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Obesity and Chronic Disease Burden among Primary Health Care Attendees in Al-Khobar, Saudi Arabia: A Cross-Sectional Analysis

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Abstract Obesity represents a major public health concern in Saudi Arabia, with increasing rates influenced by urbanization, lifestyle changes, and dietary habits. This study aimed to determine the prevalence of obesity and its associated chronic disease burden among clients attending primary health care centers (PHCs) in Al-Khobar and to explore associated demographic and clinical determinants. **Methods:** A retrospective cross-sectional study was conducted in August 2023 using data extracted from the national electronic health record platform (Raqeem). A total of 300 participants from ten randomly selected PHCs in Al-Khobar were included. Data on body mass index (BMI), age, gender, marital status, and comorbidities such as diabetes, hypertension, dyslipidemia and thyroid disorders were analyzed. Statistical associations were tested using chi-square analysis. **Results:** Among the 300 participants (51.7% females and 48.3% males), 32.7% were obese, 22% overweight, and 45.3% within the normal BMI range. Significant associations were found between obesity and age group, marital status, hypertension, type II diabetes, and hypothyroidism ($p < 0.01$). Females exhibited higher rates across all obesity classes, particularly in Class I and II categories. **Conclusion:** Obesity is highly prevalent among PHC attendees in Al-Khobar, particularly among women and middle-aged adults. The findings underscore the need for targeted, gender- and age-specific public health interventions and early screening strategies integrated within primary health care services to mitigate obesity-related comorbidities.

Keywords: *Obesity prevalence, Diabetes, Hypertension, Hypothyroidism, Primary Health Care, Saudi Arabia*

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1. Introduction

Obesity is recognized as a critical global public health challenge. According to the World Health Organization [1], global obesity rates have nearly tripled since 1975, with more than 650 million adults currently classified as obese [2]. The WHO defines obesity as "abnormal or excessive fat accumulation that may impair health," typically measured using the Body Mass Index (BMI) [3].

In Saudi Arabia obesity prevalence has increased markedly over the past two decades with recent national surveys showing that nearly one in three adults is obese, and women are disproportionately affected [4]. The condition has become a major contributor with the country's non-communicable disease burden and healthcare expenditure, estimated at nearly 9.5% of GDP [5]. Reducing obesity rates by 3% is one of the Vision 2030 health targets aimed at improving quality of life and extending life expectancy [6].

Multiple determinants contribute to this epidemic, including sedentary lifestyles, high-calorie diets, genetic predisposition, and sociocultural norms that limit physical activity, especially among women [6,7,8,9,10]. Urbanization and higher income levels have further intensified the problem [8,10,11,12]. Obesity also carries serious health consequences, including an increased risk of cardiovascular disease, type 2 diabetes, musculoskeletal disorders, and certain cancers, highlighting its dual impact on public health and economic sustainability [3,12,13,14].

Despite growing national attention, region-specific data from the Eastern Province remain limited. Al-Khobar, a rapidly urbanizing area with diverse demographics, offers a relevant setting to assess obesity trends and related comorbidities. This study therefore aims to determine the prevalence of obesity among patients attending primary health care centers in Al-Khobar and to examine demographic and clinical factors associated with obesity. The findings are intended to guide targeted prevention and

management strategies consistent with Vision 2030 objectives.

1.2. Rationale

Despite numerous national studies [8,9,10,11,15], localized data on obesity prevalence and its associated comorbidities remain limited in the Eastern Province, particularly in Al-Khobar. This study aims to assess the prevalence of obesity and related chronic conditions among clients attending primary health care centers in Al-Khobar, providing region-specific insights that can inform preventive strategies aligned with Saudi Vision 2030.

2. Methodology

This descriptive, retrospective cross-sectional study was conducted to determine the prevalence of obesity among clients who visited Primary Health Care Centers (PHCs) in Al-Khobar, Eastern Province, Saudi Arabia, during August 2023.

2.1. Data Collection

Data were retrospectively extracted in February 2025 from the national electronic health records platform (Raqeem). A multi-stage random sampling strategy was employed to ensure representative and unbiased selection of participants.

Data extracted for analysis included patients' Body Mass Index (BMI) history, demographic characteristics (age, sex, and place of residence), and medical history of comorbidities. These variables were utilized to stratify patients and assess the prevalence of obesity in both adult and paediatric populations.

2.2. Participants

The study population consists of patients who attended any of the ten selected PHCs in AL-Khobar during the identified dates in August 2023 and met the inclusion criteria.

2.3. Inclusion and Exclusion Criteria

Individuals of all age groups who visited primary health care centers (PHCs) in Al-Khobar, Eastern Province, Saudi Arabia, during August 2023. To ensure the relevance and accuracy of the findings, only residents of Al-Khobar were considered eligible. Certain groups were excluded to minimize confounding factors. These included pregnant women, as pregnancy can significantly affect body weight and BMI; individuals who do not reside in Al-Khobar; and patients seen at the Specialty Clinics in Al-Aqrabiyah, given its specialized services that differ from the general PHC population and could introduce selection bias.

2.4. Sample Size and Sampling Method

A multi-stage random sampling method was employed to ensure a representative and unbiased sample of the study population. The sampling process began with the random selection of calendar dates during August 2023. On each of these selected dates, clients were drawn from the ten participating primary health care centers (PHCs) in Al-Khobar. The random selection used National Identification Numbers (NINs) to ensure objectivity and reduce the risk of selection bias. In cases where selected patients had incomplete data for the specified date and PHC, they were replaced by the next eligible individual in the sampling list who met the inclusion criteria and had complete records available.

2.5. Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) at the Al-Khobar Research Unit. To ensure confidentiality, all data w stored in a password-protected Excel sheet accessible only to authorized study investigators. The original dataset, which contains patient identifiers, was stored separately from the anonymized dataset used for analysis.

Each participant was assigned a randomly generated code to de-identify the data. In the event of discrepancies or the need for data auditing, the Principal Investigator (PI) maintained two separate, secure files: one linking NINs to codes (for IRB use only) and another containing only de-identified data.

3. Results

3.1. Age and Gender Distribution

A total of 300 patients were included in the study, consisting of 145 males (48.3%) and 155 females (51.7%). The age distribution across gender is detailed in Table 1.

The majority of participants were in the 19–44 years age group (46.7%), followed by the 45–60 years group (18%) and the 2–12 years group (12.7%). Infants (0–1 years) comprised the smallest proportion of the sample (5%).

A Chi-square test of independence was performed to examine the relationship between age group and gender. The test revealed a statistically significant association between gender and age distribution ($p = 0.001$), indicating that gender representation varied significantly across different age categories.

Table 1. Age Group by Gender

Age Group	Gender		Total
	Male	Female	
0-1 yrs	5	10	15
2-12 yrs	19	19	38
13-18 yrs	11	13	24
19-44 yrs	67	73	140
45-60 yrs	23	31	54
>60 yrs	15	14	29
Total	145	155	300

3.2. Health Status Distribution by Gender

Table 2 summarize health status characteristics of

participants. A total of 300 participants were included, comprising 145 males (48.3%) and 155 females (51.7%), indicating a slightly higher representation of females. The age distribution revealed that the largest proportion of participants were aged 19–44 years (46.7%), followed by those aged 45–60 years (18%), reflecting a predominantly younger to middle-aged cohort.

A statistically significant association was observed between gender and age group (χ^2 test, p = 0.001), suggesting that the gender distribution varied significantly across different age categories. This finding implies potential demographic influences that may affect health status and risk factors, including obesity, among the studied population.

3.2.1. Obesity Classification

Among the total sample, 136 participants (45.3%) were classified as having normal BMI, while 66 (22%) were overweight, and 98 (32.7%) were obese, including Class I, II, III and super-obesity. Females showed higher rates of Class I (36 vs. 21), Class II (15 vs. 9), and Class III obesity (11 vs. 5) compared to males. However, the gender difference in obesity classification was statistically significant (p = 0.055).

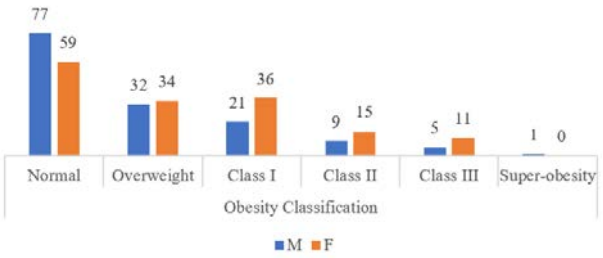

Figure 1. BMI Classification by Gender

The analysis of conditions among the study population revealed notable patterns in prevalence and gender distribution. Hypertension emerged as the most prevalent comorbidity, identified in 40 participants (13.3%). A statistically significant gender difference was observed (p < 0.01), with a higher number of cases among females (n = 17). Type I diabetes mellitus (DMI), though infrequent, was present in 3 participants (1%), and notably, this condition exhibited a significant difference between genders (p < 0.01), suggesting potential underlying biological or healthcare-seeking behaviour differences.

Type II Diabetes Mellitus (DM II) was reported in 50 participants (16.7%), representing the second most common comorbidity. However, in contrast to DM I and hypertension, the prevalence of DM II did not differ significantly between male and female participants (p = 0.87), indicating a more uniform distribution across genders in this population. Hypothyroidism was observed in 14 participants (4.7%), with a highly significant gender disparity (p < 0.01); 13 of the 14 cases were found in females, underscoring a well-established gender predisposition.

Other conditions were less prevalent. Dyslipidemia was reported in 19 participants (6.3%) and did not show a statistically significant difference between genders (p = 0.272). Similarly, depression was identified in only 3 participants (1%), with no significant gender variation (p = 0.954). Hyperthyroidism was the least common comorbidity, affecting just one female participant (0.3%), and the difference was not statistically significant (p<0.01). These findings highlight the gender-specific distribution of certain chronic conditions and underscore the importance of targeted screening and management strategies in PHC settings.

3.2.2. Health Status

Table 2 presents the medical history of participants. Most participants, 214 individuals (71.3%), were medically free, with no diagnosis of any chronic health condition. The comparison between genders showed no statistically significant difference in the proportion of medically free individuals, as indicated by a p-value of 0.986. This suggests that the prevalence of being medically free was similar among males and females in the study population.

Table 2. Health Status Distribution by Gender

Health Condition		Gender		Total	P Value
		M	F		
Obesity Classification	Normal	77	59	136	p=0.055
	Overweight	32	34	66	
	Class I	21	36	57	
	Class II	9	15	24	
	Class III	5	11	16	
	Super-obesity	1	0	1	
Total		145	155	300	
Medically free	No	41	45	86	p=0.986
	Yes	104	110	214	
Total		145	155	300	
Hypertension	No	128	132	260	P<0.01
	Yes	17	23	40	
Total		145	155	300	
Diabetes Mellitus Type I	No	143	154	297	P<0.01
	Yes	2	1	3	
Total		145	155	300	
Diabetes Mellitus Type II	No	118	132	250	P=0.87
	Yes	27	23	50	
Total		145	155	300	
Hyperthyroidism	No	145	154	299	p=1.000
	Yes	0	1	1	
Total		145	155	300	
Dyslipidemia	No	133	148	281	p=0.272
	Yes	12	7	19	
Total		145	155	300	
Hypothyrodism	No	144	142	286	P<0.01
	Yes	1	13	14	
Total		145	155	300	
Depression	No	143	154	297	p=0.954
	Yes	2	1	3	
Total		145	155	300	

Table 3 illustrates the distribution of chronic diseases across different obesity classifications among the 300

participants. It shows that certain chronic diseases are more prevalent in higher BMI categories. Hypertension was present in 40 individuals (13.3%). Among them, 13 (32.5%) were Class I obese, 5 (12.5%) were Class II, and 6 (15%) were Class III obese. Type 2 Diabetes Mellitus (DM II) was found in 50 individuals (16.7%), with 15 (30%) classified as Class I obese, 4 (8%) as Class II, and 6 (12%) as Class III obese. Hypothyroidism affected 16 participants (5.3%).

Notably, 8 (50%) of them were Class I obese or higher. Dyslipidemia was seen in 19 individuals (6.3%), of whom 9 (47.4%) were obese (Class I or higher). Depression was rare, affecting only 3 individuals (1%), with no clear association with obesity levels. Type 1 Diabetes Mellitus (DM I) and Hyperthyroidism were also rare (each affecting 4 and 1 individuals, respectively), showing minimal distribution among obesity categories. Overall, obesity classification correlates positively with the presence of hypertension, DM II, hypothyroidism, and dyslipidemia. These findings suggest that as BMI increases, the risk for these comorbidities also increases, underlining the public health burden of obesity in Al Khobar. Table 4 presents the distribution of obesity classifications among male and female participants according to age group and marital status. A total of 300 individuals were assessed, 155 females and 145 males.

Among females, the prevalence of overweight and obesity combined was 54.2%, with 21.9% classified as overweight (BMI 25–29.9 kg/m²) and 32.3% classified as obese (BMI ≥30 kg/m²). Among males, the overall prevalence of obesity was 46.9%, comprising 22.1% overweight (BMI 25–29.9 kg/m²) and 24.8% obese (BMI ≥30 kg/m²). Non-obese participants (BMI <25 kg/m²) accounted for 38% of females and 53.1% of males. Across both sexes, the 19–44 years age group exhibited the highest prevalence of overweight and obesity, representing the largest proportion of participants (47% of females and 46.2% of males. Within this age group, females accounted for 58.8% of all overweight cases, 52.7% of Class I obesity, 60.0% of Class II obesity, and 63.6% of Class III obesity.

On the other hand, male patients accounted for 40.6% of all overweight cases, 47.6% of Class I obesity, 66.7% of Class II obesity, and 80.0% of Class III obesity. In contrast, children aged 0–12 years of both sexes showed no cases of overweight or obesity, accounting for 37.5% of non-obese males and 40.5% of non-obese females.

Among elderly males, obesity was also present across all classes and notably included the only recorded case of super obesity, representing 100% of that category. Although severe obesity occurred exclusively in older males, its overall prevalence remained lower compared to that observed in young adult males.

Table 3. Disease and Obesity Classification Distribution

Obesity classification		Non-Obese (<25)	Overweight (25-29.9)	Class I Obese (30-34.9)	Class II (≥35)	Class III (≥40)	Total
Hypertension	No	130	56	44	19	11	260
	Yes	6	10	13	5	6	40
	Total	136	66	57	24	17	300
DM I	No	134	65	56	24	17	296
	Yes	2	1	1	0	0	4
	Total	136	66	57	24	17	300
DM II	No	128	49	42	20	11	250
	Yes	8	17	15	4	6	50
	Total	136	66	57	24	17	300
Hyperthyroidism	No	135	66	57	24	17	299
	Yes	1	0	0	0	0	1
	Total	136	66	57	24	17	300
Dyslipidemia	No	133	61	54	21	15	284
	Yes	3	5	3	3	2	15
	Total	136	66	57	24	17	300
Depression	No	134	66	56	24	17	297
	Yes	2	0	1	0	0	3
	Total	136	66	57	24	17	300

Table 4. Age, Gender, and Marital Status Distribution with Obesity Classification

Age Group / Marital Status	Gender	Non-Obese BMI < 25	Overweight BMI 25–29.9	Class I BMI 30–34	Class II BMI≥35–39.9	Class III BMI≥40–49.9	Super-Obesity BMI>49.9	Total
Gender	F	n 59	n 34	n 36	n 15	n 11	n 0	n 155
	M	n 77	n 32	n 21	n 9	n 5	n 1	n 145
0-1	F	5	0	0	0	0	0	5
	M	10	0	0	0	0	0	10
2–12	F	19	0	0	0	0	0	19
	M	19	0	0	0	0	0	19

Age Group / Marital Status	Gender	Non-Obese BMI < 25	Overweight BMI 25–29.9	Class I BMI 30–34	Class II BMI≥35–39.9	Class III BMI≥40–49.9	Super-Obesity BMI>49.9	Total
13-18	F	10	1	0	2	0	0	13
	M	8	2	1	0	0	0	11
19-44	F	18	20	19	9	7	0	73
	M	34	13	10	6	4	0	67
45-60	F	6	7	13	3	2	0	31
	M	5	10	6	2	0	0	23
>60	F	1	6	4	1	2	0	14
	M	1	7	4	1	1	1	15
Total	F	59	34	36	15	11	0	155
	M	77	32	21	9	5	1	145
Single		105	18	16	4	8	0	151
Married		31	45	38	17	8	1	140
Divorced		0	3	2	3	0	0	8
Widowed		0	0	1	0	0	0	1
Total		136	66	57	24	16	1	300

The distribution of obesity classifications across different marital status categories in the sample of 300 individuals. Among single individuals (n 151), the majority were within the normal BMI range (n 105; 69.5%), followed by smaller proportions in overweight (n 18; 11.9%), Class I obese (n 16; 10.6%), and Class III obese (n 8; 5.3%) categories. In contrast, among married participants (n 140), a lower percentage fell within the normal BMI range (n 31; 22.1%), with higher proportions classified as overweight (n 45; 32.1%) and Class I obese (n 38; 27.1%). Notably, married individuals showed the highest counts in both Class II (n 17) and Class III (n 8) obesity groups, with one individual classified as super-obese. Divorced (n 8) and widowed (n 1) individuals comprised a small proportion of the sample. Among divorced participants, a minor distribution was observed across overweight (n 3), Class I (n 2), and Class II (n 3) categories. The only widowed individual was classified under Class I obesity.

Overall, distribution patterns suggest a trend where married individuals exhibit a higher prevalence of overweight and obesity (especially Class I and II), but single individuals tend to fall within the normal weight category. These findings highlight a possible association between marital status and BMI classification in the studied population.

Table 5 presents the results of the chi-square analysis assessing the association between obesity classification and a range of demographic and clinical variables. The findings indicate that several variables demonstrated statistically significant associations with obesity classification.

A highly significant association was found between age group and obesity classification ($\chi^2 = 124.5$, df = 25, $p < 0.00001$), suggesting that obesity prevalence varied considerably across different age categories. Likewise, marital status was significantly associated with obesity ($\chi^2 = 87.77$, df = 15, $p < 0.01$), indicating that individuals' marital status may influence their obesity risk.

Among the clinical variables examined, type 2 diabetes mellitus showed a strong and statistically significant association with obesity classification ($\chi^2 = 23.38$, df = 4, $p = 0.0001$), supporting its well-established link with obesity. Similarly, significant associations were observed for hypertension ($\chi^2 = 22.25$, df = 4, $p = 0.0002$) and hypothyroidism ($\chi^2 = 23.7$, df = 4, $p = 0.0001$), both of which are commonly reported comorbidities in obese individuals.

Table 5. Association of Obesity with Demographic Variables

Variable	Chi-square	df	P value
Age group	124.5	25	<0.00001
Gender	10.82	5	0.055
Marital status	87.77	15	<0.01
DMI	0.67	4	0.9553
DM II	23.38	4	0.0001
Hypertension	22.25	4	0.0002
Hyperthyroidism	1.21	4	0.8765
Hypothyroidism	23.7	4	0.0001
Dyslipidemia	6.04	4	0.1961
Depression	1.71	4	0.7884

On the other hand, gender did not reach statistical significance ($\chi^2 = 10.82$, df = 5, $p = 0.055$), although it was near the conventional threshold and may suggest a potential trend. No significant associations were found between obesity classification and DMI ($\chi^2 = 0.67$, df = 4, $p = 0.9553$), hyperthyroidism ($\chi^2 = 1.21$, df = 4, $p = 0.8765$), dyslipidemia ($\chi^2 = 6.04$, df = 4, $p = 0.1961$), or depression ($\chi^2 = 1.71$, df = 4, $p = 0.7884$).

These findings highlight that age, marital status, type 2 diabetes, hypertension, and hypothyroidism are significantly associated with obesity classification among the study population, underscoring the complex interplay between demographic and clinical factors in the development and progression of obesity.

4. Discussion

This study investigated the prevalence of obesity among patients attending primary health centers in Al-Khobar, Saudi Arabia, using a representative sample collected retrospectively through the national Raqeem electronic health records system. With a total of 300 participants, the study revealed patterns consistent with national and international trends, reinforcing the growing burden of obesity in urban Saudi communities. These

findings mirror national prevalence estimates and align with [5], that demonstrated the significant economic burden of obesity on the Saudi healthcare system.

The majority of participants were Saudi nationals (82%), and females represented a slight majority (51.6%). The age group 19–44 years accounted for nearly half of the study population and showed the highest prevalence of overweight and obesity across both genders. Males were more likely to be overweight (BMI 25.0–29.9), while females had higher representation in Class I (30.0–34.9 kg/m²), Class II (35.0–39.9 kg/m²), and Class III (≥40.0 kg/m²) obesity categories [8,9,13]. This gender-based disparity aligns with previous findings in Saudi Arabia, which suggest that cultural, behavioral, and physiological factors may contribute to the higher prevalence of obesity among women [8,9,16, 17].

A key finding of this study is the strong association between age and BMI. Excessive weight starts accumulating early, at teen and young adulthood years, which aligns with findings from other studies on Saudi young populations [18,19,20,21]. The prevalence of obesity increased significantly with age, particularly among individuals aged 45–60 years, indicating age as a major risk factor. A statistically significant relationship was observed between age group and gender distribution ($p = 0.001$), with middle-aged adults (19–44 and 45–60 years) bearing the highest burden of overweight and obesity. This trend is consistent with global literature suggesting that metabolic rate, physical activity, and hormonal changes contribute to weight gain with aging [4,12,13].

4.1. Comorbidities and Risk Associations

Comorbid conditions, particularly hypertension and type II diabetes mellitus, were commonly observed among obese individuals. Hypertension affected 13.3% of participants and showed a statistically significant difference between genders ($p < 0.01$), while type II diabetes mellitus was present in 16.7% of the sample. Hypothyroidism was also significantly associated with gender ($p < 0.01$), with 13 of the 14 cases occurring in females, reflecting a well-established female predisposition to thyroid disorders. Furthermore, hypertension ($p < 0.01$) and Type I diabetes mellitus demonstrated significant associations with gender, with females exhibiting higher prevalence rates ($p < 0.01$).

The distribution of chronic diseases across obesity classifications confirmed a positive correlation between increasing BMI and the occurrence of hypertension, Type II diabetes mellitus, hypothyroidism, and dyslipidemia, suggesting that higher obesity classes may serve as a predictor of multimorbidity.

Although depression and dyslipidemia were identified in a subset of participants, these conditions did not show statistically significant associations with BMI categories in this sample. However, their presence highlights the multifactorial burden of obesity and the need for integrated chronic disease management within primary healthcare settings. These findings are supported by a recent study conducted in Al-Khobar among patients with type 2 diabetes [20], which aligns with other local findings that reported high rates of obesity and cardiovascular risk factors [12,16,22].

4.2. Interpretation and Public Health Implications

The findings from this study highlight the substantial burden of obesity in Al-Khobar, particularly among younger and middle-aged adults. The disparity in obesity classification points to the importance of tailoring prevention strategies by sex and age group. Gender also demonstrated a near-significant trend ($p = 0.055$), with females exhibiting higher rates across all obesity classes, particularly in Class I and Class II obesity categories. These age cohorts represented the majority of Class I–III obesity cases, reinforcing the need for early intervention during working-age adulthood.

This finding aligns with existing literature citing sociocultural and physiological determinants of elevated obesity prevalence among women in Saudi Arabia [6,8,10,12]. The analysis of marital status further revealed that married individuals exhibited significantly higher rates of overweight and obesity, particularly in Class I and Class II categories, compared to their single counterparts. This trend supports previously reported behavioral shifts in dietary and physical activity patterns post-marriage.

These findings align with the objectives of Saudi Arabia's Vision 2030, which targets a 3% reduction in obesity prevalence through lifestyle and preventive initiatives. Given the substantial national expenditure attributed to obesity [5], implementing early interventions and lifestyle programs at the primary care level could significantly reduce long-term healthcare costs and improve population well-being.

The study reinforce obesity as a gateway condition for non-communicable diseases (NCDs). This is consistent with global evidence from the WHO, which identifies obesity as a major risk factor for cardiovascular disease, diabetes, and premature mortality [3]. The high prevalence of hypertension and diabetes among overweight and obese individuals underscores the urgency of implementing robust screening programs and early lifestyle interventions at the primary care level [3].

5. Strengths and Limitations

One strength of this study lies in its use of real-world data from the Raqeem system, ensuring accuracy and representativeness. The application of multi-stage random sampling enhanced the generalizability of findings within Al-Khobar. However, several limitations must be acknowledged. The cross-sectional design restricts causal inference. Additionally, the study excluded pregnant women and patients from specialty clinics, which may underestimate the overall burden. Certain variables, including dietary habits, physical activity, and socioeconomic data were not captured, limiting the exploration of behavioral risk factors. Future studies employing longitudinal designs and broader variable inclusion are recommended to deepen understanding of causal pathways.

6. Conclusion

This study demonstrates a substantial burden of overweight and obesity among adults attending primary health centers in Al-Khobar, with particularly elevated rates among females and middle-aged individuals. The strong associations observed between higher BMI categories and chronic conditions, such as hypertension, diabetes, and thyroid disorders, reinforce obesity as a major driver of multimorbidity in this population.

These findings underscore the need for gender- and age-sensitive public health interventions, along with strengthened preventive and screening programs within primary care. In alignment with Saudi Arabia's Vision 2030 objectives, prioritizing early lifestyle counseling, risk stratification, and integrated chronic disease management could help mitigate the long-term health and economic burden of obesity.

Future research incorporating behavioral, dietary, and socioeconomic determinants is recommended to further elucidate the drivers of obesity and to support development of more targeted, evidence-based prevention strategies.

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