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REVIEW

Evidence-Based Synthesis for Practice: Lifestyle Interventions in Type 2 Diabetes with Obesity

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Purpose: This systematic evidence synthesis evaluates lifestyle interventions for type 2 diabetes with obesity, providing clinical guidance based on rigorously appraised Chinese and international evidence to support healthcare decision-making.

Methods: Two researchers independently conducted systematic searches across multiple databases including CNKI, Wanfang, PubMed and Cochrane Library. Using standardized protocols, they extracted and synthesized evidence from qualifying publications, with all included studies undergoing dual quality assessment through AGREE II and AMSTAR-2. Discrepancies were resolved through consensus discussion involving a third senior researcher.

Results: The analysis incorporated thirteen high-quality evidence sources: six clinical guidelines comprising two Chinese and four international publications, three systematic reviews, three expert consensuses and one clinical decision framework. These yielded thirty-eight distinct evidence statements addressing five essential domains: the necessity of lifestyle intervention, assessment and monitoring approaches, multidisciplinary care coordination, multidimensional lifestyle components including nutrition, physical activity, stress management, sleep optimization and social support, along with long-term follow-up systems. Twenty-nine recommendations represented the highest grade of evidence, with demonstrated outcomes including clinically significant weight loss (5–15% of body weight) associated with improved metabolic control, diabetes remission in patients achieving ≥15kg weight reduction, and reduced reliance on glucose-lowering medications.

Conclusion: This evidence synthesis provides healthcare systems with thirty-eight clinically validated recommendations for implementing lifestyle interventions. The findings support real-world application by standardizing protocols, training clinicians, and adapting patient education while maintaining fidelity to evidence-based core components and allowing necessary local adaptations to meet diverse patient needs across different healthcare settings.

Keywords: type 2 diabetes, obesity, lifestyle interventions, evidence-based care, evidence summary

Introduction

Obesity has emerged as one of the most significant public health challenges of the twenty-first century, representing a complex chronic metabolic disorder with increasing global prevalence.Current projections from The World Obesity Report 2025 indicate that by 2030, approximately 3 billion adults (50% of the global adult population) will be affected by overweight or obesity.[1] This epidemic shows particular severity in China, where recent data demonstrate that adult overweight and obesity rates have already exceeded 50% and are predicted to reach 61% by 2030 - the largest absolute burden worldwide.[2] The rising prevalence of obesity directly contributes to increasing rates of type 2 diabetes (T2D) through a well-established bidirectional pathophysiological mechanism involving insulin resistance, β-cell dysfunction, hepatic glucose overproduction, and hyperinsulinemia.[3,4]

The clinical consequences of comorbid obesity in T2D are particularly grave, significantly elevating risks for chronic renal disease, obstructive sleep apnea(OSA), microvascular complications, and cardiovascular events compared to T2D alone.[5,6] In recognition of these risks, leading professional societies including the ADA and EASD have established

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lifestyle interventions as first-line therapy in their most recent consensus guidelines, emphasizing patient-centered comprehensive management approaches.[7]

While pharmacological options exist, lifestyle modification remains the cornerstone of treatment for T2D and obesity.[8] Evidence-supported lifestyle interventions encompassing nutritional optimization, physical activity, and behavioral modifications demonstrate consistent benefits for both weight management and glycemic control. However, the growing proliferation of clinical guidelines and systematic reviews has created unintended challenges for practitioners. Despite the availability of multiple high-quality recommendations, substantial variations in methodological approaches and focus areas complicate the derivation of consolidated clinical guidance.

This study addresses this critical gap through a best evidence synthesis methodology that systematically identifies core intervention components with consistent evidentiary support across major guidelines, rigorously evaluates evidence strength using standardized criteria, and transforms these findings into clinically actionable recommendations. The resulting framework aims to empower healthcare providers with an evidence-based yet flexible approach that accommodates individual patient characteristics and diverse clinical contexts while maintaining fidelity to established evidence standards.

Materials and Methods

Question Identification

To create evidence-based inquiries, the clinical questions were organized using the PIPOST methodology. P (Population): T2D and obesity in adults. I (Intervention): Lifestyle changes (such as blood glucose monitoring, nutrition, exercise, and health education). P (Professional): Patients with T2D and obesity, family members, and healthcare professionals (clinicians, nurses). O (Outcome): Glycemic control (reduction of glycated hemoglobin, fasting glucose), weight loss, cardiovascular risk factors, adherence rates, and the probability of diabetes remission were important measures. S (Setting):Community health facilities and hospitals. T (Evidence Type): Expert consensus statements, systematic reviews, meta-analyses, clinical practice guidelines, and evidence summaries.

Search Strategy

The "6S" evidence resource model states that evidence retrieval is done in a top-down manner. BMJ Best Practice, Up To Date, National Institute of Health and Clinical Excellence (NICE), National Guideline Clearinghouse, Guideline International Network, Scottish Intercollegiate Guidelines Network, Registered Nurses' Association of Ontario, Chinese Medlive Guideline Network (CMGN), Australian JBI Evidence-Based Health Care Database, Cochrane Library, PubMed, CINAHL, Embase, Web of Science, China Biology Medicine, China Knowledge Resource Integrated Database (CNKI), Wanfang, VIP, Grey literature, including websites of professional and governmental organizations, China's significant doctoral/master's thesis full-text database, Baidu academic database, Yi Mai Tong, and Google Scholar were among the databases searched.

Medical Subject Headings (MeSH) and free-text phrases were used to create the search terms. Three main elements made up the search strategy: the first concentrated on type 2 diabetes and obesity, the second on lifestyle therapies, and the third on the categories of evidence. ("type 2 diabetes" OR "T2D" OR "diabetes mellitus type 2") AND ("obesity" OR "obese" OR "body mass index" OR "BMI") AND ("lifestyle intervention" OR "medical nutrition therapy" OR "exercis*" OR "physical activity" OR "behavior therapy" OR "weight management" OR "diet" OR "caloric restriction" OR "energy intake") AND ("guideline" OR "practice guideline" OR "systematic review" OR "meta-analys*" OR "evidence summary" OR "best practice" OR "consensus*"). The literature from the database's creation until August 15, 2025, was included in the search.

Literature Inclusion and Exclusion Criteria

The criteria for inclusion and exclusion from the literature were as follows: (i) studies of adults with T2D and obesity. (ii) Lifestyle intervention studies (eg, diet, exercise, behavioral therapy, or multidisciplinary management) for patients with T2D and obesity; (iii) Expert intervention studies for patients with T2D and obesity; (iii) Literature type:expert consensus statement, clinical guideline, best practice recommendation, summary of evidence,or systematic review; (iv) Publication in Chinese or English. Exclusion criteria were as follows: (i) pregnant patients; (ii) type of literature, including meeting

abstracts, guideline interpretations, study recommendations, or outdated guidelines that have been superseded; and (iii) studies with low methodological quality, limited data, or no full text.

Study Selection and Data Extraction

The obtained literature was evaluated by two reviewers separately based on the inclusion and exclusion criteria. Any disagreement would be settled by consulting a third author or by discussion until a consensus was formed. Following a standardized data extraction form, the same reviewers then separately extracted the data while being blind to one another's procedures. The study characteristics—the name and institution of the first author, the year, the source, the type of evidence, and the article's topic were included in the data.

Literature Quality Evaluation Criteria

Guideline

The Appraisal of Guidelines for Research and Evaluation from 2017 (AGREE II) was applied.[9] Each of the 23 items in the six fields on the tool is scored on a 7-point scale, where one represents complete disagreement and seven represents entire agreement. Each field's score is the total of all the item scores in that field, expressed as a percentage of the field's maximum potential score. Based on their scores, the recommendations were separated into three levels: Grade B (recommended after some adjustments and improvements), with a score of 30% to 60% in ≥ 3 fields; Grade C (not recommended), with a score of $< 30\%$ in ≥ 3 fields; and Grade A (may be directly recommended without change), with a score of $\geq 60\%$ in all six fields.

Systematic Reviews

The 2017 AMSTAR-2 was employed.[10] It consists of sixteen items that are assessed as partial yes, no, or yes. The overall quality was taken into consideration when deciding whether to include it.

Expert Consensus

The 2016 JBI expert opinions and expert consensus articles quality rating methods were used to assess expert consensus.[11]

Clinical Decision Making

The Critical Appraisal for Summaries of Evidence (CASE) was used as an evaluation technique.[12]

Literature Quality Evaluation Process

Two or more researchers with training in evidence-based practice and professional experience in endocrinology and diabetes care independently conducted the literature quality evaluation. The assessors chose the right appraisal instruments based on the kind of literature. Disagreements were settled by debate or by seeking advice from a third senior researcher, who ultimately made the decision.

To ensure a transparent and hierarchical approach to evidence synthesis, a pre-defined decision-making framework was applied. This framework explicitly prioritized evidence types based on the accepted hierarchy of evidence. Systematic reviews and meta-analyses were accorded the highest level of influence on the summary findings. Expert consensus was valued for providing practical insights and guidance in areas where higher-level evidence was lacking; however, its recommendations were never used to override or contradict the findings of high-quality systematic reviews. In cases of discrepancy, the following precedence was enforced: 1) findings from systematic reviews of randomized controlled trials, 2) recommendations from high-quality clinical guidelines, and 3) expert consensus statements. This approach ensured that the final synthesis was grounded in the most robust evidence available.

This study followed the guidelines of giving precedence to the most recent, authoritative literature in the field of managing T2D and obesity, as well as favoring higher-quality evidence when there were discrepancies between the results drawn from various sources of information.

Evidence Extraction, Summarization and Level

A third researcher verified the evidence after two researchers separately extracted and manufactured it. When evidence from different sources had complementary or consistent conclusions, a combined or general expression was used. However, if

there were conflicting evidence from different sources, the principles of evidence-based priority, high-quality evidence priority, and latest published authoritative literature priority were followed. The evidence was first categorized into Levels 1 through 5 using the Australian JBI Evidence Hierarchy (2014 version).[13] The highest rating was given to evidence backed by several studies with differing grades. Additionally, using the JBI 2014 evidence grading method in conjunction with the JBI FAME framework (Feasibility, Appropriateness, Meaningfulness, and Effectiveness), the study team assessed the recommendations' strength (strong recommendation [Grade A] or poor recommendation [Grade B]).

Results

General Characteristics of the Included Literature

Through the retrieval of 1307 related literatures, 13 literatures were finally included, including 6 guidelines, 3 systematic reviews, 3 expert consensuses and 1 clinical decision. Among them, 247 duplicate literatures were excluded, 956 articles were excluded after reading the title and abstract, and 73 articles were excluded after reading the full text. Figure 1 describes the literature screening process, and Table 1 lists the basic attributes of the included literature.

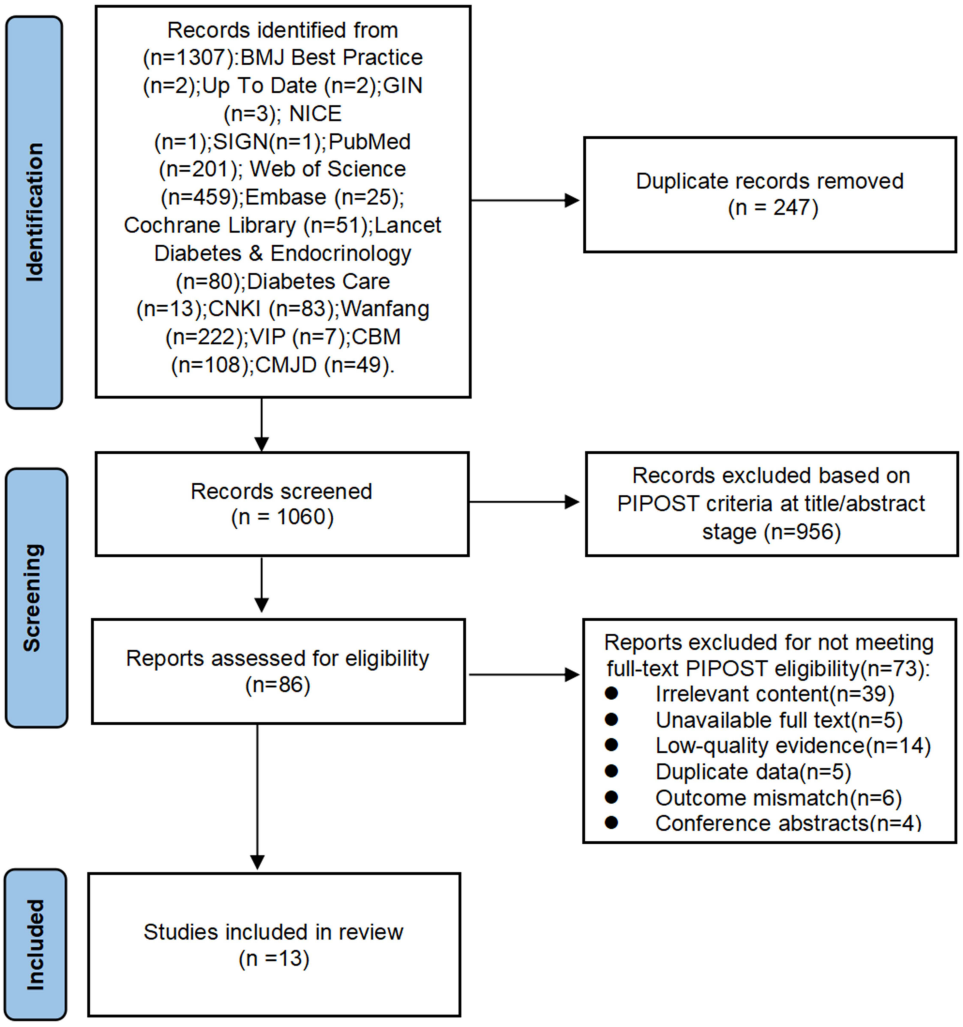

Figure 1 Flow diagram of literature search.

Notes: PRISMA figure was adapted from Page MJ, McKenzie JE, Bossuyt PM et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews BMJ 2021; 372:n71 doi:10.1136/bmj.n71. Creative Commons.[14]

Abbreviations: GIN,Guidelines International Network;NICE,National Institute for Health and Care Excellence;SIGN,Scottish Intercollegiate Guidelines Network;CNKI, China National Knowledge Infrastructure;CBM,China Biology Medicine;CMJD,China Medical Journal Network.

Table 1 General Information of the Included Literature (N=13)

Included Literature	Year	Literature Sources	Type of Evidence	Title	Primary Evidence Focus
National Center of Gerontology et al[15]	2024	CNKI	Guideline	Guideline for exercise therapy of type 2 diabetes mellitus in China (2024)	Exercise Therapy as a key component in T2DM management
Diabetes Prevention and Control Committee of Chinese Preventive Medicine Association[16]	2025	Wanfang	Guideline	Chinese diabetes behavior and lifestyle intervention guidelines (2024)	Behavioral and Lifestyle Interventions including diet, physical activity, and health education
National Institute for Health and Care Excellence[17]	2025	NICE	Guideline	Overweight and obesity management	Comprehensive Interventions including diet, exercise, and behavioral therapy for T2DM patients with obesity
International Diabetes Federation[18]	2025	PubMed	Guideline	IDF Global Clinical Practice Recommendations for Managing Type 2 Diabetes-2025.	Integrated Diabetes Care encompassing glycemic control, weight management
Rosenfeld, RM et al[19]	2025	Web of Science	Guideline	Lifestyle Interventions for Treatment and Remission of Type 2 Diabetes and Prediabetes in Adults: A Clinical Practice Guideline From the American College of Lifestyle Medicine	Lifestyle Interventions (nutrition, physical activity, stress management, sleep, social support) as first-line management for T2DM and obesity
American Diabetes Association Professional Practice Committee[20]	2025	PubMed	Guideline	8. Obesity and Weight Management for the Prevention and Treatment of Type 2 Diabetes: Standards of Care in Diabetes-2025	Comprehensive Management Strategies including medical nutrition therapy, increased physical activity for T2DM patients with obesity
Churuangsuk C et al[21]	2022	Web of Science	Systematic Review	Diets for Weight Management in Adults with Type 2 Diabetes: An Umbrella Review of Published Meta-Analyses and Systematic Review of Trials of Diets for Diabetes Remission	Dietary Interventions for weight management and diabetes remission in T2DM patients
Gostoli S et al[22]	2024	Web of Science	Systematic Review	Behavioral Lifestyle Interventions for Weight Loss in Overweight or Obese Patients with Type 2 Diabetes: A Systematic Review of the Literature	Behavioral Lifestyle Interventions for weight loss in T2DM patients with overweight/obesity
Liu, R. Y et al[23]	2024	Wanfang	Systematic Review	Study on the health effects of exercise combined with dietary intervention in obese individuals with type 2 diabetes mellitus	Exercise Combined with Dietary Intervention for improving health outcomes in obese T2DM patients
Kanaley JA et al[24]	2022	PubMed	Expert Consensus	Exercise/Physical Activity in Individuals with Type 2 Diabetes: A Consensus Statement from the American College of Sports Medicine	Exercise/Physical Activity recommendations for T2DM management
Davies MJ et al[7]	2022	PubMed	Expert Consensus	Management of Hyperglycemia in Type 2 Diabetes, 2022. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD).	Hyperglycemia Management strategies including lifestyle modifications and pharmacotherapy in T2DM
Yang, Y et al[25]	2024	CNKI	Expert Consensus	Expert consensus on weight management in patients with diabetes mellitus (2024)	Weight Management Strategies for diabetic patients, focusing on personalized goals and comprehensive approaches
Delahanty LM[26]	2025	Up To Date	Clinical decision making	Medical Nutrition Therapy for Type 2 Diabetes Mellitus	Medical Nutrition Therapy as a cornerstone of T2DM management, emphasizing individualized dietary plans

Abbreviations: CNKI, China National Knowledge Infrastructure;NICE, the National Institute for Health and Care Excellence.

Quality Evaluation Results of the Included Literature

Quality Evaluation Results of the Guidelines

This study includes six guidelines.[15–20] With a recommendation level of A, all guidelines were deemed high-quality and attained ≥60% standardization across all areas. Table 2 displays the comprehensive evaluation results.

Quality Evaluation Results of Systematic Reviews

Three systematic reviews with good overall quality were included. Table 3 displays the findings of the quality evaluation.[21–23] Two of the included reviews did not have a pre-registered protocol, which is considered a critical methodological weakness according to the AMSTAR-2 criteria. Nevertheless, these reviews were retained due to their overall methodological rigor and the relevance of their findings. In the evidence synthesis process, greater weight was given to the review that had a pre-registered protocol, consistent with our weight-of-evidence approach to developing the primary recommendations.

Table 2 Methodological Quality Evaluation Results of the Guidelines (N=6)

Included Literature	Percentage of Field Standardisation %							≥60% Field Number	≥30% Field Number	Recommendation Level
	Scopes and Objects	Participant	Rigour of the Guidelines	Clarity of Guidelines	Application of Guidelines	Independence of the Guide	Overall Score			
National Center of Gerontology et al[15]	94.44%	66.67%	75.00%	94.44%	66.67%	83.33%	80.09%	6	6	A
Diabetes Prevention and Control Committee of Chinese Preventive Medicine Association[16]	77.78%	77.78%	62.50%	83.33%	79.16%	66.67	74.54%	6	6	A
National Institute for Health and Care Excellence[17]	77.78%	72.22%	79.17%	83.33%	75.00%	83.33%	78.47%	6	6	A
International Diabetes Federation[18]	94.44%	77.78%	83.33%	83.33%	75.00%	83.33%	82.87%	6	6	A
Rosenfeld, RM. et al[19]	77.78%	72.22%	79.17%	83.33%	75.00%	83.33%	78.47%	6	6	A
American Diabetes Association Professional Practice Committee[20]	85.71%	71.43%	83.93%	85.71%	75.00%	85.71%	81.25%	6	6	A

Table 3 Quality Evaluation Results of the Included Systematic Reviews (N=3)

Items[10]	Churuangsuk C et al[21]	Gostoli S et al[22]	Liu, R. Y et al[23]
1. Did the research questions and inclusion criteria for the review include the components of PICO?	Yes	Yes	Yes
2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?	Yes	No	No
3. Did the review authors explain their selection of the study designs for inclusion in the review?	Yes	Yes	Yes
4. Did the review authors use a comprehensive literature search strategy?	Yes	Yes	Yes
5. Did the review authors perform study selection in duplicate?	Yes	Yes	Yes
6. Did the review authors perform data extraction in duplicate?	Yes	Yes	Yes
7. Did the review authors provide a list of excluded studies and justify the exclusions?	Yes	Yes	Yes
8. Did the review authors describe the included studies in adequate detail?	Yes	Yes	Yes
9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?	Yes	Yes	Yes
10. Did the review authors report on the sources of funding for the studies included in the review?	Yes	No	No
11. If meta-analysis was performed, did the review authors use appropriate methods for statistical combination of results?	Yes	Yes	Yes
12. If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?	Yes	Yes	Yes
13. Did the review authors account for RoB in primary studies when interpreting/discussing the results of the review?	Yes	Yes	Yes
14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?	Yes	Yes	Yes
15. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?	Yes	Yes	Yes
16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?	Yes	Yes	Yes
Number of Items Evaluated as "Yes" (Number)	**16**	**14**	**14**
Overall evaluation	**Included**	**Included**	**Included**

Note: Bold denotes Yes rated item counts per study and inclusion status.

Quality Evaluation Results of Expert Consensuses

Three expert consensus reports had good overall quality and were both included. Table 4 displays the findings of the quality assessment.[7,24,25]

Table 4 Expert Consensus Quality Evaluation (N=3)

Items	Kanaley JA et al[24]	Davies MJ et al[7]	Yang, Y et al[25]
1. Is the opinion source clearly identified?	Yes	Yes	Yes
2. Does the opinion source have standing in the field of expertise?	Yes	Yes	Yes
3. Are the relevant population interests the central focus of the opinion	Yes	Yes	Yes
4. Is the stated position the result of an analytical process, and is there logic in the opinion expressed?	Yes	Yes	Yes
5. Is there reference to the extant literature?	Yes	Yes	Yes
6. Is any incongruence with the literature/sources logically defended?	Yes	Unclear	Yes
Number of Items Evaluated as "Yes" (Number)	**6**	**5**	**6**
Overall evaluation	**Included**	**Included**	**Included**

Note: Bold denotes Yes rated item counts per study and inclusion status.

Quality Evaluation Results of Clinical Decision Making

This study includes one clinical decision-making process. Ratings of "partially yes" were given to the evidence synthesis by Delahanty.[26] For both "whether evidence was systematically searched" and "whether potential bias was avoided", while "yes" was given to all other evaluation criteria. It was provided and had good overall quality.

Summary of the Evidence

Based on the induction and integration of evidence from the included literature, 38 best-practice evidence statements were ultimately synthesized. These were categorized into five key aspects: (1) lifestyle interventions, (2) assessment and monitoring, (3) multidisciplinary management, (4) multidimensional lifestyle intervention system, and (5) long-term follow-up. The complete set of evidence items is presented in Table 5.

Table 5 Best Evidence Summary for Lifestyle Interventions in Type 2 Diabetes with Comorbid Obesity

Category	Evidence Content	Evidence Level	Recommendation Level	Traffic Light Indicator
The necessity of lifestyle intervention				
	1. Weight management should be a primary treatment goal alongside glycemic management in T2D with overweight/obesity. Aim for 5–15% weight loss for disease-modifying effects and possible remission.[7,18–20,25]	Level I	A	
	2. Any magnitude of weight loss is beneficial. Weight loss of 3–7% improves glycemia and cardiovascular risk factors.[20]	Level I	A	
	3. Lifestyle changes can prevent T2D progression. Metabolic markers (glycated hemoglobin, blood pressure, lipids) improve significantly with 5–15% weight loss.[7,18–20,25]	Level I	A	
Assessment and monitoring				
	4. Measure height/weight for BMI calculation. Perform additional measurements (waist circumference, waist-to-hip/height ratio) if BMI is indeterminant.[7,20]	Level 5	B	
	5. All individuals should have regular physical examinations to screen for overweight and obesity, with BMI serving as the main indicator (≥25 kg/m2, with a lower cutoff point for Asian populations). To establish a complete evaluation, this should be paired with visceral fat, body fat percentage, waist circumference, and waist-to-hip ratio. This is especially important when the BMI is between 25 and 40 kg/m², as this is when screening for abdominal obesity should be prioritized.[15–18,22,23,25]	Level 5	A	
	6. Monitor anthropometric measurements annually (quarterly during active treatment). Track weight/BMI, waist circumference, body fat%, glycated hemoglobin (3–6 monthly), fasting and postprandial blood glucose, lipids, blood pressure, and renal function.[15–26]	Level 5	B	
	7. Measure muscle mass in sarcopenia patients. Relax control targets for elderly patients appropriately.[25]	Level 5	B	
	8. To facilitate dynamic monitoring and maximize management results, we advise utilizing digital technologies including continuous glucose monitoring (CGM), wearable technology (such as activity trackers), and health management applications.[15,16,22,24]	Level I	A	

(*Continued*)

Table 5 (Continued).

Category	Evidence Content	Evidence Level	Recommendation Level	Traffic Light Indicator
Multidisciplinary management				
	9. When it comes to improving weight and metabolic markers, the "patient-centered multidisciplinary collaborative care model"—which involves physicians, dietitians, nurses, psychologists, and others—is more successful than individual approaches.[17,18,20,22,25]	Level I	A	
	10. Long-term weight maintenance programs should be delivered by an interprofessional team with appropriate training and experience.[20]	Level I	A	
	11. A professional team's diabetes self-management education and support (DSMES) can greatly enhance clinical results. In addition to employing smart health tools to accomplish data-linked monitoring, all patients should obtain DSMES in order to develop the self-management abilities they need.[7,16]	Level 5	A	
Multidimensional lifestyle intervention system				
Nutrition	12. Provide individualized Medical Nutrition Therapy (MNT) through qualified teams, considering personal preferences and nutritional needs.[7,16,19,20,24–26]	Level 5	A	
	13. Use nutritional plans that create a maintainable energy deficit (500–750 kcal/day) for weight loss, regardless of macronutrient composition.[7,20]	Level I	A	
	14. Multiple evidence-based dietary patterns are effective. Focus on identifying healthy eating habits that are feasible and sustainable.[7,15,16,18,19,25,26]	Level I	A	
	15. High-fiber foods should be the main source of carbohydrates, unsaturated fats (<10%) and trans fats (<1%) should be used in place of fats, and plant-based sources of protein should be prioritized (up to 0.8 g/kg/day for people with poor renal function). Foods that are overly processed should be avoided.[25,26]	Level 5	A	
	16. In people with T2D, the Mediterranean diet pattern can dramatically improve lipid profiles and blood glucose control while lowering the likelihood of the disease worsening.[16,26]	Level I	A	
	17. In the short run (6 months), time-restricted eating (eg, 16:8 mode) and intermittent low-calorie diets (eg, 5:2 mode) can effectively lower weight and glycated hemoglobin; however, people on insulin or sulfonylurea medications should exercise caution due to the risk of hypoglycemia.[22,24,26]	Level I	B	
	18. Although low-carb diets work well in the short term, they may raise the risk of cardiovascular disease over time. Because they can cause ketosis, very low-carb diets and ketogenic diets should be taken carefully.[17,22,24]	Level 5	B	
	19. Although a high-protein diet (protein energy ratio > 20%) can improve blood sugar regulation, decrease body fat, and promote satiety, it is not recommended for people with chronic kidney disease (CKD).[16,21,26]	Level I	B	
	20. Note that very low-calorie diets need to be monitored by a professional.[18,23,26]	Level I	A	
Physical activity	21. A medical evaluation should be performed before exercising, taking into account the patient's cardiovascular risk, exercise intensity, and past exercise habits. Elderly patients need to have their fall risk assessed further.[15,16,22,24]	Level 5	A	
	22. Exercise should be avoided if there are acute metabolic abnormalities (eg, blood glucose >250 mg/dL with ketosis or >300 mg/dL without ketosis), cardiovascular disease symptoms, or diabetic sequelae (eg, proliferative retinopathy).[15,16]	Level 5	A	
	23. The FITT-VP principles (frequency, intensity, time, type, total volume, and progression) should serve as the foundation for exercise prescriptions. These principles should incorporate resistance, flexibility, balance, and aerobic training, as well as the ideas of safety, steady progression, and individualization.[15,16,24]	Level I	A	
	24. It is advised to perform aerobic exercise (150–300 min/week of moderate- to vigorous-intensity, spread over 3–7 days) supplemented with resistance training (2–3 times/week on non-consecutive days) and flexibility/balance training (2–3 times/week).[7,15,16,19,24,25]	Level I	A	
	25. Minimize extended sitting, avoid lengthy sitting after meals, and get up every 30 minutes for three minutes of exercise.[7,17,24]	Level 5	A	
	26. As the baseline intensity, moderate-intensity aerobic exercise (40–59% of maximum oxygen uptake/heart rate reserve or 50–70% of maximum heart rate) is advised. People who are physically fit can advance to high intensity (60–89%). It is advised to use 50–85% of the 1RM load for resistance training.[15–17,19,24,25]	Level I	A	
	27. It is advised that each resistance training session last 15–20 minutes (1–3 sets, 10–15 repetitions per set) and each aerobic exercise session last 30–60 minutes, totaling ≥150 minutes per week. Blood sugar regulation can be maximized by exercising forty-five minutes after eating.[15–17,19,24,25]	Level I	A	

(*Continued*)

Table 5 (Continued).

Category	Evidence Content	Evidence Level	Recommendation Level	Traffic Light Indicator
	28. People with peripheral neuropathy should engage in non-weight-bearing activities, such as cycling or swimming. People who have retinal lesions should stay out of inverted situations and vigorous exercise. People with sarcopenia should do more traditional ethnic activities (like Tai Chi) and resistance training.[15,16,24,25]	Level I	A	
	29. The idea behind progressive exercise is to "start at low intensity and gradually increase". Every two to four weeks, increase the duration or intensity by 5 to 10%. Pay special attention to your blood sugar levels and any signs of exhaustion.[15,16,24]	Level 5	A	
Stress management	30. It is advised to refer patients with severe anxiety and depression, intervene with high-risk individuals, and perform routine psychological assessments.[16,17,19,24]	Level 5	A	
Sleep	31. A target of 7–8 hours of sleep per night is recommended for optimal metabolic health. Both insufficient (<6h) and prolonged (>9h) sleep are associated with adverse outcomes including worsened glycemic control (elevated glycated hemoglobin), insulin resistance, and increased cardiovascular risk.[7,16,19,25]	Level I	A	
	32. Sleep quality is equally important. Screen for and manage sleep disorders (eg, obstructive sleep apnea, which is highly prevalent in T2D), as they significantly impair sleep architecture and glucose metabolism.[7,16,25]	Level I	A	
Social support	33. Peer groups and family support are examples of positive social ties that can raise glycated hemoglobin levels and enhance behavioral compliance.[19]	Level I	A	
	34. Use person-centered, nonjudgmental language (eg, "person with diabetes" or "healthy weight") to foster collaboration and avoid stigma. Emphasize the promotion of "healthy behaviors" rather than focusing solely on weight loss.[17,19,20]	Level 5	B	
Avoidance of risky substances	35. Give up smoking, cut back on alcohol, and avoid recreational drug use.[7,16,19,24,26]	Level I	A	
Long-term follow-up				
	36. Create a phased follow-up strategy with shorter intervals for high-risk patients. Undertake decision cycles regularly (at least 1–2 times/year).[7,25]	Level 5	B	
	37. Provide long-term (≥1 year) maintenance programs with monthly contact, frequent self-monitoring (weekly weight checks), and support for regular physical activity (200–300 min/week).[20]	Level I	A	
	38. Provide long-term monitoring and ongoing support with continued interventions for individuals who have achieved weight loss goals to evaluate effectiveness and facilitate weight maintenance.[20]	Level 5	B	

Notes: (Green): Strong recommendation; (Yellow): Moderate recommendation; (Red): Weak recommendation.

Discussion

The Cornerstone of Treating People with T2D and Obesity is Lifestyle Interventions

It is commonly acknowledged that lifestyle interventions are the cornerstone of diabetes mellitus (DM) prevention, treatment, and long-term control. Numerous excellent studies have unequivocally shown that lifestyle interventions not only help postpone or avoid the onset of T2D,[19] but they also considerably enhance patients' metabolic indices. Weight reduction is a significant indicator for lifestyle interventions to achieve DM remission, as demonstrated by the DIRECT study, which revealed that 86% of patients who dropped more than 15 kg of weight obtained DM remission.[27,28] Furthermore, lifestyle interventions can successfully lower blood pressure and cholesterol, which lowers the risk of cardiovascular disease.These results imply that lifestyle intervention plays an indispensable role in the treatment of patients with T2D and obesity. It may have long-term health benefits, such as fewer problems and a lighter healthcare burden, in addition to improving patients' short-term metabolic indices. As a result, a key tactic in the treatment of people with T2D and obesity should be lifestyle intervention.

However, the longer-term follow-up data introduces a critical nuance. While the landmark 1-year results showed 46% of participants achieved remission, the 5-year data reveals that this rate attenuated to only 13% of the original intervention group, even though it remained significantly higher than the control group (34% vs 12% among those still in follow-up).[29] Despite the sustained relative benefit, this decline underscores a pivotal limitation and the central challenge in the field: while intensive dietary intervention is powerfully efficacious in trials, maintaining the substantial

weight loss required for lasting remission is exceedingly difficult in the long term, highlighting a significant efficacy-effectiveness gap. Nevertheless, a more optimistic and equally important finding is that among the minority who successfully maintained an average weight loss of 8.9 kg at 5 years, 26% of those in remission at 2 years sustained it. This stark contrast fuels the ongoing debate about predicting long-term responders and shifts the clinical focus from mere initial efficacy to strategies for sustaining weight loss and identifying which patients are most likely to achieve permanent remission.

Assessment and Monitoring as the Foundation for Tailored Action

Early screening identifies high-risk patients and is the first step in weight loss.[17] Body mass index (BMI, lower cut-off point for Asians) and waist circumference are used to screen high-risk patients, focusing on abdominal obesity in those with a BMI of 25–40 kg/m².[17,19] Although BMI remains a widely adopted screening indicator due to its simplicity, substantial evidence suggests that it is inadequate in assessing cardiometabolic risk, particularly among diverse ethnic groups. International guidelines, such as those from NICE, recommend lowering BMI cut-offs (overweight: ≥23 kg/m²; Obesity: ≥27.5 kg/m²), reflecting an increased risk of central obesity at lower BMI values. These international recommendations were compared and contrasted with country-specific standards, such as the Chinese criteria (overweight: ≥24 kg/m²; obesity: ≥28 kg/m²), which are based on large-scale domestic epidemiological studies. These criteria were based on large-scale domestic epidemiological studies. A developing consensus urges the integration of central obesity indicators, such as waist circumference to height ratio, with BMI to enhance risk stratification and enable more personalized intervention strategies.

The evidence shows that ≥10% weight loss is the target for DM remission, and individualized interventions are carried out,It is critical to recognize that even modest weight loss of 3–5% provides significant advantages, including reduction of cardiovascular risk factors and improved glycemic control, which may help attenuate the progression of T2D. An initial weight loss goal of 5–7% is commonly recommended in clinical practice as it produces notable metabolic improvements and is considered cost-effective. However, for disease-modifying benefits such as enhanced cardioprotection and increased likelihood of diabetes remission, a greater weight loss of 10–15% or more is frequently necessary. This hierarchical structure enables clinicians to establish customized goals that balance long-term sustainability, patient feasibility, and optimal health benefits.[7,18–20,25]

In addition, we need to establish a monitoring system that includes metabolic indicators and body composition. Muscle mass is assessed in patients with sarcopenia, and the criteria for the elderly are relaxed.[18,25] To achieve long-term maintenance of weight reduction and blood glucose control, intelligent tools are used to assess intervention progress, monitor blood glucose and weight indicators, and dynamically adapt the strategy.[30] To ensure the safety and efficacy of the weight loss program, it should be highlighted that the key to weight loss in patients with T2D and obesity is early identification, early initiation of lifestyle intervention, and regular evaluation of metabolic indicators and physical function during the weight loss process.However, the implementation of such intensive monitoring faces practical challenges, including variable patient adherence to self-monitoring, the cost and accessibility of advanced body composition analyzers, and the need for healthcare systems to support the frequent data review and intervention adjustments required.[31]

One of the Fundamental Management Models is Multidisciplinary Management

When managing T2D and obesity, the multidisciplinary team (MDT) paradigm is quite helpful. A group of multidisciplinary experts from endocrinology, nutrition, sports medicine, psychology, and other fields create a personalized, all-inclusive management plan through frequent consultations, encompassing the fundamentals of medication therapy, medical nutrition therapy, exercise prescription, and behavioral intervention.This model is based on the patient-centeredness principle.Research has demonstrated that, in comparison to traditional management models, MDT based weight loss management programs can effectively improve patients' quality of life, self-management skills (such as dietary control, physical activity), and glycemic control. In addition to optimizing metabolic markers, this integrated intervention paradigm offers patients all-encompassing health support.[17,18]

Despite its proven benefits, the MDT model's widespread adoption is often limited by significant barriers such as high operational costs, logistical complexities in coordinating care across different specialties, and reimbursement challenges within healthcare systems.[32]

Using a Multidimensional Lifestyle Intervention System as a First Line of Defense

As a first-line management tool, the multifaceted lifestyle intervention system consists of six lifestyle pillars: nutrition, physical activity, stress management, sleep, social support and avoidance of risky substances.[19] Each of these pillars will be discussed below.

Nutrition

A professional team should create and administer medical nutrition therapy (MNT), a key intervention for managing DM and obesity, with an emphasis on individualization. MNT can considerably lower glycated hemoglobin and aid in the prevention, treatment, and postponement of consequences from diabetes mellitus, according to studies.[33] MNT has been demonstrated to enhance weight-related risk factors such as hypertension, DM, hyperlipidemia, and quality of life.[34,35] Data also consistently suggest that MNT has an impact on weight reduction, BMI, and waist circumference. Studies have shown that short-term interventions can improve metabolism, reduce body mass, ameliorate insulin resistance and metabolic disorders, and improve heart and brain function.

The academic community currently widely emphasizes that there does not exist a universally applicable "best" diet plan.The choice must be individualized, weighing short-term efficacy against long-term sustainability and safety, under professional supervision.For instance, while low-carbohydrate diets often yield rapid short-term glycemic improvements, concerns remain regarding their long-term effects on lipid profiles and renal function, and evidence on their cardiovascular outcomes is less robust than that for the Mediterranean diet.[36,37] Very low-calorie diets (VLCDs) achieve rapid weight loss but pose significant challenges for long-term maintenance.[38] Therefore,the selection of a specific diet should be conducted under expert supervision, and changes in blood lipids, kidney function, and visceral fat should be monitored to avoid negative effects.

There are certain consensuses and differences between different guidelines in terms of dietary recommendations for patients with T2D and obesity. Organizations such as the Chinese Preventive Medicine Association, NICE, and the ACLM emphasize plant-based and Mediterranean-style diets that are rich in whole foods, high in fiber, and minimally processed. In contrast, the IDF supports the short-term use of VLCDs, citing strong trial data such as DiRECT, which demonstrates potential for rapid metabolic improvement and diabetes remission. On the other hand, NICE and ADA/EASD advise against overly restrictive approaches, advocating instead for flexible nutrition programs based on individual energy needs rather than fixed macronutrient composition. This divergence essentially reflects the different focuses of different guidelines on highly structured dietary interventions and sustainable, adaptive dietary patterns.

Physical Activity

For individuals with T2D and obesity, exercise and nutritional changes are an efficient way to change their lifestyle. These changes can greatly lower blood glucose levels, waist circumference, and BMI.[23] For exercise parameters with a high source of evidence rating, aerobic exercise (at least 150–300 minutes) and 2–3 sessions of resistance training per week are recommended 3–7 days per week.[1,2,17,19,24,25] Aerobic mixed with resistance exercise is better than single exercise modalities for improving glycated hemoglobin, cardiorespiratory fitness, and weight loss in T2D patients, according to extensive research.[39,40] Clinical promotion is, however, limited by the limitations of the current evidence, which include a small sample size, a short cycle length, an uncertain intensity-effect relationship, and poor long-term patient compliance. These limitations lead to inconsistent findings across studies, particularly regarding the optimal exercise "dose" for different patient subgroups and the magnitude of its independent contribution when combined with dietary changes.In order to improve the science and long-term compliance and through behavioral interventions, we must concentrate on developing personalized exercise prescriptions in the future. These developments, along with wearable device monitoring and multidisciplinary collaboration, will help to achieve the long-term metabolic benefits of exercise interventions.

Stress Management

In patients with T2D and obesity, chronic stress exposure is strongly associated with both metabolic dysregulation and impaired mental health.[41] Clinical guidelines recommend the use of brief screening instruments such as the Perceived Stress Scale (PSS, 4 items), Patient Health Questionnaire (PHQ, 2 items), and Generalized Anxiety Disorder scale (GAD, 2 items) for routine assessment.[42–44] Studies have shown that stress management interventions including cognitive behavioral therapy and regular physical activity can enhance self-management behavior, reduce BMI and glycated hemoglobin levels, and improve anxiety and depression symptoms.[41,45,46] It should be noted, however, that the benefits of stress management on glycemic outcomes are often indirect and variable compared to core lifestyle interventions such as nutrition and exercise, as they primarily operate through complex behavioral and psychological pathways.[47] Nonetheless, stress management remains a clinically relevant component of holistic care for adults with T2D and obesity and should be integrated into individualized treatment regimens.

Sleep

In recent years, sleep disorders have become an important and modifiable risk factor for this population.Guidelines recommend 6–9 hours of sleep per night, as shorter duration is associated with adverse outcomes including increased risk of T2D, obesity, hypertension, cardiovascular disease, and mortality.[19] Sleep deprivation (<6 hours per night) and circadian disruption can exacerbate hyperglycemia through reduced insulin sensitivity, increased appetite, and elevated glucose levels.[48,49] However, there are subtle differences in the optimal sleep duration management across different guidelines. The ACLM and Chinese guidelines allow for up to 9 hours of sleep, while the ADA/EASD recommends no more than 8 hours because of the observed association with negative glucose metabolism outcomes. This inconsistency indicates a lack of high-quality evidence to define the relationship between prolonged sleep and glycemic health in obese diabetic populations. Prior to further research, clinical recommendations should emphasize consistent, high-quality sleep within a 7–8 hour range, with additional attention to individual sleep quality and OSA screening.

Evidence suggests that OSA is a key interference factor that is estimated to increase the risk of diabetes by 63% and lead to insulin resistance independent of obesity, and its risk is associated with the severity of nocturnal hypoxia.[50,51] It is worth noting that OSA affects more than 50% of diabetic patients and further impairs blood glucose control through sleep fragmentation and hypoxia.[52] Therefore, clinicians should actively screen and manage sleep disorders, such as OSA, support the adoption of healthy sleep habits, and include sleep quality as part of comprehensive diabetes care. However, it should be noted that while observational data are consistent and mechanistic pathways are well-elucidated, the evidence from randomized controlled trials (RCTs) demonstrating that sleep therapy directly improves glycemic outcomes in established T2D is still evolving. This suggests that sleep interventions may be most effective as part of a multimodal strategy rather than a standalone solution.

Social Support

Peer groups and family support are critical components of positive social ties that enhance behavioral adherence and, consequently, glycemic control.[19] The mechanisms through which they operate, however, are distinct and should be evaluated precisely.Peer groups are structured programs where individuals with T2D share experiences, set collective goals, and provide mutual accountability. Their effectiveness is quantitatively measured through session attendance rates, group participation levels, and improvements in group cohesion scores using validated scales, which correlate with enhanced behavioral adherence and glycated hemoglobin reduction.[53] These measures provide objective evidence linking peer support to improved outcomes.

Family support covers many aspects, including emotional encouragement, such as praise for the efforts of family members to achieve their goals; there are also instrumental help, such as preparing healthy meals for the family, participating in sports activities together.For the level and quality of this kind of family support, objective measurement should be carried out with the help of verified psychological measurement tools. The Diabetes Family Behavior Scale (DFBC) is recommended, which can quantify the frequency of supportive behaviors and hindrance behaviors directly related to diabetes management.t.[54] This evaluation can then inform the provision of tailored diabetes self-management education and support (DSMES), which is crucial for empowering all patients.[20] Evidence confirms that high-intensity

engagement with DSMES (eg, >10 hours over 6–12 months) is associated with significantly lower glycated hemoglobin and mortality rates.This dose-response relationship strengthens the recommendation for universal access by moving from principle to evidence-based practice.[55] A key challenge, however, lies in the equitable access and uptake of these support programs, which can be hindered by socioeconomic factors, cultural barriers, and lack of referral infrastructure, potentially limiting their real-world impact.Thus, the critical issue shifts from efficacy (which is established) to effectiveness and implementation in diverse healthcare settings.

Avoidance of Risky Substances

The management of recreational substances (eg, alcohol, marijuana, and tobacco) introduces another layer of complexity, as they can detrimentally affect general health and directly impair diabetes management.[56] These substances can decrease glycaemic control, raise the risk of diabetes-related complications, and interfere with the metabolism of glycaemic drugs. This is particularly nuanced for tobacco use: while quitting smoking improves insulin sensitivity and long-term glycaemic control, clinicians must be aware that the cessation process itself can cause transient glycaemic fluctuations, often attributable to post-cessation weight gain.[57,58] Therefore, smoking cessation counseling for patients with T2D must be integrated with concurrent, proactive weight management strategies to mitigate this risk and achieve net benefit.

A Quality Control Measure for the Treatment of T2D and Obesity is Long-Term Follow-Up

Regular follow-up is necessary for high-risk patients (such as those who use insulin or have concomitant cardiovascular disease) in order to closely evaluate treatment outcomes and adverse medication responses. Research has demonstrated that tracking weight and waist circumference once a week during the first three months of weight loss is a useful way to evaluate the impact of the intervention. After six months, this can be changed to a monthly follow-up.[7,25] In addition to enabling prompt treatment plan modifications, a staged follow-up program enhances patient compliance by routine evaluation, which is especially crucial for sustaining long-term weight loss.Rather than inherent drawbacks, the main limitation of this proposed follow-up schedule is its potential rigidity. The evidence supports the value of frequent monitoring but does not preclude the need for personalization. Therefore, in practical application, the follow-up programme should be flexibly adjusted according to the individual patient's situation and weight maintenance effect, and combined with other interventions to improve the weight loss effect and patient adherence.This tailored approach addresses the concern of individual differences without dismissing the strong evidence for structured follow-up.

Conclusion

In conclusion, this evidence synthesis establishes that comprehensive, multidisciplinary lifestyle intervention serves as the cornerstone of management for T2D and obesity. Our analysis, structured around five core themes including necessity, assessment and monitoring, multidisciplinary management, a multidimensional system, and long-term follow-up, demonstrates that interventions built on the six pillars of nutrition, physical activity, stress management, sleep, social support, and avoidance of risky substances are of paramount clinical significance. The most important findings confirm that such structured strategies yield sustained improvements in glycemic control, such as glycated hemoglobin reduction, promote clinically meaningful weight loss, reduce cardiovascular risk factors, and enhance overall quality of life. These outcomes collectively surpass conventional glucose-centric approaches.

The synthesis incorporated evidence of varying methodological quality, which was addressed through a weight-of-evidence methodology. This allowed our strongest recommendations to be grounded in the most rigorous reviews, while less robust studies provided contextual insight and helped identify future research priorities.

Crucially, implementing these findings requires individualized consideration of patient preferences, metabolic phenotypes, and psychosocial circumstances. Tools such as shared decision-making aids, digital health platforms, and validated psychosocial assessments can support personalized application. For practical implementation, we recommend integrated training for multidisciplinary care teams focused on the core pillars, along with the incorporation of structured lifestyle goal-setting into routine clinical workflows.Future research should focus on practical, real-world studies that test how well these lifestyle interventions work in routine clinical practice, especially over the long term. Key priorities

include finding effective ways to maintain patient progress, comparing different dietary approaches in typical community settings, and adapting programs for underserved groups using available local resources. Ultimately, sustaining outcomes hinges on integrating evidence-based lifestyle management into coordinated, patient-centered chronic care systems.

Data Sharing Statement

Data sharing is not applicable to this article as no data were created or analysed in this study.

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Author Contributions

The individual contributions of authors to this work are as follows, in accordance with the CRediT taxonomy:

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Fei Chen (Corresponding Author): Supervision, Project administration, Funding acquisition, Writing - review & editing

Qiongdan Zhang: Data curation, Formal analysis, Visualization,Writing - review & editing

Juan Chen: Investigation, Resources, Validation, Writing - review & editing

Wenjie Zhang: Methodology, Software, Writing - review & editing

Lixue Fang: Investigation, Resources, Data curation, Writing - review & editing

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