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Body Weight as a Risk Factor for Type2 Diabetes among Libyan Women: A Cross-Sectional Study

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Abstract

Background: The increasing prevalence of overweight and obesity among women has raised serious concerns due to their strong association with type 2 diabetes mellitus (T2DM). In Libyan society, understanding the relationship between body mass index (BMI) and both the incidence and duration of T2DM is essential. This study aims to explore this association to identify emerging contributing factors, reassess the impact of known risk elements, and provide evidence-based recommendations for improving current preventive strategies and public health interventions.

Materials and methods: A cross-sectional study was conducted at the Zawia Diabetes Center and included 103 Libyan women aged between 35 and 60 years who had been diagnosed with T2DM. Each participant's BMI was calculated based on recorded height and weight, and classified as normal, overweight, or obese. Data related to age, duration of diabetes, and follow-up frequency were also collected. Statistical analysis was carried out using SPSS version 22, with tests chosen according to the distribution and type of the variables examined.

Results: The average BMI of the participants was 28.41 ± 5.41 kg/m². Nearly half of the women (45.6%) were classified as obese. Although the mean BMI was higher in those with diabetes duration less than five years (29.54 kg/m²) compared to those with a longer duration (27.49 kg/m²), this difference was not statistically

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significant (p = 0.06). Additionally, no significant association was found between BMI category and diabetes duration (p = 0.369).

Conclusions: Obesity was found to be common among diabetic women in this sample. While a trend toward higher BMI in more recently diagnosed patients was observed, no statistically significant association between BMI classification and diabetes duration was established. These findings emphasize the need for targeted prevention strategies to address obesity in at-risk populations.

Keywords: Type 2 diabetes, Body mass index, Obesity, Libyan women, Cross-sectional study**.**

وزن الجسم كعامل خطر للإصابة بمرض السكري من النوع الثاني لدى النساء الليبيات: دراسة مقطعية

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الملخص

الخلفية: أثار تزايد انتشار زيادة الوزن والسمنة بين النساء مخاوف جدية لارتباطهما الوثيق بمرض السكري من النوع الثاني (T2DM). في المجتمع الليبي، يُعد فهم العلاقة بين مؤشر كتلة الجسم (BMI) ومعدل الإصابة بمرض السكري من النوع الثاني ومدته أمرًا بالغ الأهمية. تهدف هذه الدراسة إلى استكشاف هذه العلاقة لتحديد العوامل المساهمة الناشئة، وإعادة تقييم تأثير عوامل الخطر المعروفة، وتقديم توصيات قائمة على الأدلة لتحسين الاستراتيجيات الوقائية الحالية وتدخلات الصحة العامة.

المواد والأساليب: أجريت دراسة مقطعية في مركز الزاوية للسكري، وشملت 103 امرأة ليبية تتراوح أعمارهن بين 35 و60 سنة ممن تم تشخيصهن بداء السكري من النوع الثاني. تم حساب مؤشر كتلة الجسم لكل مشاركة اعتمادًا على الطول والوزن المسجلين، وتصنيفه إلى طبيعي، وزائد الوزن، وبدين. كما جُمعت بيانات عن العمر، مدة الإصابة بالسكري،

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وتواتر المتابعة الطبية. تم إجراء التحليل الإحصائي باستخدام برنامج SPSS الإصدار 22، مع اختيار الاختبارات الإحصائية المناسبة وفقًا لنوع وتوزيع المتغيرات.

النتائج: بلغ متوسط مؤشر كتلة الجسم لدى المشاركات 28.41 ± 5.41 كغم/م²، وكانت نحو نصف النساء (45.6%) ضمن فئة السمنة. وُجد أن متوسط مؤشر كتلة الجسم أعلى لدى النساء المصابات بالسكري لمدة تقل عن خمس سنوات (29.54 كغم/م²) مقارنة بمن تجاوزت مدة إصابتهن خمس سنوات (27.49 كغم/م²)، إلا أن هذا الفرق لم يكن ذا دلالة إحصائية (p = 0.06). كما لم تُسجَّل علاقة ذات دلالة إحصائية بين تصنيف مؤشر كتلة الجسم ومدة الإصابة بالسكري (p = 0.369).

الاستنتاجات: كانت السمنة شائعة بين النساء المصابات بالسكري في هذه العينة. وعلى الرغم من وجود اتجاه نحو ارتفاع مؤشر كتلة الجسم لدى الحالات حديثة التشخيص، إلا أنه لم تُلاحظ علاقة ذات دلالة إحصائية بين تصنيف مؤشر كتلة الجسم ومدة الإصابة. تؤكد هذه النتائج الحاجة إلى استراتيجيات وقائية موجهة للحد من السمنة بين الفئات المعرضة للخطر.

الكلمات المفتاحية: داء السكري من النوع الثاني، مؤشر كتلة الجسم، السمنة، النساء الليبيات، دراسة مقطعية.

Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and progressive β-cell dysfunction, leading to hyperglycemia and long-term complications. It represents one of the most serious public health challenges of the 21st century. Globally, more than 530 million adults are estimated to be living with diabetes, and this number is projected to reach 700 million by 2045 (World Health Organization, 2023). The increasing prevalence of T2DM is strongly linked to rising obesity rates, sedentary behavior, and unhealthy dietary patterns (Islam *et al.*, 2024; Treat Obesity to Treat Type 2 Diabetes Mellitus, 2024). Beyond its metabolic consequences, diabetes contributes substantially to cardiovascular disease, kidney failure, blindness, and reduced life expectancy (Han *et al.*, 2018; CDC, 2020).

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Obesity has been widely recognized as the most significant modifiable risk factor for the development of T2DM. Excess body fat promotes insulin resistance through mechanisms involving chronic low-grade inflammation, altered adipokine secretion, and increased fatty acid flux to the liver and muscles (Boye *et al.*, 2021; Hassanloo *et al.*, 2024). In women, the relationship between obesity and diabetes risk is particularly strong due to hormonal factors, reproductive transitions, and socio-cultural barriers to physical activity (Lean *et al*., 2024). Studies have shown that women with higher BMI not only have greater susceptibility to diabetes but also experience poorer glycemic control and higher rates of comorbidities once the disease develops (Obesity and Diabetes pooled risk estimates from LMICs, 2023).

Recent evidence suggests that BMI may change as diabetes progresses. Some studies indicate that newly diagnosed patients tend to have higher BMI values, reflecting obesity-driven pathogenesis, whereas individuals with longer disease duration may experience gradual weight loss or stabilization due to treatment, dietary adjustments, or metabolic complications (Donnelly *et al.*, 2024; Variability in Body Mass Index, 2024). Understanding how BMI relates to diabetes duration is critical for optimizing management strategies, including dietary interventions and physical activity programs tailored to disease stage.

In Libya and across North Africa, the prevalence of overweight and obesity has increased dramatically over the past three decades, particularly among women (Lemamsha *et al.*, 2019; Lemamsha *et al.*, 2022). According to local surveys, more than half of Libyan women are overweight or obese, and type 2 diabetes is becoming increasingly common (Elmiladi, 2022; Masoud *et al.*, 2025). However, limited research has explored how BMI varies according to the duration of diabetes in Libyan populations. Understanding this association is essential for guiding preventive measures and improving long-term outcomes among women at risk.

Therefore, this study aims to examine the relationship between BMI and the duration of type 2 diabetes among Libyan women aged 35–60 years attending the Zawia Diabetes Center. The objectives are: (1) to determine the prevalence of overweight and obesity in this

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population, (2) to compare BMI between women with shorter (<5 years) and longer (≥5 years) diabetes duration, and (3) to assess whether a statistically significant association exists between BMI classification and diabetes duration.

Methodology

Materials and methods:

Study Design and Setting

This cross-sectional study was conducted at the Zawia Diabetes Center in Libya. The research aimed to assess the relationship between BMI and the duration of T2DM among Libyan women, following ethical approval from the relevant institutional committee. All participants provided informed consent before inclusion in the study. The study aimed to identify patterns and correlations that could inform better management and prevention strategies for diabetes in the region. The findings will contribute to a deeper understanding of how demographic factors affect diabetes spread and treatment in the Libyan population.

Study Population

The study included a total of 103 Libyan women diagnosed with type 2 diabetes mellitus. Participants were aged between 35 and 60 years, attending routine follow-up visits at the Zawia Diabetes Center. Inclusion criteria comprised women with a confirmed diagnosis of T2DM for at least one year, who were clinically stable and willing to participate. Exclusion criteria included women with type 1 diabetes, gestational diabetes, or severe comorbidities such as cardiovascular failure, chronic renal disease, or malignancy.

Sample Size Calculation

The sample size was estimated using Epi Info version 7.2.4.0, based on previous research by the Health and Social Care Information Centre (2013), which reported a 10.7% prevalence of diabetes among obese females. Using a 95% confidence level and a 5% acceptable margin of error, the minimum required sample size was calculated to be 147 females. However, due to logistical and time constraints, 103 women were included in the final analysis. This

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sample was considered adequate for exploratory cross-sectional analysis.

Data Collection

A structured questionnaire and clinical records were used to collect demographic and clinical data, including age, duration of diabetes, frequency of medical follow-up, height, and weight. BMI was calculated using the formula:

$$\text{BMI} = \frac{weight\ (kg)}{height\ (m^2)}$$

Normal weight: BMI < 25 kg/m²
Overweight: BMI 25–29.9 kg/m²
Obese: BMI ≥ 30 kg/m²

The duration of diabetes was grouped into two categories: <5 years and ≥5 years, following standard cutoffs used in similar epidemiological studies (Donnelly *et al.*, 2024; Hassanloo *et al.*, 2024).

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 22. Quantitative data were tested for normality using the Shapiro–Wilk test. Normally distributed variables were presented as mean ± standard deviation (SD), while non-normally distributed variables were summarized as median and range. Categorical data were expressed as numbers and percentages.

Comparisons between two independent groups were performed using the student's t-test for normally distributed variables or the Mann–Whitney U test for non-normally distributed variables. Associations between categorical variables were assessed using the Chi-square (χ^2) test. Correlations between continuous variables were analyzed using Pearson's or Spearman's correlation coefficient, as appropriate. A p-value of <0.05 was considered Statistically significant .

Data analysis was conducted using appropriate statistical techniques based on the type and distribution of variables.Qualitative data were described using number and percentage. Quantitative data were described using mean± Standard deviation for normally distributed

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data after testing normality using the Shapiro-Wilk test. The significance of the results obtained was judged at the 0.05 level.

- Chi-Square test was used to compare qualitative data between groups as appropriate
- Student t test was used to compare 2 independent groups for normally distributed data to assess statistically significant differences.

Ethical Considerations

The study adhered to the ethical standards of the institutional and national research committees, as well as the Declaration of Helsinki (2013 revision). Participation was voluntary, and all data was handled confidentially. No identifying information was disclosed or used in analysis or publication.

Results

A total of 103 Libyan women diagnosed with T2DM were included in this study. Their mean age was 46.97 ± 7.55 years, ranging from 33 to 60 years. The mean BMI was 28.41 ± 5.41 kg/m², with values ranging from 18 to 40 kg/m². Based on BMI classification, 33% of participants had normal weight, 21.4% were overweight, and 45.6% were obese. Regarding diabetes duration, 44.7% of the women had been diagnosed for less than five years, while 55.3% had diabetes for five years or longer. In terms of follow-up frequency, 13.6% had no regular follow-up, whereas 22.3%, 35.9%, and 28.2% attended check-ups every 3, 6, and 12 months, respectively (Table 1).

Table 1: Descriptive statistics of the study sample

	Total number =103	%
Age / years **Mean ±SD** **(Min-Max)**	**46.97±7.55** **(33-60)**	
Age group **<40** **41-50** **51-60**	 **20** **52** **31**	 **19.4** **50.5** **30.1**
BMI (Kg/m^2) **Mean ±SD** **(Min-Max)**	**28.41±5.41** **(18-40)**	

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Normal	**34**	**33.0**
Overweight	**22**	**21.4**
Obese	**47**	**45.6**
Onset of DM		
<5	**46**	**44.7**
>5	**57**	**55.3**
Follow up		
No	**14**	**13.6**
3 months	**23**	**22.3**
6 months	**37**	**35.9**
12 months	**29**	**28.2**

Table 1 shows the descriptive data showing that most participants were middle-aged and that nearly half were classified as obese. These findings highlight obesity as a prominent characteristic among women with type 2 diabetes.

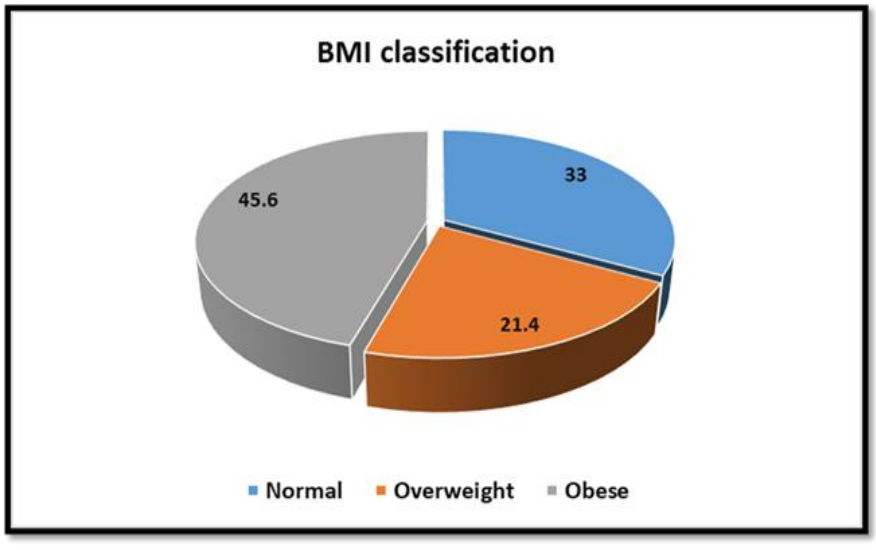

Figure 1: Distribution of BMI categories among participants

Figure 1 demonstrates that nearly half of the participants were classified as obese, while about one-third had normal BMI values. This visual distribution reinforces the high prevalence of obesity observed in Table (1).

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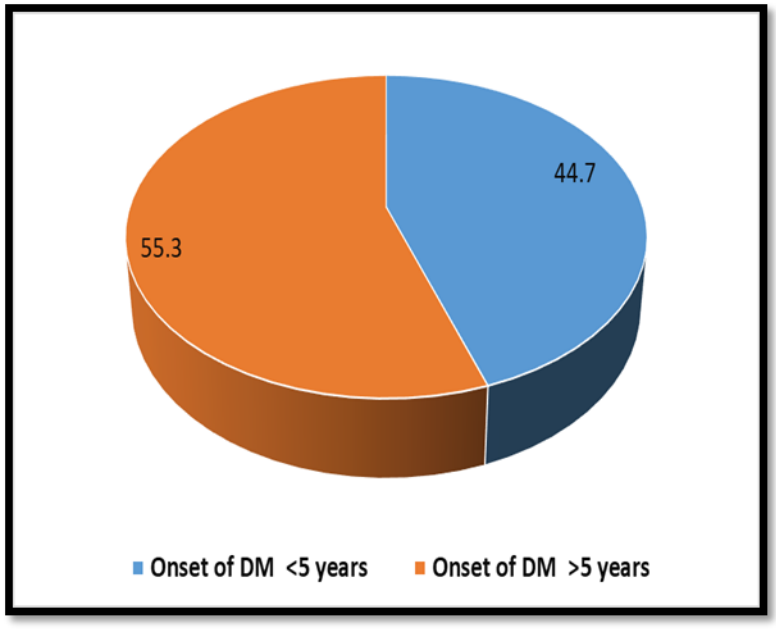

Figure 2: The distribution of diabetes duration among participants.

Figure 2 illustrates the distribution of diabetes duration among the participants. The chart shows that a slightly higher proportion of women had diabetes for more than five years, suggesting that chronic cases are common in this population and that long-term disease management is an ongoing challenge.

Table 2: Relation between weight classification and onset of diabetes among studied cases

	Weight classification			Test of significance	Within group significance
Onset of diabetes	**Normal N=34**	**Overweight N=22**	**Obese N=47**		
	N (%)	**N (%)**	**N (%)**		
<5 years	**12(35.3)**	**10(45.5)**	**24(51.1)**	**χ^2=1.99 p=0.369**	**P1=0.447 P2=0.158 P3=0.663**
>5 years	**22(64.7)**	**12(54.5)**	**23(48.9)**		

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χ^2=Chi-Square test, p1: difference between normal versus overweight, p^2: difference between normal versus obese, p3: difference between overweight versus obese

The data presented in Table 2 illustrate that no statistically significant relationship was detected between BMI classification and diabetes onset (p = 0.369). Although obesity appeared slightly more common among those diagnosed within the last five years, the difference was not significant, indicating that body weight status was similar regardless of diabetes duration.

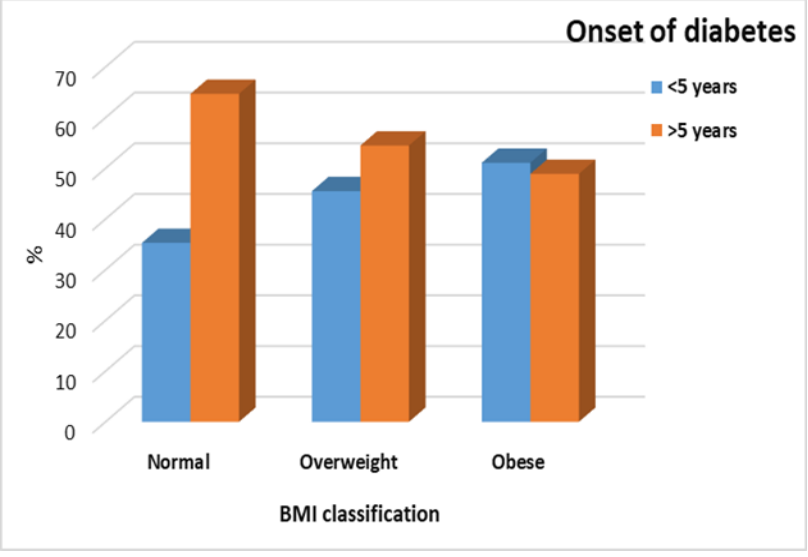

Figure 3: Distribution of BMI categories according to diabetes onset among the studied women.

Figure 3 displays the pattern of BMI distribution in relation to diabetes duration. The chart shows a slightly higher proportion of obesity among women diagnosed within the past five years compared to those with longer disease duration. This visual trend supports the numerical results in Table (2), suggesting that excess body weight may contribute more prominently at the earlier stages of type 2 diabetes, even though the association was not statistically significant.

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Table 3: Relation between body mass index and onset of diabetes among studied cases.

	BMI (Kg/m^2)	Test of significance
Onset of diabetes	**Mean ±SD**	
<5 years	**29.54±5.50**	**t=1.94 p=0.06**
>5 years	**27.49±5.19**	

t: Student t test

The data presented in Table 3 illustrate that the mean BMI was higher in women diagnosed for less than five years (29.54 ± 5.50 kg/m^2) compared with those with longer disease duration (27.49 ± 5.19 kg/m^2). This trend approached but did not reach statistical significance (p = 0.06). It may suggest that obesity contributes to early disease onset, but BMI tends to stabilize or decrease as the disease progresses.

Table 4: Relation between follow-up frequency and onset of diabetes among studied cases.

Onset of diabetes	Follow up				Test of significance
	No	3 months	6 months	12 months	
<5 years	**5(37.5)**	**12(52.2)**	**17(45.9)**	**12(41.4)**	**χ^2=1.13 p=0.770**
>5 years	**9(64.3)**	**11(47.8)**	**20(54.1)**	**17(58.6)**	

χ^2=Chi-Square test

Table 4 shows no significant association was observed between follow-up intervals and diabetes duration (p = 0.770). Most participants adhered to routine medical follow-ups regardless of how long they had been diabetic.

Summary

Overall, the results indicate that obesity is highly prevalent among Libyan women with type 2 diabetes. While higher BMI values were

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observed in more recently diagnosed patients, no statistically significant association was found between BMI classification and diabetes duration. These findings underline the continuing public health concern of obesity in this group and emphasize the importance of preventive programs targeting weight control in diabetic women.

Discussion

The present study explored the relationship between BMI and the duration of type 2 diabetes among Libyan women attending the Zawia Diabetes Center. Almost half of the participants were obese, confirming that obesity remains a key health challenge in Libyan women with diabetes. This finding aligns with national data reporting that more than half of Libyan women are overweight or obese (Lemamsha *et al.*, 2019; Lemamsha *et al.*, 2022). Similar results were reported in western Libya by Masoud *et al.* (2025), who found obesity to be highly prevalent among diabetic women. Together, these results underscore the continuing public health impact of obesity among women in Libya, despite the growing availability of diabetes awareness programs.

Although women with a shorter diabetes duration (<5 years) had a slightly higher mean BMI than those with longer disease duration, this difference was not statistically significant ($p = 0.06$). This trend supports previous studies suggesting that obesity is a major driver in the early stages of diabetes pathogenesis but tends to stabilize or decrease as the disease progresses (Donnelly *et al.*, 2024;Hassanloo *et al.*, 2024). Weight reduction over time may be linked to lifestyle modification, pharmacological therapy, or metabolic changes associated with long-standing diabetes. Donnelly *et al.* (2024) described similar trajectories, where BMI peaked around the time of diagnosis and gradually declined during follow-up.

No significant association was found between BMI classification and diabetes duration ($p = 0.369$). This observation is consistent with findings from Han *et al.* (2018) and Boye *et al.* (2021), who concluded that although obesity strongly contributes to diabetes onset, it is not necessarily related to the chronicity of the disease once established. These findings reinforce the concept that weight

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management should be a central component of diabetes prevention rather than a secondary concern after diagnosis.

The study also found no statistically significant difference between follow-up frequency and diabetes duration, suggesting that most participants maintained routine clinical visits regardless of how long they had lived with the disease. This may reflect the standardized nature of diabetes care in the region, but it could also indicate a lack of individualized, lifestyle-based interventions during follow-up visits. Elmiladi (2022) highlighted that many Libyan patients depend mainly on pharmacologic treatment, with limited emphasis on dietary and behavioral counseling. This may partially explain why obesity rates remain high even among those with longer disease duration.

Overall, the findings highlight a persistent burden of obesity among diabetic women in Libya and call for more comprehensive public health strategies. The evidence supports the need for early, culturally tailored interventions that focus on weight control, physical activity, and nutrition education as essential components of diabetes prevention and management.

Conclusion

Obesity was found to be highly prevalent among Libyan women with type 2 diabetes. Although a trend toward higher BMI was observed in more recently diagnosed patients, no statistically significant association was found between BMI classification and diabetes duration. These findings suggest that obesity likely contributes to the early development of type 2 diabetes rather than its chronic progression. Addressing obesity through targeted prevention programs, lifestyle modification, and early screening may play a vital role in reducing the future burden of diabetes among Libyan women.

Acknowledgment

The authors would like to express their appreciation to the staff of the Zawia Diabetes Center for their assistance in facilitating data collection and to all participants who took part in the study.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Limitations

This study was limited by its relatively small sample size and the inclusion of participants from a single center, which may affect the generalizability of the findings. Some clinical records were incomplete and therefore excluded from the analysis. Future studies with larger, more diverse populations are recommended to confirm these results.

References

Ahmed, A. F., Fayed, M. S., Yasser, M. H., & Lincz, L. F. (2019). Retrospective study among primary care Type 2 diabetes mellitus patients within the city of Zliten, Libya: High incidence of early-onset disease diagnosis. Libyan Journal of Medical Sciences, 3(1), 13–17.

Alawaini, K. A., & Abugila, M. A. (2020). Prevalence of obesity in diabetic patients in the north west of Libya. GSC Biological and Pharmaceutical Sciences, 12(02), 212-216.

American Society for Metabolic and Bariatric Surgery (ASMBS). (2024). Diabetes and Metabolic Surgery: Fact Sheet. Retrieved from https://asmbs.org

Boye, K. S., Lage, M. J., Thieu, V., Shinde, S., Dhamija, S., & Bae, J. P. (2021). Obesity and glycemic control among people with type 2 diabetes in the United States: A retrospective cohort study using insurance claims data. Journal of Diabetes and Its Complications, 35(9), 107975.

Centers for Disease Control and Prevention (CDC). (2020). National diabetes statistics report, 2020: Estimates of diabetes and its burden in the United States. Atlanta, GA: U.S. Department of Health and Human Services.

Chandrasekaran, P., & Weiskirchen, R. (2024). The role of obesity in type 2 diabetes mellitus—An overview. International Journal of Molecular Sciences, 25(3), 1882.

http://www.doi.org/10.62341/istj-vol38-2-ih-01

Donnelly, L. A., Zhou, K ., Morris, A. D., &Pearson, E. R. (2024). Trajectories of body mass index before and after diagnosis of type 2 diabetes and their association with outcomes. Diabetologia, 67(2), 345-356.

Han, S. J., & Boyko, E. J. (2018). The evidence for an obesity paradox in type 2 diabetes mellitus. Diabetes & Metabolism Journal, 42(3), 179–187. https://doi.org/10.4093/dmj.2018.0055.

Hassanloo, M., Sharifi, F., Mirzaei, M., & Azizi, F. (2024). Body mass index trajectories and risk of type 2 diabetes: A population-based cohort study. Scientific Reports, 14, 12345.

Health and Social Care Information Centre. (2013). Prescribing for Diabetes, England 2005–06 to 2012–13.London: HSCIC.

Islam, A. S., Sultana, H., Refat, M. N. H., Farhana, Z., Kamil, A. A., & Rahman, M. M. (2024). The global burden of overweight-obesity and its association with economic status, benefiting from STEPs survey of WHO member states: A meta-analysis. Preventive Medicine Reports, 46, 102882.

Lean, M. E., Leslie, W. S., Barnes, A. C., Brosnahan, N., Thom, G., McCombie, L., ... & Taylor, R. (2024). 5-year follow-up of the randomised Diabetes Remission Clinical Trial (DiRECT) of continued support for weight loss maintenance in the UK: an extension study. The Lancet Diabetes & Endocrinology, 12(4), 233-246.

Lemamsha, H., Randhawa, G., & Papadopoulos, C. (2019). Prevalence of overweight and obesity among Libyan men and women. BioMed Research International, 2019(1), 8531360.

Lemamsha, H., Randhawa, G., & Papadopoulos, C. (2022). Investigating the association between unhealthy dietary habits and obesity among Libyan adults. International Journal of Environmental Research and Public Health, 19(3), 1076. https://doi.org/10.3390/ijerph19031076.

Masoud, A. M. (2025). Prevalence of obesity among type II diabetes patients attending the outpatient clinic at Al-Wahda Teaching Hospital: A cross-sectional study. Libyan Journal of Medical and Allied Sciences, 13(6), 658-665.

http://www.doi.org/10.62341/istj-vol38-2-ih-01

Mehran, L., Honarvar, M., Masoumi, S., Khalili, D., Azizi, F., Blaha, M. J., & Amouzegar, A. (2024). The association of body mass index variability with cardiovascular disease and mortality: a mediation analysis of pooled cohorts. Frontiers in Endocrinology, 15, 1345781.

Okada, H., Hamaguchi, M., Habu, M., Kurogi, K., Murata, H., Ito, M., & Fukui, M. (2021). Association between variability in body mass index and development of type 2 diabetes: Panasonic cohort study. BMJ Open Diabetes Research & Care, 9(1), e002123.

Roomy, M. A., Hussain, K., Behbehani, H. M., Abu-Farha, J., Al-Harris, R., Ambi, A. M., Almahmeed, W., & Abubaker, J. (2024). Therapeutic advances in obesity management: an overview of the therapeutic interventions. Frontiers in Endocrinology, 15, 1364503.

Shah, V. N., Prattichizzo, F., &Ceriello, A. (2023). Obesity and diabetes: pooled analyses and implications for screening and thresholds. Diabetes Technology & Therapeutics, 25(1), S217-S226. https://doi.org/10.1089/dia.2023.2515.

Sulu, C., & Yumuk, V. D. (2024). Treat obesity to treat type 2 diabetes mellitus. Diabetes Therapy, 15(3), 611-622.

World Health Organization (WHO). (2023). Obesity and overweight: Key facts.Retrieved from https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.