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ASSOCIATION BETWEEN LIFESTYLE FACTORS, OBESITY, AND TYPE 2 DIABETES AMONG WOMEN ATTENDING FAMILY MEDICINE CLINICS IN SAUDI ARABIA: A CROSS-SECTIONAL STUDY

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Abstract

Background: Type 2 diabetes mellitus (T2DM) and obesity represent significant public health challenges in Saudi Arabia, particularly among women. This cross-sectional study examined the associations between lifestyle factors, obesity, and T2DM among women attending family medicine clinics.

Methods: A total of 486 women aged 18-65 years were recruited from family medicine clinics across three regions in Saudi Arabia. Data were collected through structured questionnaires, anthropometric measurements, and clinical assessments. Lifestyle factors assessed included dietary habits, physical activity, sleep patterns, and stress levels. Statistical analyses included chi-square tests, t-tests, and multivariable logistic regression.

Results: The prevalence of obesity (BMI ≥30 kg/m²) was 42.8%, while T2DM prevalence was 23.5%. Sedentary behavior (OR=2.45, 95% CI: 1.68-3.57, p<0.001), poor dietary quality (OR=1.92, 95% CI: 1.34-2.75, p<0.001), and inadequate sleep (<7 hours) (OR=1.58, 95% CI: 1.12-2.23, p=0.009) were significantly associated with obesity. Obese women had 3.2 times higher odds of having T2DM (95% CI: 2.18-4.69, p<0.001). After adjusting for obesity, low physical activity (OR=1.76, 95% CI: 1.21-2.56, p=0.003) and high sugar consumption (OR=1.84, 95% CI: 1.28-2.65, p=0.001) remained independent predictors of T2DM.

Conclusions: Lifestyle factors are strongly associated with both obesity and T2DM among Saudi women. Targeted interventions addressing physical activity, dietary habits, and sleep patterns are urgently needed to reduce the burden of these conditions.

Keywords: Type 2 diabetes, obesity, lifestyle factors, women's health, Saudi Arabia, cross-sectional study

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has emerged as one of the most pressing public health challenges worldwide, with the International Diabetes Federation estimating that 537 million adults were living with diabetes in 2021, projected to reach 783 million by 2045 (Chandrasekaran & Weiskirchen, 2024). The burden is particularly pronounced in the Middle East, where rapid socioeconomic development has led to dramatic lifestyle transitions. Saudi Arabia exemplifies this epidemic, with diabetes prevalence among the highest globally, affecting approximately 18.5% of the adult population (Al Jarad et al., 2025).

Women in Saudi Arabia face unique challenges in managing metabolic health. Cultural norms, limited opportunities for physical activity, and changing dietary patterns have contributed to increasing rates of obesity and diabetes among this population (Kassaw et al., 2024). The intersection of gender-specific biological factors, such as hormonal fluctuations and pregnancy-related metabolic changes, with sociocultural constraints creates a complex risk profile that requires targeted investigation (Ko et al., 2025).

Obesity serves as the most significant modifiable risk factor for T2DM development. Approximately 85% of individuals with T2DM are overweight or obese, with excess adiposity contributing to insulin resistance through multiple mechanisms including chronic inflammation, lipotoxicity, and altered adipokine secretion (Chandrasekaran & Weiskirchen, 2024). In Saudi Arabia, the obesity epidemic has reached alarming proportions, with recent studies reporting prevalence rates exceeding 40% among women (AlShahrani, 2021).

The pathophysiological relationship between obesity and T2DM is well-established. Excess adipose tissue, particularly visceral fat, promotes insulin resistance through the release of inflammatory cytokines such as TNF-α and IL-6, while simultaneously reducing adiponectin levels (Chandrasekaran & Weiskirchen, 2024). This inflammatory milieu disrupts normal glucose homeostasis and β-cell function, ultimately leading to the development of T2DM. Furthermore, ectopic fat deposition in the liver and muscle tissue exacerbates metabolic dysfunction, creating a vicious cycle of worsening insulin resistance (Abdulaziz Alrashed et al., 2023).

Lifestyle factors play a crucial role in both obesity development and diabetes risk. Physical inactivity, prevalent among Saudi women due to cultural and environmental constraints, significantly contributes to weight gain and metabolic dysfunction. Studies have shown that regular physical activity can reduce T2DM risk by 30-50%, independent of weight loss, through improvements in insulin sensitivity and glucose uptake (Taousani et al., 2025). However, opportunities for women to engage in physical activity remain limited in many Saudi communities, with only 17% meeting WHO recommendations for physical activity (Al Jarad et al., 2025).

Dietary transitions in Saudi Arabia have been particularly dramatic. The traditional diet, rich in dates, whole grains, and lean proteins, has been increasingly replaced by Western-style fast food, sugar-sweetened beverages, and processed foods (Kassaw et al., 2024). This dietary shift has been associated with increased caloric intake, higher glycemic loads, and reduced fiber consumption, all of which contribute to obesity and diabetes risk. Studies from the region indicate that frequent consumption of fast food (>3 times per week) is associated with a 2.5-fold increased risk of T2DM (AlShahrani, 2021).

Sleep patterns and stress management represent often-overlooked components of metabolic health. Chronic sleep deprivation, defined as less than 7 hours per night, has been associated with increased diabetes risk through mechanisms including altered cortisol rhythms, increased sympathetic nervous system activity, and disrupted glucose metabolism (Moon et al., 2023). Similarly, chronic stress contributes to metabolic dysfunction through elevated cortisol levels and stress-induced eating behaviors (Richter et al., 2025).

The family medicine clinic setting provides a unique opportunity to study these associations in a real-world clinical context. These clinics serve as the primary point of contact for many Saudi women seeking healthcare, offering access to a diverse population across different socioeconomic backgrounds (Yong et al., 2020). Understanding the specific risk factors and lifestyle patterns in this population is essential for developing targeted interventions that are both culturally appropriate and clinically effective.

Recent studies have highlighted concerning trends in metabolic health among Saudi women. The National Health Survey reported that 65% of Saudi women are either overweight or obese, with central obesity particularly prevalent (Abdulaziz Alrashed et al., 2023). Moreover, the age of diabetes onset has been decreasing, with increasing numbers of women developing T2DM during their reproductive years, which has significant implications for maternal and child health (Taousani et al., 2025).

Cultural factors significantly influence health behaviors among Saudi women. Gender segregation in public spaces, limited female-only exercise facilities, and cultural preferences for indoor activities all contribute to sedentary lifestyles (Ko et al., 2025). Additionally, social gatherings often center around

food, with cultural norms encouraging generous hospitality through elaborate meals and sweets, making dietary modification challenging (Kassaw et al., 2024).

The economic burden of diabetes in Saudi Arabia is substantial, with annual costs estimated at over 17 billion Saudi Riyals, representing approximately 20% of the total health expenditure (Al Jarad et al., 2025). This economic impact, combined with the personal suffering and reduced quality of life associated with diabetes complications, underscores the urgent need for effective prevention strategies.

Despite the magnitude of this public health challenge, there remains a significant gap in gender-specific research examining the complex interplay between lifestyle factors, obesity, and diabetes among Saudi women. Most existing studies have either focused on the general population or have not adequately addressed the unique sociocultural factors affecting women's health behaviors (Richter et al., 2025). This knowledge gap hinders the development of targeted, culturally appropriate interventions.

Therefore, this study aims to comprehensively examine the associations between lifestyle factors, obesity, and T2DM among women attending family medicine clinics in Saudi Arabia. By identifying specific risk factors and their relative contributions to disease development, this research seeks to inform evidence-based interventions that can effectively address the diabetes epidemic among Saudi women.

METHODS

A cross-sectional study was conducted among adult women (≥18 years) attending family medicine clinics in urban and semi-urban regions of Saudi Arabia. Eligible participants were residents of Saudi Arabia who consented to participate; women who were pregnant, within six months postpartum, diagnosed with type 1 diabetes, cognitively impaired, or under treatment for eating disorders were excluded.

A systematic random sampling approach was applied, with every third or fourth eligible patient invited to participate. The required sample size (n ≈ 400–500) was calculated assuming a 20% prevalence of type 2 diabetes, 95% confidence level, 5% margin of error, and a design effect of 1.5 to account for clustering.

Data were collected via a structured questionnaire adapted from validated instruments, covering sociodemographic data, medical history, dietary habits, physical activity (IPAQ), sleep, and stress. Anthropometric measures (height, weight, waist circumference) were obtained following WHO protocols, and BMI was calculated. Clinical data (blood pressure, fasting glucose) were extracted from records or measured during visits.

Interviews and measurements were conducted by trained female researchers in private clinic rooms to ensure confidentiality. Instruments were calibrated daily, and duplicate measurements were taken. Ethical approval was obtained from the relevant IRB, and written informed consent was secured.

Data analysis was performed in SPSS v27. Descriptive statistics summarized sample characteristics. Chi-square and t-tests examined bivariate associations, while multivariable logistic regression identified predictors of obesity and diabetes. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 486 women participated in the study (response rate: 93.5%). The mean age was 38.4 ± 11.2 years, with most participants married (72.8%) and holding secondary education or higher (68.3%). Sociodemographic characteristics are presented in **Table 1**.

Table 1. Sociodemographic Characteristics of Study Participants (N=486)

Characteristic	n (%) or Mean ± SD
Age (years)	38.4 ± 11.2
18–29	124 (25.5)
30–39	142 (29.2)
40–49	128 (26.3)
50–65	92 (18.9)
Education Level	
Primary or less	78 (16.0)
Secondary	156 (32.1)
Diploma	98 (20.2)
University or higher	154 (31.7)
Marital Status	
Single	86 (17.7)
Married	354 (72.8)
Divorced/Widowed	46 (9.5)
Employment Status	
Employed	178 (36.6)

Unemployed	208 (42.8)
Student	42 (8.6)
Retired	58 (11.9)
Monthly Household Income (SAR)	
<5,000	96 (19.8)
5,000–10,000	142 (29.2)
10,001–15,000	128 (26.3)
>15,000	120 (24.7)
Number of Children	
None	114 (23.5)
1–2	156 (32.1)
3–4	142 (29.2)
≥5	74 (15.2)

Prevalence of Obesity and Type 2 Diabetes

The prevalence of obesity (BMI ≥30 kg/m²) was 42.8% (n=208), while 26.5% (n=129) were overweight. Central obesity was present in 48.6% (n=236). T2DM prevalence was 23.5% (n=114), and 14.2% (n=69) had prediabetes. Obese women had significantly higher BMI, waist circumference, blood pressure, fasting glucose, and HbA1c compared with non-obese women (**Table 2**).

Table 2. Anthropometric and Clinical Characteristics

Variable	Total (N=486)	Non-Obese (n=278)	Obese (n=208)	p-value
BMI (kg/m²)	29.1 ± 5.8	24.8 ± 2.6	34.8 ± 4.2	<0.001
Waist Circumference (cm)	88.4 ± 12.6	80.2 ± 8.4	99.4 ± 9.8	<0.001
Systolic BP (mmHg)	124.6 ± 15.8	120.4 ± 13.2	130.2 ± 17.4	<0.001
Diastolic BP (mmHg)	78.4 ± 10.2	76.2 ± 9.4	81.4 ± 10.6	<0.001
FPG (mg/dL)	108.6 ± 32.4	98.4 ± 24.6	122.2 ± 36.8	<0.001
HbA1c (%)	6.2 ± 1.4	5.7 ± 0.9	6.9 ± 1.6	<0.001
Type 2 Diabetes	114 (23.5%)	42 (15.1%)	72 (34.6%)	<0.001
Prediabetes	69 (14.2%)	28 (10.1%)	41 (19.7%)	0.002

Lifestyle Factors and Obesity Status

Over half of participants (58.2%) reported low physical activity, and obese women were significantly more likely to be inactive (69.7% vs. 49.6%). One-third consumed fast food ≥3 times per week, and 38.3% reported daily sugar-sweetened beverage (SSB) intake. Obese women also had higher stress scores and shorter sleep duration compared to non-obese women (**Table 3**).

Table 3. Lifestyle Factors by Obesity Status

Lifestyle Factor	Total (N=486)	Non-Obese (n=278)	Obese (n=208)	p-value
Physical Activity				<0.001
Low	283 (58.2%)	138 (49.6%)	145 (69.7%)	
Moderate	133 (27.4%)	92 (33.1%)	41 (19.7%)	
High	70 (14.4%)	48 (17.3%)	22 (10.6%)	
Daily Sitting Time (hrs)	8.2 ± 3.4	7.4 ± 3.2	9.3 ± 3.4	<0.001
Dietary Quality Score (0–9)	4.8 ± 2.1	5.4 ± 2.0	4.0 ± 1.9	<0.001
Fast Food Consumption				0.002
Never/Rarely	142 (29.2%)	96 (34.5%)	46 (22.1%)	
1–2 times/week	198 (40.7%)	112 (40.3%)	86 (41.3%)	
≥3 times/week	146 (30.0%)	70 (25.2%)	76 (36.5%)	
Sugar-Sweetened Beverages				<0.001
Daily	186 (38.3%)	86 (30.9%)	100 (48.1%)	
Weekly	174 (35.8%)	104 (37.4%)	70 (33.7%)	
Rarely/Never	126 (25.9%)	88 (31.7%)	38 (18.3%)	
Sleep Duration				0.009
<7 hours	194 (39.9%)	98 (35.3%)	96 (46.2%)	
7–9 hours	246 (50.6%)	152 (54.7%)	94 (45.2%)	
>9 hours	46 (9.5%)	28 (10.1%)	18 (8.7%)	
Perceived Stress Score	18.6 ± 6.2	17.4 ± 5.8	20.2 ± 6.4	<0.001

Factors Associated with Obesity

In multivariable logistic regression, low physical activity (OR=2.45, 95% CI: 1.68–3.57), poor dietary quality (OR=1.92, 95% CI: 1.34–2.75), daily SSB consumption (OR=1.56, 95% CI: 1.10–2.21), and

inadequate sleep (<7 hours) (OR=1.58, 95% CI: 1.12–2.23) were significant independent predictors of obesity (**Table 4**).

Table 4. Multivariable Logistic Regression Analysis for Factors Associated with Obesity

Variable	Unadjusted OR (95% CI)	p-value	Adjusted OR* (95% CI)	p-value
Physical Activity				
High (ref)	1.00		1.00	
Moderate	0.97 (0.54–1.76)	0.932	1.12 (0.58–2.16)	0.734
Low	2.29 (1.63–3.22)	<0.001	2.45 (1.68–3.57)	<0.001
Dietary Quality				
Good (7–9) (ref)	1.00		1.00	
Moderate (4–6)	1.42 (0.96–2.10)	0.078	1.38 (0.91–2.09)	0.128
Poor (0–3)	2.14 (1.52–3.01)	<0.001	1.92 (1.34–2.75)	<0.001
Fast Food ≥3/week	1.68 (1.21–2.33)	0.002	1.45 (1.02–2.06)	0.038
Daily SSB	1.89 (1.37–2.61)	<0.001	1.56 (1.10–2.21)	0.013
Sleep <7 hrs	1.72 (1.24–2.38)	0.001	1.58 (1.12–2.23)	0.009
High Stress (PSS ≥20)	1.64 (1.19–2.26)	0.002	1.42 (1.01–2.00)	0.044

*Adjusted for age, education, marital status, employment, income, and number of children

Relationship Between Obesity and Type 2 Diabetes

T2DM prevalence was significantly higher among obese women (34.6%) compared to non-obese women (15.1%, p<0.001). Obesity was associated with a threefold increased risk of diabetes (unadjusted OR=3.20, 95% CI: 2.18–4.69), which remained significant after adjusting for age and family history (adjusted OR=2.84, 95% CI: 1.89–4.27). Hierarchical logistic regression results are summarized in **Table 5**.

Table 5. Hierarchical Logistic Regression Models for Type 2 Diabetes

Variable	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Age (per 10 yrs)	1.82 (1.48–2.24)***	1.76 (1.42–2.18)***	1.68 (1.35–2.09)***
Family History of DM	2.34 (1.68–3.26)***	2.18 (1.54–3.08)***	2.06 (1.44–2.94)***
Low Physical Activity	–	1.86 (1.29–2.68)**	1.76 (1.21–2.56)**
Poor Dietary Quality	–	1.62 (1.14–2.30)**	1.48 (1.03–2.13)*
Daily SSB	–	1.94 (1.36–2.77)***	1.84 (1.28–2.65)**
Sleep <7 hrs	–	1.38 (0.98–1.94)	1.32 (0.93–1.87)
Obesity (BMI ≥30)	–	–	2.64 (1.78–3.92)***
Nagelkerke R^2	0.156	0.248	0.312
Hosmer-Lemeshow p	0.642	0.718	0.694

*p<0.05, **p<0.01, ***p<0.001

Subgroup Analysis

Stratified analysis by age revealed that the impact of lifestyle factors on T2DM was stronger among younger women (18–39 years). For example, low physical activity was associated with an OR of 2.34 (95% CI: 1.42–3.86) in younger women, compared to 1.52 (95% CI: 0.94–2.46) in women aged 40–65 years (p for interaction = 0.042).

DISCUSSION

This study highlights the high burden of obesity (42.8%) and type 2 diabetes (23.5%) among Saudi women attending family medicine clinics. These figures are striking when compared with national averages, where pooled analyses report obesity prevalence around 35–40% and T2DM prevalence close to 18–20% in women (Alwadeai & Alhammad, 2023; Salem et al., 2022). The higher prevalence in our sample may reflect the clinic-based population, who are more likely to seek care for chronic conditions. Our finding that 42.8% of participants were obese is comparable to studies from Jeddah, which reported obesity in 47.2% of adults (Al-Raddadi et al., 2019), and Al-Khobar, where 46% of T2DM patients were obese (Jatoi et al., 2022). In Bisha, obesity prevalence among women with diabetes was even higher at 55% (AlShahrani, 2021). These variations likely reflect regional dietary patterns and socioeconomic differences.

Our diabetes prevalence of 23.5% mirrors findings from Abha (22.8%) (Al Jarad et al., 2025) and aligns with pooled estimates of 24% in meta-analyses covering 2016–2022 (Alwadeai & Alhammad, 2023). Compared to international data, these figures are considerably higher than the global prevalence of 10.5%

reported by the IDF (Chandrasekaran & Weiskirchen, 2024), underscoring the urgency of Saudi-specific interventions.

Physical inactivity was widespread, with 58.2% reporting low activity levels. This is consistent with adolescent studies in Saudi Arabia, where 60–70% of girls reported insufficient activity (Al-Hazzaa et al., 2012), and with adult surveys linking inactivity to higher obesity risk (Midhet et al., 2010). Our regression model confirmed that inactivity nearly doubled the odds of obesity (OR=2.45).

Dietary habits were equally concerning. One-third of women consumed fast food at least three times per week, while 38% reported daily sugar-sweetened beverage (SSB) intake. Similar patterns have been documented in Jeddah and Riyadh, where high consumption of processed foods and SSBs was strongly correlated with obesity and dyslipidemia (Al-Raddadi et al., 2019; Alzaheb & Altemani, 2020). Our finding that daily SSB intake increased obesity odds by 56% mirrors global data linking sugary drinks to central adiposity and metabolic risk.

Poor sleep (<7 hours per night) was reported by 40% of participants, more common among obese women (46%). Sleep deprivation has been repeatedly associated with insulin resistance and obesity in Middle Eastern populations (Moon et al., 2023). Our adjusted models confirmed inadequate sleep increased obesity risk by 58%.

We found that obese women were more than three times as likely to have diabetes (34.6% vs. 15.1%). This finding aligns with studies from Abha (Al Jarad et al., 2025) and Bisha (AlShahrani, 2021), where obesity was identified as the strongest predictor of T2DM. International evidence also shows that over 80% of T2DM patients are overweight or obese (Chandrasekaran & Weiskirchen, 2024).

Importantly, our analysis showed that even after adjusting for obesity, low activity (OR=1.76) and daily SSB consumption (OR=1.84) remained significant predictors of diabetes. This mirrors findings from a large Saudi cohort where lifestyle factors predicted complications independently of BMI (Alramadan et al., 2019). Globally, lifestyle interventions such as increased physical activity reduce diabetes incidence by 30–50%, even without major weight loss (Taousani et al., 2025).

From a practical perspective, these findings highlight three urgent intervention targets: (1) expanding opportunities for women's physical activity through culturally acceptable female-only facilities and workplace programs; (2) reducing SSB and fast food consumption via public health campaigns and fiscal measures like taxation; and (3) addressing sleep hygiene as part of diabetes prevention. Similar strategies have proven effective in countries undergoing rapid lifestyle transitions (Salem et al., 2022).

Clinical Implications

Our findings have several important clinical implications. First, the high prevalence of obesity and diabetes among women attending family medicine clinics suggests these settings are ideal for screening and intervention programs. The fact that nearly one-quarter of women already have diabetes, with an additional 14% having prediabetes, indicates that many women presenting for routine care have undiagnosed or poorly controlled metabolic conditions.

Second, the strong associations with modifiable lifestyle factors provide clear targets for intervention. Programs focusing on increasing physical activity, improving dietary quality, and addressing sleep hygiene could potentially prevent or delay diabetes onset in high-risk women. The independent effects of lifestyle factors suggest that even modest improvements in these behaviors could yield metabolic benefits, regardless of weight loss achieved.

Third, the particularly strong associations observed in younger women argue for age-tailored intervention strategies. Prevention programs for younger women might emphasize establishing healthy lifestyle habits early, while programs for older women might focus more on managing existing conditions and preventing complications.

Public Health Implications

From a public health perspective, our findings support the need for comprehensive, culturally appropriate strategies to address the obesity and diabetes epidemics among Saudi women. Policy interventions might include creating more female-only exercise facilities, implementing nutrition labeling and taxation on sugar-sweetened beverages, and developing workplace wellness programs that accommodate cultural norms.

The high prevalence of modifiable risk factors suggests substantial potential for population-level impact through lifestyle interventions. If the associations we observed are causal, reducing the prevalence of low physical activity from 58% to 30% could potentially prevent thousands of diabetes cases. Similarly, reducing sugar-sweetened beverage consumption could yield significant public health benefits.

Educational initiatives should address the specific barriers Saudi women face in adopting healthier lifestyles. This might include culturally adapted nutrition education, home-based exercise programs, and family-centered approaches that recognize women's roles in household food preparation and family health decisions.

Strengths and Limitations

This study has several notable strengths. The relatively large sample size (N=486) provides adequate statistical power for multivariable analyses. The comprehensive assessment of multiple lifestyle factors allows for examination of independent and combined effects. The use of validated instruments and

standardized measurements enhances the reliability of our findings. The multi-regional sampling improves generalizability to Saudi women attending primary care clinics.

However, several limitations must be acknowledged. The cross-sectional design precludes causal inference, and reverse causation cannot be excluded. For instance, women with diabetes may have modified their lifestyles following diagnosis. The reliance on self-reported lifestyle behaviors may introduce recall and social desirability bias, potentially underestimating unhealthy behaviors. The clinic-based sample may not represent the general population, as women attending clinics may have different health profiles than those who do not seek regular medical care.

Additionally, we did not assess certain potentially important factors such as psychological well-being, social support, or detailed medication history, which might confound or mediate the observed associations. The definition of diabetes based on available clinical data may have missed some undiagnosed cases, potentially underestimating the true prevalence.

Future Research Directions

Our findings highlight several priorities for future research. Longitudinal studies are needed to establish temporal relationships and identify trajectories of weight gain and metabolic deterioration. Intervention studies testing culturally adapted lifestyle modification programs could provide evidence for effective prevention strategies. Qualitative research exploring barriers and facilitators to healthy lifestyle adoption among Saudi women would inform intervention design.

Research examining the role of emerging risk factors, such as air pollution, endocrine disruptors, and the gut microbiome, could provide additional insights into the diabetes epidemic. Studies investigating the intergenerational transmission of metabolic risk, particularly the impact of maternal obesity and diabetes on offspring health, are crucial given the high prevalence among women of reproductive age.

Finally, implementation research examining how to effectively deliver and scale lifestyle interventions within the Saudi healthcare system would bridge the gap between evidence and practice. This might include studies of technology-based interventions, peer support programs, and integration of lifestyle counseling into routine clinical care.

CONCLUSION

This cross-sectional study provides compelling evidence of the high burden of obesity and type 2 diabetes among Saudi women attending family medicine clinics, with prevalences of 42.8% and 23.5%, respectively. The strong associations between modifiable lifestyle factors—particularly physical inactivity, poor dietary quality, and inadequate sleep—and both obesity and diabetes highlight the potential for lifestyle-based prevention strategies.

Importantly, our findings demonstrate that lifestyle factors maintain independent associations with diabetes risk even after accounting for obesity, suggesting that behavioral interventions may provide metabolic benefits beyond weight loss. The particularly strong associations observed among younger women emphasize the need for early intervention to prevent the development of metabolic disorders.

These results underscore the urgent need for comprehensive, culturally appropriate public health strategies targeting lifestyle modification among Saudi women. Such interventions should address the specific barriers women face in adopting healthier behaviors while respecting cultural norms and preferences. Family medicine clinics, given their reach and regular contact with at-risk populations, represent ideal settings for implementing screening and intervention programs.

As Saudi Arabia continues its healthcare transformation under Vision 2030, prioritizing the prevention and management of obesity and diabetes among women should be a key focus. The high prevalence of modifiable risk factors identified in this study suggests substantial potential for impact through well-designed lifestyle interventions. Ultimately, addressing these interconnected epidemics will require coordinated efforts across multiple sectors, including healthcare, education, urban planning, and food policy, to create environments that support healthy lifestyles for all Saudi women.

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