% in the US population (Hedley, 2004).

The difference in OW/OB prevalence reveals their unhealthy eating habits.Female students were more motivated to lose weight and achieve their ideal weight, andthis trend has been increasing, especially in recent years (Jalali-Farahaniet et al.,2014). Overweight and obesity have a complex cause, and many factors may be associated with this issue, which can vary among different populations in various geographical areas.

5.1 Factors Related to Obesity

Finding out what percentage of Saudi Arabian females in their formative years areoverweight and obese is the most crucial objective of this investigation. This study aimsto discover which students are most impacted by specific illnesses due to OW/OB and how institutions can more effectively help them. Not only does my research prove that Saudi Arabia has an obesity epidemic among teenagers, but it also sheds light on what may be causing teens to put on weight. Notably, Saudi Arabia is experiencing a rise in overweight and obese women, which aligns with global trends.

Considering the effects on the children's weight is essential, but how they get to school is much more crucial. The results show that students who use school services or other transportation forms, such as walking, to go to school are less likely to become OW/OB than those who use private cars (p-value < 0.001; OR = 2.064; 95% CI: 0.037– 0.297). This survey also showed that personal automobiles were the most popular mode of transportation (81.6%), with walking and school bus usage coming in a distant secondand third, respectively (18.4%).

Following other studies, Das et al. (2022) study showed that most pupils drive themselves to school by automobile (70%), while a manageable percentage of kids (19%)trek on foot. According to the same research, various forms of student transportation maycontribute to their BMI. Students who drove had a significantly higher BMI (21.81) thanthose who walked or biked (Das et al., 2022).

Research conducted by Khan et al. (2017) revealed that a higher prevalence of overweight (21.26%) and obesity (17.72%) was observed among students who utilized vehicles as their mode of transport.

According to this study, there is a correlation between parents' education level and a student's weight (p-value < 0.001 for both the mother and father). Previous research indicates that maternal characteristics may impact children's health more than paternal ones (Keane et al., 2012; Yang et al., 2016). Another study found that maternal education was linked to adolescents' weight, while paternal

education was not (Alshaikh et al., 2023). In addition, Feng et al. (2019) discovered that children of highly educated mothers were likely to be OW/OB. Yang et al. (2016) also highlighted the impact of mothers' education on children's weight. additionally, studies conducted in Western countries demonstrate a negative correlation between mothers' education level and children's weight issues, such as OW/OB (Lamerz et al., 2015).

Overweight and obesity were found to be more prevalent among students with highly educated parents (P = 0.008) (Dahi et al., 2014). Similarly, the prevalence of overweight and obesity was higher among schoolchildren with highly educated mothers (P = 0.008) (Al-Saeed et al., 2006). In a study conducted in Khobar City, Saudi Arabia, researchers discovered that the prevalence of overweight was significantly higher amongschoolchildren with highly educated mothers (p = 0.008) (Al-Saeed et al., 2006).

Surprisingly, our findings revealed a higher prevalence of obesity among childrenwith highly educated fathers (53%) and when the mother's education level was below thatof a university graduate (61%), since she was responsible for food selection for their children as well as their lifestyle activities. This agrees with several studies carried out inthe developed countries which explain this association by the belief of low educated mother that overweight children are healthier than normal weight children. (Hassan et al.,2016). Another factor associated with students' weight identified in this research is the type of school they attend (p-value < 0.001), which is consistent with Farsi et al.'s study from the Kingdom of Saudi Arabia (Farsi et al., 2016). The study found that the prevalence of obesity is higher among students in public schools (63.9%) compared to 36.1% in private schools. This result is consistent with a study conducted by Baniissa Wet al. in 2020, which showed that a significantly higher percentage of participants from public schools were OW/OB (37.8% vs. 31.1%) compared to those from private schools(Baniissa et al., 2020). Farisi et al. (2024) found that obesity was higher in adolescents attending public schools.

Differences in obesity rates between private and public schools have been reported in different countries in studies that used BMI. Similar to our findings, a study examining obesity rates among students in Palermo reported more public-school studentswere overweight/obese compared with private school students (age 13 years: 40.8% vs 34.5%; age 15 years: 36.7% vs 30.2%)(Provenzano et al., 2018).

Several studies have presented conflicting findings regarding the prevalence of overweight and obesity in private versus public school students. For instance, a study in Kenya reported a significantly higher rate of overweight/obesity (29.0%) among private school children compared to those from public schools (11.5%) (Kyallo F et al., 2013). Similar trends were observed in studies from India (Sangwan, 2016), Pakistan (Mansooriet al., 2018), china (Adom, 2019), Kenya (Kyallo et al., 2013), and Saudi Arabia (Al-Hazzaa et al., 2011; Al-Hazzaa et al ;2014), where obesity rates were higher in private schools than in public schools. These inconsistent findings may be attributed to differences in the sociodemographic, environmental, and cultural factors of the students attending these schools, leading to varying eating habits among different cultures.

Factors such as the availability of unhealthy items in vending machines, poor communication between food suppliers and school personnel, and limited physical activity facilities at schools may contribute to the differences in adolescent body weight (Dighe et al., 2020). Different lifestyles contribute to childhood obesity depending on thefamily's socioeconomic status (Alqahtani, 2014).

The results of this study do not reject the null hypothesis at the 5% level (p-value< 0.003), suggesting that the living arrangement of students with their parents significantly affects students' weight. It was found that students often experience late parent absences (OR = -1.737; 95% CI 1.803–17.904), indicating that students who lived with both parents were less likely to be OW/OB than those in this group, which contradicts the result of a recent study. The findings of a recent study suggest that overweight and obesity are more prevalent among students living with both parents (P = 0.031) (Al-Enazy et al., 2024). Additionally, a comprehensive analysis revealed that obesity levels were higher among single parents with obese children (Duriancik & Goff, 2019).

Research has shown that different family arrangements have mixed effects on anadolescent's weight (Chen & Escarce, 2014; Eidsdóttir et al., 2013; Parikka, 2015; Tabaket al., 2012). However, the strength of this link varied. Even though they may be strapped for cash, children from single-parent households may afford to eat well, obtain the necessary equipment, and attend fitness courses or activities (Moncrief et al., 2014; Youngblut et al., 2005). Because one parent may not have the resources to cook healthy meals for their family, time restrictions will likely differ for one-parent households compared to two-parent families (Badura et al., 2021; Langøy et al., 2019).

There is a significant difference in the lifestyles of pupils from high and low socioeconomic backgrounds. Research has shown that children whose families' incomesfall below the median are more likely to be classified as OW/OB compared to students whose families' incomes are above the median (p-value = 0.021; OR = 1.006; 95% CI 1.162–6.441). Numerous studies have examined the correlation between socioeconomic status and obesity, including the impact of social causes such as stigma and

prejudice. Low income has been linked to obesity in 21 different research groups. More credible research consistently supports the view that overweight individuals may have future income concerns. At the same time, research also suggests that obesity may affect futureincome (Kim & von dem Knesebeck, 2018).

According to the statistics shown above, there is a strong correlation between socioeconomic status and obesity, which is crucial for understanding the physical health issues caused by excess weight. Adolescent OW/OB is a direct outcome of the nutritionaldifferences that most studies have shown among students throughout the world. Hormonal changes during puberty cause this to happen quickly to children. After birth, fast growth occurs naturally, except in the first year. Because they immediately impact people's eating habits, these consequences could have positive or negative repercussionson the community's diet (Ge et al., 2001).

In this study, the prevalence of obesity is higher among Saudi students (68.4%) compared to non-Saudi students (31.6%). According to the Saudi General Authority for Statistics, the total number of non-Saudis in 2018 was 12 million, representing a large percentage of the Saudi population of 33 million (AlEnazi et al., 2023). The findings of the current study show that Saudi children have a significantly higher rate of overweight/obesity. The prevalence of both obesity and overweight is significantly loweramong non-Saudi children compared to Saudi children (AlEnazi et al., 2023). The differences in nationalities and cultures of non-Saudis living in Saudi Arabia play a significant role in these findings. Another school-based study that used the Saudi growth reference found that the prevalence of obesity was slightly lower among non-Saudi children compared to Saudi children. In comparison, the prevalence of overweight was marginally higher among non-Saudi children (Gordon-Larsen et al., 2010).

CH.6 – CONCLUSION

The results of the study provide alarming evidence-based data on the considerable prevalence of childhood overweight and obesity among amongst high school female students, mainly in the Dammam and Khobar areas of Saudi Arabia, as well as the variables related to the condition. This study's outcomes contribute to the current body of information about obesity among teenagers in Saudi Arabia and provide insights into the possible risk factors contributing to this problem. The present study identified several lifestyle factors associated with obesity that may represent valid targets for the prevention and management of obesity among Saudi adolescents.

Our research highlights the concerning prevalence of OW/OB among female students in the Dammam and Khobar areas. These findings align with global trends and emphasize the need for effective policies and interventions. We have identified several influential factors such as SDF, including the education level of students' parents, their mode of transportation to school, their family's financial situation, the type of school they attend, and their living arrangements with their parents, all of which can impact a student's BMI. These findings emphasize the need for targeted interventions to reduce childhood and adolescent obesity by addressing demographic, socioeconomic, and lifestyle factors.

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