

DOI: <https://doi.org/10.63332/joph.v6i1.3865>

## The Role of Lifestyle Medicine on Obesity Management in Primary Health Care: The Integration of Digitally Based Monitoring Systems

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### Abstract

Lifestyle medicine is an evidence-based medicine that promotes comprehensive lifestyle modifications. The effective role of lifestyle medicine interventions in treating obesity is limited in Saudi Arabia. This study aims to measure the role of lifestyle medicine in obesity care through intelligent tools. **Methods:** This is a retrospective study with 419 patients in the LSM clinics of Wazarat Health Care Center in Family Medicine, Prince Sultan Military Medical City (PSMMC). The primary outcome is the change in weight parameters, including total body weight loss, waist circumference, and BMI. **Results:** A total of 419 patients were included in the current work. In 6 months of follow-up, a significant reduction in total body weight loss (TBWL) from  $93.71 \pm 13.39$  at baseline to  $87.01 \pm 13.41$  at 6 months. The absolute reduction was  $6.70 \pm 7.85$  % ( $p < 0.001$ ), waist circumference (WC), and body mass index (BMI). Data were visualized through a dashboard monitoring system. **Conclusion:** The role of lifestyle interventions has shown clinically meaningful results in obesity management and weight parameters. The use of a dashboard monitoring system may improve the quality of services in obesity care.

**Keywords:** Lifestyle Medicine, Obesity, Primary Health Care, Lifestyle Medicine Clinics, Dashboard.

### Introduction

Obesity is a major global disease that is increasing in prevalence, the associated adverse health implications, high care costs of managing the disease, and related comorbidities. Epidemiological studies have argued that there is a statistically significant association between obesity characterized by a high Body Mass Index (BMI) and multiple chronic diseases, including metabolic dysfunction-associated steatotic liver disease (MASLD), diabetes mellitus (Type 2), cardiovascular diseases, musculoskeletal diseases, mental disorders, chronic kidney disease, and multiple malignancies(1). Scholarly evidence found that over 1.9 billion adults, accounting for 39%, are overweight, while 650 million (13%) individuals globally are obese.

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In Saudi Arabia, the prevalence of obesity and overweight is 33.7% and 68.2%, respectively(2). The Obesity management guidelines recommend that individuals who are overweight (BMI 25.0–29.9 kg/m<sup>2</sup>) or with obesity (BMI 30 kg/m<sup>2</sup>) would benefit from weight loss and be advised to participate in a comprehensive lifestyle intervention for at least 6 months. The three principal components of a comprehensive lifestyle intervention (ie, diet, physical activity, and behavior therapy) produce an average weight loss of up to 8 kg in 6 months, reductions that are associated with clinically meaningful improvements in cardiovascular disease risk factors, and quality of life. The comprehensive lifestyle interventions are delivered through trained interventionists in multiple sessions to reach the targeted weight loss outcomes (3). Lifestyle medicine is an evidence-based medicine that promotes comprehensive lifestyle changes (especially about nutrition and dietary planning, physical activity and exercise intervention, stress management for behavioral changes, social interaction support, and altered environmental exposures) to prevent, effectively manage and reverse the progression of underlying chronic diseases by addressing the cause (4) Lifestyle medicine intervention has emerged as a newer discipline to enhance conventional medical management therapy while addressing lifestyle-associated disorders to bring behavioral changes toward leading a healthy life comprising of regular physical activity, balanced nutritional diet, and living a stress-free life. Thereby, lifestyle medicine targets introducing real and progressive evidence-based behavioral changes to reduce the risks of lifestyle-related acute and chronic complications of obesity (5).

Among Arab countries, Saudi Arabia is one of the leading countries in lifestyle medicine experience. In 2020, lifestyle medicine clinics were launched by the Medical Services General Directorate of the Ministry of Defense hospitals (MODHS) in Saudi Arabia to be one of the first health institutions that focuses on improving people's lifestyle. Obesity screening was a major goal of lifestyle medicine clinics (LMC), which encourage obesity treatment(6).

Monitoring, measuring, and responding to healthcare outcomes and decision metrics are essential for modern healthcare. Strategic healthcare organizations often utilize data for various operational decision-making processes, ranging from individual patient treatment planning to population health management. Healthcare organizations have increasingly employed specialized tools to collect, analyze, and evaluate organizational and patient data to identify trends such as social determinants of health that impact patients(7). A dashboard denotes a specialized business intelligence tool that employs data visualization to provide healthcare providers with actionable feedback, thus improving performance, resource utilization, and adherence to evidence-based practices(8). Dashboards display benchmarks, performance trends, and peer comparisons using visual elements and coding to improve interpretability(8,9).

Dashboards in health care can help the providers visually monitor the quality of provided care and patient access measures. Furthermore, healthcare executives may prefer dashboards to have graphic performance trends, and healthcare providers working with vulnerable patient populations may necessitate real-time and patient-level health data to allow them to timely intervene(9). Therefore, it is vital to develop dashboards tailored to the specific needs of the targeted end users to facilitate healthcare performance improvements.

This study aims to measure the effect of lifestyle medicine clinics in primary health care settings on obesity metrics for weight reduction, including total body weight loss, BMI, waist circumference, and the effect on associated metabolic changes. Also, this project will focus on the role of using the digital dashboard as a modern healthcare follow-up system.

**Methodology**

**Study design**

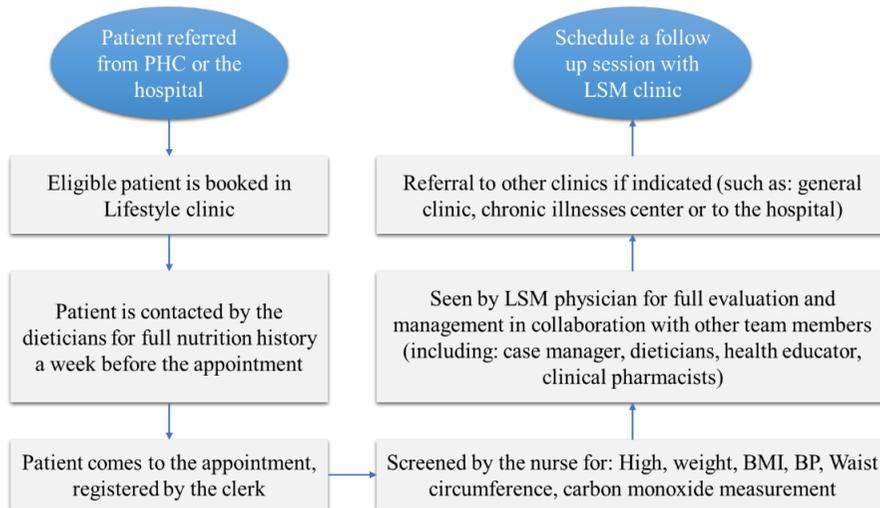
This is a retrospective study of 419 patients from the LSM clinics of Wazarat Health Care Center in family medicine at Prince Sultan Military Medical City (PSMMC) who underwent obesity management between May 2025 and November 2025.

**Participants**

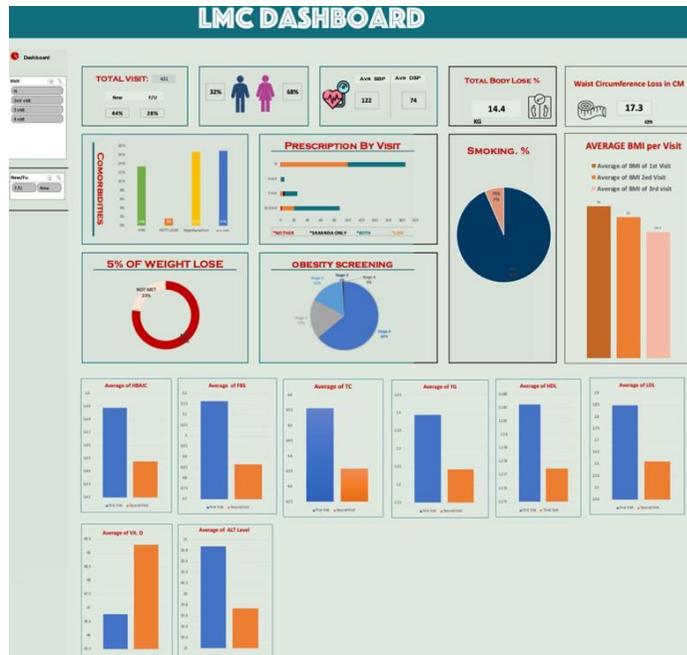
Adults with obesity (BMI 30 and above) with chronic medical conditions, including pre-diabetes, hypertension, dyslipidemia, hypothyroidism, and MASLD, were included. Patients with diabetes, unstable medical conditions such as chronic kidney disease, end-stage liver disease, heart failure, and any type of cancer were excluded. All patients were treated with behavioral therapy, which is consistent with lifestyle intervention therapy, including an individualized diet plan provided by a trained nutritionist as well as exercise programs and \ or the use of liraglutide once daily injections according to the clinical case used as an intervention. The clinical pathway with the included working team is demonstrated in Figure 1.

**Variables**

Patient information, including general characteristics, obesity metrics for every visit, obesity choice of therapy, and metabolic parameters, was registered through a digital dashboard (Figure 2). Obesity metrics, including BMI, waist circumference (WC), weight difference in kgs, and total body weight loss (TBWL), were traced through follow-up visits. Tracking such data through the use of a digital dashboard as a monitoring tool (Figure 2).



**Figure 1:** The clinical pathway inside the lifestyle medicine clinic. Ht: height, Wt: weight, BMI: body mass index, BP: blood pressure, WC: Waist circumference, CO measurement: carbon monoxide measurement.



**Figure 2:** Monitoring digital dashboard.

### Measures

#### Obesity definition

Obesity occurs when excess fat accumulates, which increases the risk for adverse health outcomes. The obesity classification system should be based on practical measurements. BMI and waist circumference (W.C), despite several limitations, provide relevant information and are easily obtained in a variety of practice settings. The international definitions of BMI are illustrated in Table 1. The W.C. is a better indicator of abdominal obesity and metabolic diseases ( Table 2). Total bodyweight loss of at least 5% is considered to be clinically meaningful in obesity management. In this study, the primary outcome was the changes in obesity metrics, including TBWL, WC, and BMI, that were measured at every visit for patients who attended LSM clinics. Secondary outcomes are the changes in metabolic parameters that were measured at each visit, including HbA1c, fasting blood glucose, blood pressure, lipid profile, and Vitamin D levels. All of these parameters were followed.

BMI	Classification
< 18.5	Underweight

18.5-24.9	Healthy
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25-29.9	Overweight
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30-39.9	Obese
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<b>BMI</b>	<b>Classification</b>
≥ 40	Morbidly obese

**Table 1: WHO classification of BMI.**

Level	Men	Women	Health risk*
Below action level 1	< 94	< 80	Low
Action levels 1 to 2	≥ 94-101.9	≥ 80-87.9	Increased
Above action level 2	≥ 102	≥ 88	High

**Table 2: Levels of health risks associated with waist circumference (cm), defined by waist circumference action levels in white men and women.**

### *Analysis*

This project utilized a descriptive analysis to present the findings. Categorical data were presented as frequencies and percentages, while continuous data were presented as mean and standard deviation (SD) or median and interquartile range (IQR), based on data normality. Study outcomes at baseline and 6-month visits were compared using a paired t-test when the data were normally distributed and a Wilcoxon signed-rank test when the data were not normally distributed. All P-values were two-tailed. A P-value of 0.05 was considered significant. SPSS (Version 25.0, Armonk, NY: IBM Corp) was used for all statistical analyses.

### *Ethics*

As this study uses de-identified patient records, no informed consent or ethical consent is required. The study protocol was approved by the Research Ethics Committee of the Prince Sultan Military Medical City to the Declaration of Helsinki 1964.

### **Results**

A total of 419 patients were included in the current analysis. Table 3 shows all the baseline characteristics. The mean age was 39.9±11.2 years, with 32.5% of the patients being below 35 years and 31.7% above 45 years. The majority (73.0%) of the patients were females.

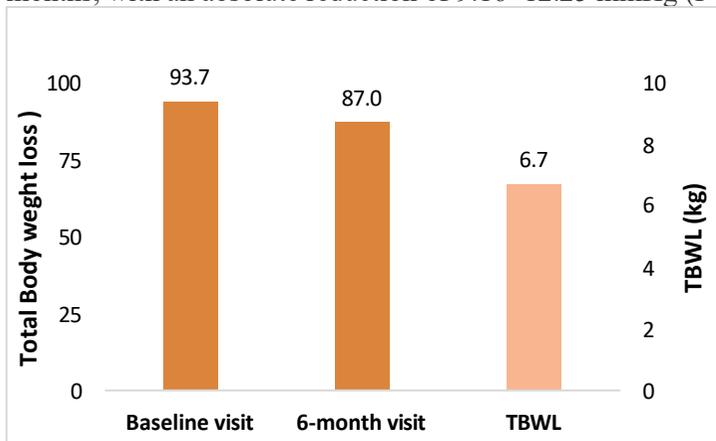
The mean body mass index (BMI) was 35.6±3.5, with 95.7% of the patients considered obese (BMI≥30) and 4.3% were considered overweight. The main comorbid diseases included pre-diabetes (15.8%), hypothyroidism (12.4%), and hypertension (8.6%). The majority (64.0%) of patients had stage zero at the Edmonton obesity scoring system (EOSS), while 23.4% had stage only 12.6% had stage 2 or higher. Approximately 25.8% of the patients were on a diet, 23.6% were doing exercises, and 29.6% were either on a diet or doing exercises. Approximately 4.8% of the patients reported depressive symptoms using the Patient Health Questionnaire-2 (PHQ-2). The most frequent change phase was preparation (56.6%), followed by action (22.2%), maintenance (20.0%), and finally relapse (1.2%). The majority (96.2%) of patients were practicing lifestyle modification. The majority (83.7%) of the patients were assessed by a dietitian, and more than half (53.3%) received health education.

<b>Characteristic</b>	<b>Total (N=419)</b>
<b>Age (years)</b>	
Mean±SD	39.9±11.2
<35	136 (32.5%)
35-45	150 (35.8%)
>45	133 (31.7%)
<b>Gender</b>	
Male	113 (27.0%)
Female	306 (73.0%)
<b>Comorbidity</b>	
Hypertension	36 (8.6%)
NASH ( MASH)	4 (1.0%)
Hypothyroidism	52 (12.4%)
Pre-diabetes	66 (15.8%)
<b>Edmonton obesity scoring system (EOSS) stage</b>	
Median (IQR)	0 (0-1)
Stage 0	268 (64.0%)
Stage 1	98 (23.4%)
Stage 2+	53 (12.6%)
<b>Body mass index (BMI)</b>	
Mean±SD	35.6±3.5
Overweight	18 (4.3%)
Obesity	401 (95.7%)
<b>Smoking status</b>	
No	367 (96.3%)
Yes	14 (3.7%)
<b>Diet</b>	
No	311 (74.2%)
Yes	108 (25.8%)
<b>Exercise</b>	
No	320 (76.4%)
Yes	99 (23.6%)
<b>Diet or exercise</b>	
No	295 (70.4%)
Yes	124 (29.6%)
<b>Depressive symptoms by PHQ2</b>	
Negative	399 (95.2%)
Positive	20 (4.8%)
<b>Lifestyle modification</b>	
No	16 (3.8%)
Yes	402 (96.2%)

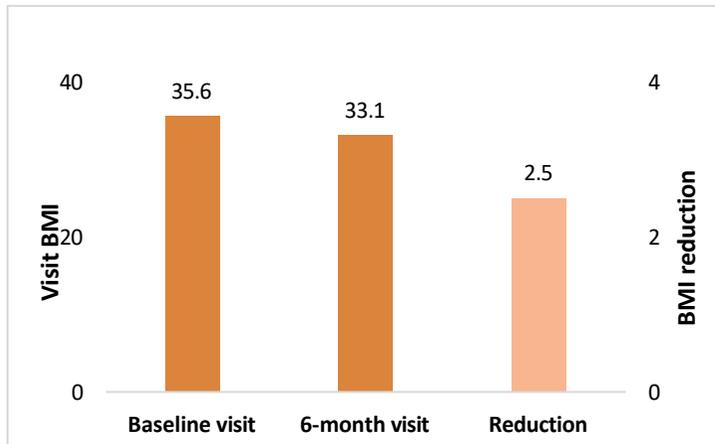
Characteristic	Total (N=419)
<b>Sleep</b>	
No	412 (99.0%)
Yes	4 (1.0%)
<b>Health education</b>	
No	195 (46.7%)
Yes	223 (53.3%)
<b>Dietitian</b>	
No	
Yes	

**Table 3: Demographic and clinical characteristics of the Lifestyle clinic cohort**  
SE, standard deviation; IQR, inter-quartile range

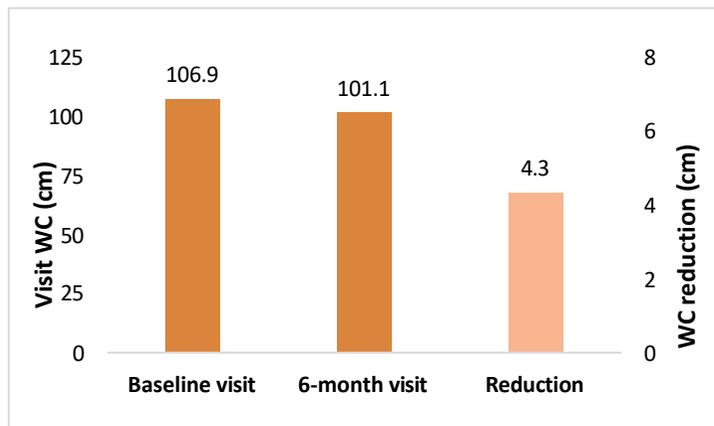
Figure 3 shows the magnitude of the outcome change. Total body weight loss (TBWL) changed from  $93.71 \pm 13.39$  at baseline to  $87.01 \pm 13.41$  at 6 months. The absolute reduction was  $6.70 \pm 7.85$  % ( $p < 0.001$ ). The body mass index (BMI) significantly decreased from  $35.62 \pm 3.54$  at baseline to  $33.11 \pm 3.99$  at 6 months in Figure 4, with an absolute reduction of  $2.51 \pm 2.85$  ( $P < 0.001$ ). Waist circumference significantly decreased from  $106.96 \pm 10.58$  cm at baseline to  $101.17 \pm 9.62$  cm at 6 months, with an absolute reduction of  $4.37 \pm 9.45$  cm ( $P < 0.001$ ), Figure 5. Systolic blood pressure significantly increased from  $122.2 \pm 13.1$  mmHg at baseline to  $131.9 \pm 22.2$  mmHg at 6 months, with an absolute increase of  $7.83 \pm 22.83$  mmHg ( $P < 0.001$ ). Diastolic blood pressure significantly decreased from  $76.1 \pm 9.2$  mmHg at baseline to  $67.7 \pm 7.9$  mmHg at 6 months, with an absolute reduction of  $9.16 \pm 12.25$  mmHg ( $P < 0.001$ ).



**Figure 3:** Weight changes by Total Body Weight Loss (TBWL). Baseline and after 6 months of follow-up.



**Figure 4:** Weight changes by BMI, Baseline, and after 6 months of follow-up.



**Figure 5:** Waist Circumference (WC), Baseline and after 6 months of follow-up.

The changes in blood lipids were significant for triglycerides and LDL cholesterol but were minor and insignificant for total and HDL cholesterol. Triglycerides decreased by  $0.55 \pm 1.56$  mmol/L ( $P < 0.001$ ) while LDL cholesterol increased by  $0.22 \pm 1.13$  mmol/L ( $P = 0.025$ ). Both HBA1C and fasting blood sugar decreased at 6- 6-month visits; by  $0.13 \pm 0.39$  for HBA1C ( $P < 0.001$ ) and by  $0.34 \pm 0.80$  mmol/L for fasting blood sugar ( $P = 0.001$ ). Vitamin D significantly increased from  $44.1 \pm 25.6$  ng/mL at baseline to  $47.9 \pm 24.9$  ng/mL at 6 months, with an absolute increase of  $4.0 \pm 30.5$  ng/mL ( $P = 0.017$ ). Table 4 shows all the study outcomes.

**Table 4: Changes in study outcomes at 6 months**

Outcome	Base (N=419)	6 month (N=419)	Total (N=419)		Total (N=419)	
			Change	p-value	Test	Value
Weight (TBWL%)	93.71±13.39	87.01±13.41	-6.70±7.85	<0.001	T-test	0.078
BMI change	35.62±3.54	33.11±3.99	-2.51±2.85	<0.001	T-test	0.082
Waist (cm)	106.96±10.58	101.17±9.62	-4.37±9.45	<0.001	T-test	4.126
Systolic blood pressure (mmHg)	122.2±13.1	131.9±22.2	7.83±22.83	<0.001	T-test	0.177
Diastolic blood pressure (mmHg)	76.1±9.2	67.7±7.9	-9.16±12.25	<0.001	T-test	7.039
HBA1C (%)	5.66±0.37	5.55±0.38	-0.13±0.39	<0.001	T-test	1.392
Fasting blood Sugar (mmol/L)	5.18±0.65	4.92±0.61	-0.34±0.80	0.001	T-test	3.611
Total cholesterol (mmol/L)	4.88±0.95	4.79±0.91	-0.09±0.96	0.125	T-test	0.340
Triglycerides (mmol/L)	1.3 (0.9-1.9)	1.1 (0.8-1.5)	-0.55±1.56	<0.001	MW	- 1.043
HDL cholesterol (mmol/L)	1.26±0.37	1.29±0.30	0.02±0.39	0.206	T-test	9.265
LDL cholesterol (mmol/L)	2.88±1.15	2.97±0.87	0.22±1.13	0.039	T-test	0.471
Alanine aminotransferase (U/L)	15 (10-23)	15 (11-22)	1.50±14.60	0.095	MW	- 0.934
Vitamin D (ng/mL)	42 (28-54)	42 (31-58)	4.00±30.47	0.017	MW	- 0.140

**Table 4: Changes in study outcomes at 6 months**

\* Median and interquartile range (IQR) using the Mann-Whitney (MW) test, while the rest were mean and standard deviation (SD) using an independent t-test. LDL, low-density lipoprotein; HDL, high-density lipoprotein. P-value 1 (Wilcoxon Signed Ranks) test the statistical significance of the change in the outcomes from baseline to the 6-month visit

## Discussion

Lifestyle medicine has been emerging recently through addressing a variety of life aspects that focus on preventing and improving multiple diseases and health-related complications (10). The Saudi Vision 2030 and the national transformations in health programs have led to rapid developments in living standards and impacted the level of awareness and practice toward a healthy lifestyle (11). Obesity poses a burden on the Saudi health system, raising the level of national lifestyle interventions to prevent and treat this challenge(12). Previous landmark trials have revealed the effect of intensive behavioral therapy on chronic illnesses such as the Diabetes Prevention Program (DPP) and the Action for Health in Diabetes (Look AHEAD) trial(3,13). A 5-7% weight loss was associated with highly intensive behavioral changes ( including diet and physical activities) in a total of 6 months. The role of lifestyle medicine clinics, which include behavioral changes along with pharmacological treatment, has proven superior effectiveness in the treatment of obesity that could reach up to 7-10% on liraglutide injections (14). In this study, lifestyle medicine interventions, which included a structured healthy balanced dieting, evaluation and advice regarding physical activities, motivated discussions around stress management, and pharmacological therapy, were the treatment pathways. This approach has shown a reduction in more than one obesity measure. Total body weight loss, BMI, and WC were followed since the first visit. A 6.7% of TBWL in 6 months of lifestyle medicine follow-up. A significant reduction of BMI and WC with 4.37 % and 2.6 % respectively. Our results were close to the international outcomes of such interventions.

Additionally, a significant improvement in multiple cardiometabolic measures, including levels of triacylglyceride, LDL, and glycemic control, was noticed after 6 months of follow-up. Cardiometabolic measures have been reported in other RCTs and systematic reviews that support the use of behavioral therapy and antiobesity medications(14,15).

The recent technology has revolutionized the delivered services of obesity treatment as well as the monitoring of patients' treatment progression. A dashboard denotes a specialized intelligence tool that employs data visualization to provide healthcare providers with actionable feedback, thus improving performance, resource utilization, and adherence to evidence-based practices(8,9). In our study, through the digitally oriented dashboard, captured processes and outcomes of data access as recorded by clinicians and administrative staff, the graphic performance of clinical trends was used to tailor and follow specific targets of clinical outcomes in obesity management such as intelligent visualization of clinical data would demonstrate measurable key performances indicators for stakeholders and health executives to monitor and improve the quality of health services facilitating timely decision-making based on the real-time data.

The generalization of such efforts on a larger scale, with empowering lifestyle medicine practice, will expand the effect on multiple chronic illnesses, including diabetes, hypertension, dyslipidemia, and obesity, to reach the Saudi health vision.

## Limitations

Our findings are based on data from a small sample size with limited cultural diversity, which limits the generalization of conclusions. The limited number of clinics could be a contributing factor to the small size of the population. Liraglutide was the only anti-obesity medication used during this study. Liraglutide and recently teriparatide were the only Saudi FDA-approved injectable anti-obesity medications at the time we started the clinical practice. Larger, longitudinal, and culturally diverse, geographically and gender-diverse studies using a variety of anti-obesity medications are needed to better understand the impact of lifestyle medicine

interventions on the management of obesity in primary care settings. The integration of smart-based artificial intelligence platforms would aim for better monitoring of obese patients.

### **Conclusion**

Lifestyle medicine is an emerging healthcare service in Saudi Arabia. The role of lifestyle interventions has shown clinically meaningful results in obesity management and weight parameters. The integration of an intelligent dashboard for a smart visualization of the clinical data flow would improve the quality of provided services in monitoring key performance indicators that show the impact of lifestyle medicine on obesity care.

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