

Post-print of the Chinese Guidelines for Obesity Behavior and Lifestyle Intervention

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Date: 2026-03-04T08:40:10+00:00

Abstract

Obesity is a chronic disease characterized by abnormal or excessive fat accumulation, which significantly increases various health risks. Weight loss in individuals with obesity can reduce the risk of multiple diseases and improve physical and social functions. Behavior and lifestyle interventions (BLIs) are the cornerstone of weight management and should follow the principles of effectiveness, gradual progression, comprehensiveness, and individualization. Implementation strategies for BLIs include the application of established behavior change theories, behavioral change techniques (BCTs), and cognitive behavioral therapy (CBT).

Dietary behavior intervention strategies include controlling total energy intake, adjusting dietary patterns, and scientifically managing the timing, manner, location, and emotions associated with eating. Exercise intervention strategies include providing psychological and behavioral support and prescribing individualized exercise prescriptions. Psychological interventions should combine BCTs and cognitive restructuring to change values regarding diet and physical activity. Sleep interventions should emphasize education and self-management, CBT, relaxation training, regular exercise, light therapy, and circadian rhythm regulation.

The BLI process includes pre-intervention assessment, prioritization, and the determination of intervention goals, content, setting, mode, intensity, duration, and effectiveness evaluation, while also emphasizing the implementation of the multi-disciplinary team (MDT) diagnostic and treatment model. Obesity interventions for children and adolescents should adopt family, school, community, clinical, multi-sectoral, and full-developmental-cycle strategies. Digital technology focuses on strengthening precision diagnosis, personalized intervention, and full-cycle monitoring.

The evaluation of BLI effectiveness includes formative, process, and outcome evaluations, combined with high-quality research evidence for comprehensive

judgment. Other key considerations include improving practical effectiveness, preventing weight regain, enhancing cultural adaptability, and ensuring the rational application and standardized referral for pharmacological and surgical treatments.

Full Text

Preamble

• Guidelines • Consensus •

Chinese Guidelines for Behavioral and Lifestyle Interventions for Obesity

Chinese Nutrition Society Obesity Prevention and Control Branch

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Abstract Obesity is a chronic disease characterized by abnormal or excessive fat accumulation that significantly increases the risk of multiple health complications. Weight loss among individuals with obesity can reduce the risk of various diseases and improve both physical and social functioning. Behavior and lifestyle interventions (BLIs) constitute the cornerstone of weight management and should adhere to the principles of effectiveness, gradual progression, comprehensiveness, and individualization. Implementation strategies for BLIs include the application of established behavior change theories, behavioral change techniques (BCTs), and cognitive behavioral therapy (CBT). Dietary intervention strategies involve controlling total energy intake, adjusting dietary patterns, and scientifically managing the timing, methods, locations, and emotional aspects of eating. Exercise intervention strategies include providing psychological and behavioral support and prescribing individualized exercise regimens.

Psychological interventions should combine BCTs with cognitive restructuring to transform values and beliefs regarding diet and physical activity. Sleep interventions should emphasize education, self-management, CBT, relaxation training, regular exercise, light therapy, and circadian rhythm regulation. The BLI process encompasses pre-intervention assessment, prioritization, and the determination of intervention goals, content, settings, methods, intensity, duration, and outcome evaluation; it also emphasizes the implementation of a multi-disciplinary team (MDT) diagnostic and treatment model. For childhood and adolescent obesity, interventions should adopt strategies involving families, schools, communities, clinical settings, multi-sectoral collaboration, and a full-developmental-cycle approach. Digital technologies should focus on enhancing precision diagnosis, personalized intervention, and full-cycle monitoring.

The evaluation of BLI effectiveness includes formative, process, and outcome evaluations, combined with comprehensive judgments based on high-quality research evidence. Other critical considerations include improving practical effectiveness, preventing weight regain, enhancing cultural adaptability, and ensuring the rational application of pharmacological and surgical treatments alongside standardized referral protocols.

[Keywords] Obesity; Weight loss; Behavior and lifestyle interventions; Diet; Physical activity; Psychosocial intervention; Sleep; Childhood obesity; Digital technology

[CLC Number] R 589.25, R 163 **[Document Code]** A **DOI:** 10.12114/j.issn.1007-9572.2026.0008

BLIs implementation strategies incorporate established behavior change theories, behavioral change techniques (BCTs), and cognitive behavioral therapy (CBT). Dietary behavioral intervention strategies encompass controlling total energy intake, adjusting dietary patterns, and scientifically managing eating time, manner, location, and emotional factors. Exercise intervention strategies include providing psychological and behavioral support and prescribing individualized exercise regimens. Psychological interventions should integrate BCTs with cognitive restructuring to modify values and beliefs regarding diet and physical activity.

Sleep interventions should emphasize education and self-management, cognitive behavioral therapy (CBT), relaxation training, regular exercise, light therapy, and circadian rhythm regulation. The behavioral and lifestyle interventions (BLIs) process comprises pre-intervention assessment, priority determination, intervention objectives, content, settings, delivery methods, intensity, duration, and outcome evaluation, while emphasizing the implementation of a multidisciplinary team (MDT) collaborative care model. Childhood and adolescent obesity interventions should adopt family-based, school-based, community-based, clinical, multi-sector, and full developmental life-cycle strategies. Digital technologies should focus on enhancing precision diagnosis, personalized interventions, and full-cycle monitoring. BLIs effectiveness evaluation includes formative evaluation, process evaluation, and outcome evaluation, integrated with comprehensive judgment based on high-quality research evidence. Other critical considerations include improving practical effectiveness, preventing weight regain, enhancing cultural adaptability, and ensuring rational application and standardized referral for pharmacotherapy and bariatric surgery.

Funding: National Science and Technology Innovation 2030—“Major Projects on Four Major Chronic Diseases” (2023ZD0508500, 2023ZD0508504, 2023ZD0508502, 2023ZD0508503, 2023ZD0508505, 2023ZD0508506).

Citation: Chinese Nutrition Society Obesity Prevention and Control Branch. Chinese guidelines for behavioral and lifestyle interventions for obesity [J]. Chinese General Practice, 2026, 29(16): 1-28. DOI: 10.12114/j.issn.1007-9572.2026.0008. [www.chinagp.net]

Overweight and obesity refer to abnormal or excessive fat accumulation that poses a risk to human health [?]. Obesity is not only an independent metabolic disease [?] but also a common risk factor for various chronic conditions, including type 2 diabetes mellitus (T2DM), cardiovascular and cerebrovascular diseases, and certain types of cancer [?].

Nearly half (48%) of global deaths can be attributed to risk factors associated with obesogenic lifestyles or susceptibility, including dietary and metabolic risks as well as low physical activity [?]. A high body mass index ($BMI \geq 25.0 \text{ kg/m}^2$) is associated with 8.5% of global mortality [?].

The prevalence of obesity is increasing rapidly worldwide. From 1990 to 2022, the obesity rate among children and adolescents aged 5–19 rose from 2% to 8%, while the adult obesity rate increased from 7% to 16% [?]. National chronic disease surveillance data from 2018 show that the overweight rate among Chinese adults (≥ 18 years) was 34.3%, with an obesity rate of 16.4%. Among children and adolescents aged 6–17, the overweight and obesity rates were 11.1% and 7.9%, respectively; for children under 6 years of age, these rates were 6.8% and 3.6% [?]. Obesity has become a major public health issue in China, ranking as the sixth leading factor for death and disability, and imposing a significant burden on sustainable socio-economic development as well as public safety and health [?].

Weight loss in patients with obesity yields significant health benefits. Based on synthesized evidence from various countries [?], moderate weight loss in overweight or obese adults can reduce cardiovascular disease risk (A); a weight loss of at least 2 kg can lower systolic blood pressure (A); sustained weight loss leads to modest improvements in lipid profiles (A); and weight loss can prevent or delay the progression of T2DM (A). Maintaining a weight loss of 5 kg improves glycemic control (A). For adults with a $BMI < 35.0 \text{ kg/m}^2$ who have prediabetes or hypertension, a weight loss of 2–3 kg through behavioral and lifestyle interventions (BLIs) can lead to a clinically significant reduction in systolic blood pressure, benefiting obese patients with T2DM [?]. Lifestyle medicine is a medical specialty that utilizes therapeutic BLIs as the primary means to treat chronic diseases, including but not limited to obesity, cardiovascular disease, and T2DM [?]. By implementing evidence-based, patient-centered, and prescriptive BLIs, the goal is to prevent, treat, or reverse these conditions [?]. The six core pillars of lifestyle medicine are a whole-food, plant-predominant dietary pattern, regular physical activity, restorative sleep, stress management, avoidance of risky substances, and the cultivation of positive social connections [?].

Most guidelines recommend developing individualized BLI plans by integrating patient preferences, values, social environment, comorbidities, and the stage and severity of obesity [?]. Key methods of lifestyle medicine applied in obesity intervention include cognitive restructuring, managing dietary triggers and social scenarios, developing supplemental dietary coping strategies, self-monitoring, stimulus control, relapse prevention, goal setting, building social support, self-

reinforcement training, barrier identification, and motivational interviewing [?].

To date, China has not yet developed a specialized guideline for obesity BLIs. To consolidate evidence on the effectiveness of weight loss BLIs and provide a scientific basis and practical methods for obesity BLI practice in China, this guideline working group—referencing existing obesity prevention and control guidelines—invited interdisciplinary experts in the field. Using evidence-based medical methods and the international GRADE evidence grading system, combined with lifestyle medicine techniques, we have developed these guidelines. This document aims to provide scientific guidance for obesity prevention and control professionals in China and is applicable to medical and health institutions and personnel at all levels. The content may also serve as a reference for public weight management.

1. Association Between Obesity and Behavior/Lifestyle

(A). Intentional weight loss is associated with significant improvements in physical function and self-esteem. The occurrence of obesity is closely linked to behavior and lifestyle; consequently, weight reduction can lead to marked improvements in sexual health and occupational performance. Greater weight loss is correlated with more substantial improvements in psychosocial functioning [?], as well as enhanced satisfaction with body image [?]. Furthermore, even moderate weight loss is associated with the alleviation of depressive symptoms [?].

Behavioral Lifestyle Interventions (BLIs) serve as the cornerstone of weight management and are the preferred primary treatment for obesity. Various obesity intervention guidelines identify BLIs as a core component [?], and their implementation is strongly recommended for patients who are overweight or obese [?] (A). Structured BLI programs address behaviors related to diet and physical activity, which are particularly critical for patients with cardiovascular disease [?] and impaired glucose metabolism [?].

1.1 Diet

An unhealthy diet is a critical risk factor for obesity. When dietary energy intake exceeds the energy expended through basal metabolism, daily activities, and physical exercise, the surplus energy accumulates in the body in the form of fat. Excessive consumption of foods high in sugar and fat, yet low in dietary fiber, can stimulate appetite-related neurons in the central nervous system. This stimulation leads to an imbalance in appetite regulation mechanisms, which subsequently results in obesity [?].

There is a significant positive correlation between the consumption of sugar-sweetened beverages and genetic susceptibility to obesity [?]. Furthermore, the frequency of chili pepper consumption has been significantly and positively associated with the prevalence of obesity [?]. The rising obesity rates in China are linked to the continuous increase in the consumption of Western-style diets,

animal-derived foods, refined grains, and ultra-processed foods characterized by high sugar and high fat content [?].

1.2 Physical Activity

Insufficient energy expenditure caused by a lack of physical activity is the most direct mechanism underlying the development of obesity [?]. Sedentary behaviors and lifestyles, such as prolonged screen time, are also significantly associated with the occurrence of obesity [?]. Moderate-intensity aerobic exercise should be prioritized as the primary recommendation [?] (A).

1.3 Sleep

Sleep disturbances can trigger abnormalities in glucose and lipid metabolism, subsequently leading to obesity. The specific mechanisms underlying this process are associated with circadian rhythm disruption, alterations in adipokines, systemic inflammatory responses, and enhanced oxidative stress [?]. Furthermore, the association between phenotypic characteristics of obesity and genetic risk is exacerbated by poor sleep patterns [?]. Additionally, insufficient sleep and circadian misalignment can lead to an imbalance in the secretion of ghrelin, leptin, and peptide YY (PYY), resulting in increased appetite and reduced energy expenditure, which ultimately contributes to weight gain and obesity [?].

Conversely, sleep interventions play a positive role in weight regulation and the maintenance of metabolic homeostasis [?] (A).

1.4 Psychosocial Factors

Chronic stress activates the hypothalamic-pituitary-adrenal (HPA) axis, leading to a chronic elevation of cortisol levels. This physiological shift subsequently results in the decline of cognitive, metabolic, and immune functions [?].

Chronic stress and its associated sleep disturbances negatively impact an individual's motivation for physical activity, which can lead to reduced energy expenditure. Furthermore, emotional eating (EE) represents a critical factor influencing the long-term effectiveness of weight loss interventions [?].

Mindfulness-based cognitive behavioral therapy (CBT) is effective in reducing the BMI of adolescents with obesity [?] (A).

1.5 Weight Monitoring

The lack of regular weight monitoring is a significant risk factor for obesity [?]. Conversely, long-term consistent weight monitoring is associated with successful weight reduction [?]. Self-monitoring interventions delivered via mobile technology platforms have been shown to significantly reduce body weight [?] (Level I, Grade A).

1.6 Other Behaviors

Alcohol consumption disrupts the liver's cholesterol synthesis function and leads to obesity. Furthermore, the patterns of body fat distribution and intrahepatic lipid accumulation are dependent on the volume of alcohol intake [?].

Smoking is associated with more severe obesity-related characteristics [?]. While smoking cessation can reduce total cholesterol levels and improve respiratory function and metabolic indicators in obese patients [?], post-cessation weight gain and the development of new-onset metabolic diseases remain significant concerns [?] (II B). Therefore, it is necessary to develop scientifically sound smoking cessation protocols.

2. Principles of BLIs

Principles such as individualization (Table 1) must be upheld, while simultaneously emphasizing the implementation of the multi-disciplinary team (MDT) diagnosis and treatment model.

2.1 Principle of Effectiveness

Setting weight loss goals that lack sufficient challenge can lead to a lack of motivation in patients; conversely, excessively high targets may result in feelings of frustration and failure (C) [?]. During the initial phase of intervention, the objective should be a weight loss of 0.5–1.0 kg per week, 2.0–4.0 kg per month, or 5%–15% of total body weight over six months. This approach ensures physiological adaptation and prevents complications such as malnutrition or metabolic disturbances [?] (A).

By employing incremental adjustments—such as gradually reducing the intake of high-calorie foods and progressively increasing physical activity duration—patients can establish healthy lifestyle habits without experiencing excessive psychological stress [?] (A). Intervention strategies should be adjusted in a timely manner based on the patient's progress to ensure steady weight loss [?]. Furthermore, emphasis must be placed on the sustainability of newly formed behaviors and lifestyles to prevent weight regain [?].

2.2 Principle of Gradual Progression

Changing behavioral patterns that patients have developed over the long term—or those formed based on their own physiological, psychological, and environmental factors—presents a significant challenge through Behavioral Lifestyle Interventions (BLIs). Therefore, such interventions should be guided by established theoretical frameworks and employ a comprehensive range of methods, including environmental modifications, service provision, education, counseling, and direct guidance, to create a synergistic effect [?]. Implementing collaborative goal setting, encouraging patient self-monitoring, assisting patients in identify-

ing and managing emotional issues, and effectively reducing Expressed Emotion (EE) can enhance the overall efficacy of weight loss interventions [?, ?, ?] (C).

2.3 Principle of Comprehensive Intervention

Intervention programs should be customized based on the patient' s behavioral characteristics, psychological state, and social environment [?] (A). To achieve differentiated intervention, an accurate assessment of the patient' s behavioral preferences must be conducted [?] (B). Wearable devices can continuously and dynamically collect data, providing a foundation for these personalized approaches.

2.4 Principle of Individualization

Monitoring perceived stress and weight loss outcomes is conducive to the timely adjustment of intervention strategies [?] (A). Cultural background exerts a profound influence on an individual' s dietary habits and lifestyle [?]. Therefore, integrating a patient' s cultural background, personal values, and preferences into the treatment plan allows for the formulation of recommendations that are more aligned with their practical circumstances. This approach can significantly enhance both the acceptance and the overall effectiveness of the intervention [?].

3. BLIs Strategies and Methods

The implementation of Behavior Change Interventions (BLIs) requires adherence to behavior change theories, the adoption of teach-back health education (TBHE), the utilization of Behavior Change Techniques (BCTs), and the active application of digital technologies.

3.1 Based on Established Behavior Change Theories

According to the conceptual framework of behavioral change theoretical models , effectiveness is the fundamental prerequisite for Behavior Change Literacy Interventions (BLIs). This effectiveness encompasses several key components: (1) Adherence to theoretical guidance and evidence-based scientific principles. This involves prioritizing the use of behavioral change techniques that have been empirically proven effective for BLIs to determine appropriate intervention content, objectives, tools, and workflows. Furthermore, it requires the clear definition of specific intervention measures, data collection protocols, and evaluation methodologies [?].

3.1.1 Stimulating Patients' Behavioral Intention for Weight Management Under the guidance of the Theory of Planned Behavior (TPB), health-care providers can offer counseling and training services to assist patients in reframing their perceptions of barriers—such as fatigue and perceived lack of time—and identifying potential solutions. These interventions are designed to

enhance the self-efficacy of patients with obesity, thereby facilitating sustainable behavioral change [?].

3.1.2 Improving Patient Self-Efficacy Attitudes toward weight management, the ability to accurately assess one’s own condition and evaluate strategies to enhance weight loss motivation, the modification of sedentary behaviors and other unhealthy lifestyles, and the cultivation of behavioral habits and lifestyles conducive to long-term weight management are essential components of effective intervention [?].

3.1.3 Providing Targeted Guidance for Patients at Different Stages of Behavior Change Based on the Transtheoretical Model (TTM), also known as the Stages of Change, corresponding intervention plans and measures should be formulated according to the patient’s current stage. For instance, for patients in the pre-contemplation stage, measures should focus on helping them recognize the health hazards of obesity and the importance of weight loss to encourage their transition into the contemplation stage. Conversely, for those already in the action stage, specific behavioral guidance and support must be provided to help them maintain weight loss behaviors and prevent weight regain [?].

Furthermore, based on the Health Belief Model (HBM), healthcare providers should utilize face-to-face consultations and the distribution of health education materials, such as popular science videos, to help obese patients perceive the severity of their condition and its potential health risks. These interventions aim to help patients recognize the benefits of healthy behaviors and lifestyles—including a balanced diet, rational exercise, and regular sleep—while identifying and addressing potential barriers they may encounter when adopting these healthy lifestyle changes.

3.1.4 Creating a Supportive Environment for Weight Management

Table 1 Principles of Behavioral and Lifestyle Interventions (BLIs)

Principle	Description
Individualization	Interventions should be tailored to the patient’s specific health status, cultural background, socioeconomic conditions, and personal preferences.
Goal Setting	Establish clear, measurable, achievable, relevant, and time-bound (SMART) goals to guide behavior change.

Principle	Description
Self-Monitoring	Encourage patients to track their own behaviors (e.g., food intake, physical activity, weight) to increase self-awareness and accountability.
Problem Solving	Identify potential barriers to lifestyle changes and develop practical strategies to overcome these obstacles.
Social Support	Leverage support from family, friends, or peer groups to enhance motivation and long-term adherence to the intervention.
Stimulus Control	Modify the environment to reduce triggers for unhealthy behaviors and increase cues for healthy actions.
Cognitive Restructuring	Help patients identify and modify negative thought patterns or beliefs that hinder healthy lifestyle choices.
Relapse Prevention	Develop strategies to manage high-risk situations and prevent a return to previous unhealthy habits after initial success.

1. Application of Behavior Change Theories in Obesity BLIs

As shown in Table 2, several core theories provide the framework for behavioral lifestyle interventions (BLIs) in obesity management:

- **Theory of Planned Behavior (TPB) [?]:** This theory suggests that more positive attitudes toward a behavior, stronger subjective norms, and greater perceived behavioral control lead to stronger behavioral intentions. In practice, counseling and training services can help patients change their attitudes toward weight management, recognize the benefits of healthy eating and exercise, and correctly assess their ability to increase weight-loss motivation.
- **Health Belief Model (HBM) [?]:** Individuals adopt healthy behaviors only when they perceive a health threat from a disease, recognize the benefits of action, and face minimal barriers. Health education helps patients understand the hazards of obesity and the benefits of healthy lifestyles (such as balanced diets, rational exercise, and regular sleep). It also addresses potential obstacles and coping strategies, thereby stimulating weight-loss intentions and self-efficacy.
- **Transtheoretical Model (TTM) / Stages of Change [?]:** Behavior change occurs across five stages: pre-contemplation, contemplation, preparation, action, and maintenance. Each stage features distinct psycholog-

ical characteristics and requires specific intervention strategies. Tailored intervention plans are developed based on the specific stage the patient currently occupies.

- **Social Cognitive Theory (SCT)** [?]: SCT emphasizes that personal behavior is influenced by the reciprocal interaction of individual factors, behavioral factors, and environmental factors (triadic reciprocal determinism). Individuals acquire new behavior patterns by observing others and regulate their behavior through self-efficacy. Weight management programs can be developed using situational perception, outcome expectations, goal setting, self-monitoring, and social support.

2. Implementation Strategies based on Social Cognitive Theory

Under the framework of Social Cognitive Theory (SCT), health education and the creation of supportive environments are used to motivate patients to manage their weight. Specific implementation methods include [?]:

- **Situational Perception:** Organizing lectures on the hazards of obesity and its impact on work performance.
- **Outcome Expectations:** Facilitating group discussions on the benefits of weight improvement for health, work, and quality of life.
- **Self-Efficacy Enhancement:** Sharing successful case studies of individuals who achieved weight loss goals through incremental, small changes.
- **Goal Setting and Self-Monitoring:** Guiding patients on how to set short-term and long-term weight loss goals and monitor their progress.
- **Social Support:** Engaging family, friends, communities, and workplaces to build a supportive environment.

Patients should be encouraged to record all daily food and beverage intake along with energy content to determine if dietary goals are met. Additionally, patients should record personal feelings—particularly those related to binge eating or unplanned eating—and identify triggers for such behaviors to better manage their weight loss journey.

3.2 TBHE

Teach-back health education (TBHE) is a bidirectional communication method that requires patients to demonstrate their mastery of health knowledge and skills through repetition, description, or practical demonstration after receiving training and guidance [?]. TBHE has demonstrated significant effectiveness in improving patient health literacy, enhancing disease prevention and control knowledge [?], and optimizing dietary behaviors [?]. Furthermore, TBHE can strengthen patients' sense of self-efficacy, promote the development of self-management behaviors [?, ?], and serve as a tool for the real-time assessment of health education outcomes [?].

3.3 Effective Use of BCTs

Commonly used Behavior Change Techniques (BCTs) include goal setting, self-monitoring, stimulus control, and problem-solving [?]. BCTs are indispensable for helping patients with obesity strengthen self-management, adhere to intervention protocols, and promote long-term behavioral change [?], as detailed in

3.3.1 Goal Setting Goal setting refers to the process of establishing specific behavioral or weight-loss objectives for patients with obesity, thereby encouraging them to proactively adopt weight-related behaviors and lifestyle changes. Research indicates that setting weight-loss goals leads to more significant weight reduction compared to not setting goals at all [?]. Furthermore, establishing more ambitious weight-loss targets—particularly when motivated by the pursuit of health or physical fitness—results in more pronounced weight-loss outcomes and lower attrition rates [?]. Practitioners should conduct periodic reviews of goal attainment and assist patients in setting new objectives. If established interim goals are not met, clinicians should help patients identify and eliminate barriers to success or adjust the original targets accordingly [?].

3.3.2 Self-Monitoring Self-monitoring provides patients with immediate feedback on the effectiveness of their behavioral changes, thereby enhancing their awareness of target behaviors and their subsequent impact on weight management. Patients should be encouraged to use tools such as pedometers to record the duration and type of their daily physical activities; furthermore, they should be instructed to measure and record their body weight at least once a week [?]. Regular monitoring of weight, physical activity, and dietary intake is associated with superior weight loss outcomes [?].

3.3.3 Stimulus Control Stimulus control can be utilized to modify both external and internal cues that influence eating and exercise behaviors [?], thereby helping patients construct an environment conducive to weight loss. For instance, patients should be encouraged to place healthy, low-calorie foods in highly visible and accessible locations within their homes and workplaces, while storing snacks out of sight in cupboards. Additionally, using smaller tableware can help control portion sizes. To increase prompts for physical activity, patients may be advised to establish routines such as walking with family members at specific times each day or keeping exercise equipment in their vehicles [?].

3.3.4 Problem Solving To improve weight loss outcomes, it is essential to analyze the specific causes of problems and barriers encountered by obese patients during the weight loss process—such as Emotional Eating (EE) and perceived lack of time. By developing concrete coping strategies, clinicians can enhance patients' ability to navigate these obstacles and significantly reduce dropout rates. For instance, for patients citing a lack of time for exercise, a “fragmented exercise” plan can be designed to incorporate physical activity into short intervals

throughout the day. Similarly, for patients struggling with EE, practitioners can recommend substituting snacking with a short walk as a primary coping mechanism during periods of high anxiety or stress.

3.4 CBT

Cognitive Behavioral Therapy (CBT) can identify, test, and correct maladaptive cognitions, thereby modifying emotions or behaviors and encouraging patients to adopt lifestyles and behaviors conducive to weight loss and maintenance [?, ?]. For example, mindful eating training can enhance self-control and food selection capabilities in patients with obesity while increasing their awareness of binge-eating triggers. This approach effectively reduces the frequency of binge-eating episodes, lowers total dietary energy intake, and decreases body weight, BMI, and waist circumference [?].

3.5 Comprehensive Measures to Prevent Weight Regain

Preventing weight regain remains a significant challenge for Behavior Lifestyle Interventions (BLIs). Effective strategies to address this include: (1) maintaining continuous contact with patients, either through face-to-face or remote communication, after the completion of the initial weight loss program; (2) participating in long-term weight maintenance programs, such as those lasting at least one year and involving at least one consultation per month; and (3) sustaining high levels of physical activity, adhering to a low-calorie diet, and performing regular weight monitoring following initial weight loss. Emphasis should be placed on the application of diverse intervention techniques, as utilizing a greater number of weight control strategies is more conducive to the long-term maintenance of a healthy weight [?, ?].

Table 3: Behavior Change Techniques (BCTs) for Promoting Weight Management

Behavior Change Technique (BCT)	Description	Impact on Weight Management
Goal Setting and Review	Establish specific, measurable, achievable, relevant, and time-bound (SMART) goals. After each intervention phase, review the patient's progress and assist in setting new objectives. If goals are not met, help the patient identify and mitigate barriers or adjust the original targets accordingly.	Setting specific goals for energy intake, dietary habits, physical activity, and weight loss can significantly improve patient adherence to behavior change programs.
Self-Monitoring	Enhance patient self-awareness and accountability by recording data such as dietary intake, exercise, and body weight. This provides immediate feedback on the effectiveness of behavior changes and increases cognitive awareness of target behaviors and weight fluctuations.	Self-monitoring is positively correlated with weight loss outcomes and effectively enhances the long-term maintenance of healthy behaviors.
Stimulus Control	Modify the environment to reduce triggers for unhealthy eating behaviors and increase the convenience of healthy actions, thereby helping patients establish internal and external environments conducive to weight loss.	Implementing stimulus control measures—such as managing the dining environment, controlling snack access, and creating exercise triggers—can reduce mindless eating and increase physical activity levels.

Behavior Change Technique (BCT)	Description	Impact on Weight Management
Problem Solving	Develop specific coping strategies for obstacles encountered during the weight loss process, such as emotional eating or time constraints.	Problem-solving training improves a patient's ability to navigate obstacles during weight management, thereby reducing the likelihood of premature dropout.

3.6 Active Adoption of Digital Technologies

The application of digital technology facilitates the monitoring of food intake, physical activity levels, and changes in anthropometric indicators such as body weight and waist circumference. This approach can enhance adherence to intervention measures and improve overall intervention efficacy [?]. Integrating digital technologies with Behavior Change Techniques (BCTs) to innovate obesity intervention strategies can provide the necessary technical support for achieving sustained behavioral change.

Intervention measures based on digital technology, such as assisting patients in setting weight loss goals, are also conducive to achieving weight reduction targets [?]. Digital interventions can provide personalized feedback regarding weight, diet, and physical activity, while facilitating remote consultations to monitor the intervention process and its outcomes. Compared to other methods, digital platforms, social media, virtual reality, online gaming, and mobile applications can be effectively utilized in weight loss interventions [?].

3.7 Combining Individual, Group, and Social Interventions

Group-based behavioral lifestyle interventions (BLIs) have been shown to be as effective as individualized weight loss counseling [?]. Within a group intervention setting, individuals can benefit from more robust social support, mutual understanding, and healthy competition, leading to superior outcomes in weight loss behavioral interventions. Furthermore, group therapy offers better cost-effectiveness compared to individualized counseling [?].

4. Intervention Strategies and Methods for High-Risk Dietary Behaviors in Obesity

4.1 Controlling Total Energy Intake

Energy restriction is essential for achieving clinically significant weight loss (defined as a reduction of at least 5% of initial body weight). It is recommended that patients with obesity reduce their daily energy intake by 500-1,000 kcal,

or decrease their total energy intake by 30%. For individuals with a BMI $> 30.0 \text{ kg/m}^2$, or those with a BMI $> 27.0 \text{ kg/m}^2$ accompanied by comorbidities, a very-low-calorie diet (VLCD) is recommended. Maintain a daily caloric distribution of 15%-20% from protein, 20%-30% from fat (with saturated fat not exceeding 10%), and 50%-60% from carbohydrates. It is recommended to reduce portion sizes and limit the intake of added sugars and fats [?]. Diets designed for portion control may include shakes, meal replacement bars, and pre-packaged entrees.

4.2 Adhering to Dietary Patterns Conducive to Weight Loss

Adherence to dietary patterns such as the Mediterranean diet (MD) can facilitate effective weight loss in patients with obesity [?], as detailed in . To achieve weight loss goals, patients should select an appropriate dietary pattern based on their individual health status, lifestyle, and personal preferences. Low-carbohydrate diets (LCD) and high-protein diets (HPD) result in greater weight loss within 3 to 6 months; however, their long-term weight loss efficacy (exceeding 1 year) is generally modest [?]. When selecting specific foods, individual cardiometabolic risk factors and dietary preferences should be taken into consideration.

4.3 Eating Habits, Patterns, Locations, and Emotional Management Conducive to Weight Loss

Appropriate intervention methods should be adopted based on the specific manifestations of various dietary behaviors [?, ?], as detailed in Table 5 .

4.4 Dietary Behavior Intervention Measures

4.4.1 Application of Behavior Change Theories Behavior change theories can be effectively applied to obesity weight loss interventions [?]. Obesity behavioral lifestyle interventions (BLIs) must focus on high-risk dietary behaviors and the control of total energy intake, as shown in . These interventions aim to promote healthy eating habits, including adherence to the principles outlined in relevant dietary guidelines.

4.4.2 Measures for Changing Dietary Behavior Modifying dietary behavior can be systematically advanced by integrating behavior change theories with Behavior Change Techniques (BCTs) across four dimensions: self-awareness, substitution and reinforcement, environmental design, and social support. The core objective is to transform “eating” from an automatic habit into a manageable, conscious behavior [?].

Self-Awareness and Behavioral Modification: The first step in behavioral change is self-awareness, which involves systematic recording followed by reflection. For a period of 3-7 days, document “when, where, and what was eaten,” as well as “emotional state and level of hunger.” By reviewing these records,

individuals should circle high-frequency triggers—such as watching television, working overtime, or passing by a bakery—to identify 2-3 specific “high-risk scenarios” that most urgently require intervention.

Dietary Patterns Conducive to Weight Loss

- **Mediterranean Diet (MD):** The Mediterranean Diet (MD), particularly when combined with exercise interventions, can significantly reduce body weight and body fat in the short term. Furthermore, it demonstrates a positive effect on cardiovascular risk factors, such as lowering blood glucose, glycated hemoglobin (HbA1c), and triacylglycerol (TG) levels, while increasing high-density lipoprotein cholesterol (HDL-C) levels [?].
- **Plant-Based Diets:** Plant-based diets may be more effective for weight loss than other more moderate dietary recommendations [?]. Research indicates that weight loss in plant-based diet groups is significantly greater than in other dietary groups, including vegetarian, pescatarian, semi-vegetarian, and omnivorous groups. Additionally, plant-based diets are highly effective in reducing total fat and saturated fat intake.
- **Calorie-Restricted and Low-Carbohydrate Diets:** Short-term interventions involving a low-carbohydrate diet (LCD, where energy contribution is $\leq 40\%$), a calorie-restricted diet (CRD), or a combination of both (LCD+CRD) are effective in reducing body weight and BMI in individuals with simple overweight or obesity [?]. Under conditions of equal energy restriction, further limiting the proportion of carbohydrates yields more significant weight loss results.
- **High-Protein Diet (HPD):** Combining the Theory of Planned Behavior (TPB) with a low-carbohydrate diet for targeted regulation in patients with type 2 diabetes mellitus (T2DM) and comorbid obesity can significantly reduce BMI and improve lipid metabolism [?]. An HPD, where protein accounts for 20%–30% of total energy or $1.5\text{--}2.0 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$, can reduce hunger, increase satiety, and elevate resting energy expenditure.

Eating Habits, Patterns, Locations, and Emotional Management Conducive to Weight Loss in Individuals with Obesity

A. Eating Habits

Establishing healthy eating habits is a fundamental component of weight management for individuals with obesity [?]. 1. Adhere to a regular eating schedule and avoid skipping meals. 2. Prioritize unprocessed or minimally processed foods and reduce intake of high-sugar, high-fat, and high-salt foods. Substitute unhealthy ingredients with healthy ones, such as using oils rich in monounsaturated fatty acids (e.g., olive oil, tea seed oil, rapeseed oil) instead of butter. 3. Adjust total daily energy intake based on individual needs and distribute energy reasonably across three meals (e.g., 30% breakfast, 45% lunch, 25% dinner) [?].

4. Strictly limit food intake outside of the three primary meals. 5. Follow a rational eating sequence: prioritize fiber-rich foods (e.g., green leafy vegetables) or low-GI vegetables (e.g., tomatoes, cucumbers), followed by healthy fats (e.g., nuts, deep-sea fish), proteins (e.g., lean meats, legumes), and finally carbohydrates (e.g., brown rice, whole-wheat bread) [?].

B. Dining Location [?]

1. When dining out, prioritize restaurants offering healthy options like the Mediterranean diet, ensure food diversity, and maintain adequate intake of fresh vegetables and whole grains.
2. Limit intake of red meat, processed meats, sweets, and beverages.

C. Emotional Eating [?]

1. Identify emotional eating (EE) triggers (e.g., stress, loneliness, anxiety) by keeping a food diary that includes emotional states. Use mobile apps or paper logs for at least two consecutive weeks.
2. After identifying triggers, choose non-eating activities (e.g., 10-min walk, deep breathing, social interaction) to alleviate negative emotions.
3. Practice mindful eating (e.g., 10-second pause before eating, sensory focus, thorough chewing) for at least 5 minutes per session, at least 3 times per week.
4. Establish social support networks and use online mutual aid platforms to share progress and challenges.
5. If EE is accompanied by persistent depression or anxiety, refer to a psychologist or registered dietitian for structured CBT.

Common Behavior Change Theories Used in Dietary Behavior Interventions

- **Transtheoretical Model (TTM) [?]**: Matches interventions to the patient's psychological state across stages (pre-contemplation to maintenance). It is suitable for long-term self-management but can be complex to implement.
- **Theory of Planned Behavior (TPB) [?]**: Quantifiably predicts behavioral intentions and offers clear strategies for short-term interventions. However, a gap often exists between intention and actual behavior.
- **Social Cognitive Theory (SCT) [?]**: Emphasizes multi-dimensional intervention (cognitive, environmental, behavior) and social support. It is effective for groups with strong cultural influences but requires significant resources.

Measures for Changing Dietary Behavior (Continued): - Substitution and Reinforcement: Start with the “easiest to win” point. Begin with simple changes like adding fruit to breakfast or replacing sugary drinks with water. Prioritize natural foods high in fiber and protein to promote satiety. Replace

refined grains with whole grains to minimize psychological resistance. - **Environmental Design:** Place healthy foods at eye level and store high-calorie snacks in inconvenient locations. Use smaller plates and bowls. Establish rules such as not eating while distracted by electronic devices. - **Scientific Planning:** Tailor meal frequency to individual needs. A “three meals and two snacks” pattern can reduce hunger before main meals [?]. For eligible patients, “16/8 intermittent fasting” may be considered, provided nutrient intake remains balanced [?]. - **Social Support:** Build confidence through social support from family, friends, and peer groups [?]. Communities can support weight loss by providing facilities for physical activity and hosting health workshops [?].

5. Intervention Strategies and Methods for High-Risk Exercise Behaviors in Obesity

5.1 Exercise Modalities Related to Obesity Treatment

5.1.1 Aerobic Exercise It is recommended that patients with obesity engage in at least 150 minutes of moderate-intensity aerobic exercise per week. To achieve long-term weight management, gradually increase to at least 250 minutes per week across 5 to 7 days [?] (A).

5.1.2 Resistance Training Resistance training is essential for increasing muscle strength, improving body composition, and elevating basal metabolic rate. Combining resistance training with optimized protein intake helps prevent sarcopenic obesity [?] (I A).

5.1.3 Combined Training (Aerobic + Resistance) Comprehensive training effectively improves cardiorespiratory endurance and metabolic function [?, ?] (I A). While highly effective, it requires a commitment of 300–400 minutes per week [?].

5.1.4 High-Intensity Interval Training (HIIT) HIIT is time-efficient and helps improve exercise adherence, making it a valuable tool for patients with limited time [?, ?] (I A).

5.2 Comprehensive Behavioral Intervention Strategies

5.2.1 Multi-component Behavioral Interventions High-intensity programs consisting of at least 14 sessions within 6 months can achieve 5%–10% weight reduction and improve health indicators [?, ?] (A).

5.2.2 Supervision and Social Support Implementing moderate-to-high intensity exercise interventions with supervision can significantly improve adherence [?] (I A).

5.2.3 Reallocating Physical Activity Intensity Moderate-to-vigorous physical activity significantly reduces BMI and waist circumference [?, ?] (A). Low-intensity activity can serve as a starting point for sedentary individuals.

5.2.4 Precision Intervention Strategies Implementing precision interventions based on individualized assessment (genetic, metabolic, behavioral) maximizes efficacy [?, ?] (I A).

5.2.5 Combining Diet and Exercise Comprehensive interventions integrating diet, exercise, and behavioral support yield superior results compared to single-modality programs [?, ?, ?] (A).

5.3 Behavioral Change Techniques for Exercise

- **BCTs:** Self-monitoring, goal setting, and feedback mechanisms increase adherence [?] (A).
- **Motivational Interviewing:** Stimulates intrinsic motivation and executive capacity [?] (A).
- **Digital Health Tools:** Facilitate monitoring and enhance engagement, especially for childhood obesity [?] (II A).

5.4 Personalized Exercise Prescription

Foundational assessment includes body composition analysis and cardiopulmonary exercise testing (CPET) to determine safe aerobic exercise parameters [?, ?]. For the elderly, programs should balance low-impact activities like Tai Chi with strength training [?]. For children, interventions should emphasize fun and social interaction [?].

6. Psychosocial Intervention Strategies and Methods for Obesity

6.1 Correlation Between Mental Disorders and Obesity

Obesity and emotional disorders like depression have a bidirectional relationship [?]. Chronic stress can trigger emotional eating (EE) as a coping mechanism [?].

6.2 Strategies and Methods for Psychosocial Intervention

Multi-component interventions combining behavioral modification with CBT should be used (I A). CBT, Acceptance and Commitment Therapy (ACT), and motivational interviewing are effective [?] (I A). Strategies are summarized in .

6.3 Referral for Psychological Issues

Referral should be considered for significant life stressors, mood disorders, eating disorders, or severe mental illnesses.

Table 7: Strategies and Methods of Psychological Intervention for Patients with Obesity

Intervention Approach	Recommendations for Healthcare Professionals	Patient Action Tasks
Motivational Interviewing	Stimulate intrinsic motivation; use open-ended questions and reflective listening.	Reflect on personal reasons for change; list benefits and difficulties.
CBT	Identify and correct negative thinking to alter emotions and behavior.	Maintain an emotion-eating diary; practice cognitive reframing.
ACT	Accept inevitable thoughts while committing to actions consistent with values.	Define core values; learn to observe impulses through mindfulness.
Mindfulness	Pay non-judgmental attention to the present eating experience.	Avoid distractions while eating; slow down and savor food; identify satiety signals.

7. Sleep Behavior Intervention Strategies and Methods for Obesity

7.1 Evidence for Sleep Intervention in Weight Loss

Extending sleep duration to 8.5 h/d can reduce energy intake and promote weight loss [?] (A). Sleep intervention improves BMI and body fat percentage [?] (A).

7.2 Strategies and Methods for Sleep Intervention

Psychosocial interventions can effectively extend sleep duration [?] (A). Methods include education, CBT, relaxation training, light therapy, and circadian rhythm regulation [?] (A).

8. Process and Implementation of BLIs

The BLI process includes pre-intervention assessment, identification of priorities, and determination of goals, content, settings, methods, intensity, and duration

[Figure 1: see original paper].

8.1 Pre-intervention Assessment

Assessment includes personal information, anthropometric indicators (BMI, waist circumference), metabolic indicators, behavioral patterns (diet, exercise, sleep), and psychosocial factors [?].

8.2 Identification of Priority Intervention Items

Priority should be given to high-risk behaviors like high-calorie diets and EE based on patient preference and health benefits [?, ?] (I A). A “Goal Negotiation Table” () can be used.

8.3 Determination of Intervention Goals

Goals should be established in stages: short-term (behavioral shaping), medium-term (weight loss and metabolic improvement), and long-term (maintenance and complication prevention) [?, ?, ?] (I A). Goals should follow SMART principles .

8.4 Determination of Intervention Content

Content involves multi-dimensional synergy covering diet, exercise, and psychosocial support .

8.5 Determination of Intervention Settings

Settings include medical institutions, communities, homes, and digital platforms [?, ?] (I B).

8.6 Determination of Intervention Modalities

Modalities include face-to-face, remote online, group activities, or hybrid models [?] (I B).

8.7 Determination of Intervention Intensity

Intensity should be dynamically adjusted across stages (short-term high frequency to long-term low frequency) [?] (I A).

8.8 Determination of Intervention Duration

Recommended duration is ≥ 1 year to prevent weight regain [?] (I A).

8.9 Evaluation of Intervention Effectiveness

Evaluation should be multi-dimensional (physiological, behavioral, psychological) and integrated throughout the process [?] (I B).

[Figure 1: see original paper] Flowchart of behavioral and lifestyle interventions (BLIs) for patients with obesity

Goal Negotiation Table (Example)

Key Points of BLIs at Different Stages

Comparison of obesity intervention goal stratification and the SMART principle

9. BLIs for Childhood and Adolescent Obesity

Childhood obesity often persists into adulthood and is driven by high-calorie diets, physical inactivity, and psychosocial factors [?].

9.1 Screening, Diagnosis, and Classification

BMI is the primary metric for screening [?]. Assessment should also include dietary behavior, physical activity habits, and psychosocial factors [?].

9.2 Intervention Measures

- **Diet:** Balanced structure, portion control, and regular eating intervals [?] (A).
- **Physical Activity:** At least 60 min/d of moderate-to-vigorous activity; limit screen time [?] (A).
- **Sleep:** Ensure age-appropriate duration and regular cycles [?] (A).
- **Psychosocial Support:** Help children cope with negative emotions in healthy ways.

9.3 Strategies for Childhood Obesity BLIs

Intervention requires collaboration across family, school, community, and clinical levels [?] (A).

9.4 Family Support

Parents play an indispensable role by modeling healthy behaviors, providing a supportive environment, and avoiding weight-related criticism [?, ?] (A).

10. Application of Digital Technology in Obesity Intervention

Digital technology enhances precision diagnosis, personalized intervention, and full-cycle monitoring [TABLE:12, TABLE:13].

10.1 Definition and Characteristics

Digital tools include apps, wearable devices, AI, and XR, offering accessibility, data continuity, and personalized feedback.

10.2 Application Scenarios

- **Dietary Management:** Real-time recording and personalized recommendations [?].
- **Exercise Intervention:** Goal setting, real-time feedback, and gamification [?] (I A).
- **Sleep and Stress Management:** Screen time restriction and biofeedback [?] (II B).

10.3 Implementation Mechanisms

Mechanisms include behavioral guidance messages, real-time multi-dimensional feedback, and integrated monitoring systems [?].

10.4 Considerations for Digital Technology

Focus on data security, privacy protection, and stratified implementation based on resource accessibility [?].

Advantages of Digital Technology in Obesity Intervention

Monitoring Functions of Wearable Devices

11. Effectiveness Evaluation of BLIs

Evaluation assesses improvements in behaviors, lifestyle, weight, and health status.

11.1 Principles of Evaluation

Evaluation should be continuous (formative, process, outcome), scientific (RCTs preferred), systematic (systems thinking), and flexible [?].

11.2 Design of Evaluation Plans

Designs include RCTs, cluster RCTs, stepped-wedge designs, and mixed-methods research [?].

11.3 Evaluation Indicators

Indicators cover physiological (BMI, metabolic markers), behavioral (diet, exercise adherence), and psychosocial (quality of life, self-efficacy) domains [?].

11.4 Data Collection

Data is collected through physical exams, lab tests, standardized scales, behavioral diaries, and wearable devices.

Primary Evaluation Designs for Obesity Interventions

Classification of Obesity Intervention Evaluation Indicators

12. Critical Considerations and Future Directions

12.1 Improving Practical Effectiveness

Intensive BLIs can be resource-intensive and have high attrition rates. Adherence to standardized guidelines is essential [?, ?].

12.2 Preventing Weight Regain

Weight regain is common due to metabolic adaptation and hormonal changes. Long-term maintenance programs (≥ 1 year) and consistent self-monitoring are vital [?].

12.3 Cultural Adaptability

Interventions must consider individual preferences and cultural backgrounds to enhance acceptance and effectiveness [?].

12.4 Rational Use of Pharmacotherapy and Surgery

BLIs are foundational, but pharmacological and surgical treatments are necessary for severe obesity or when BLIs are insufficient [?].

12.5 Standardized Referral Protocols

Referral to specialists should be considered for severe obesity, significant comorbidities, or suspected underlying medical etiologies.

In summary, Behavioral and Lifestyle Interventions (BLIs) are the cornerstone of obesity management. Training healthcare personnel and enhancing patient awareness are critical for the successful implementation of these strategies.

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Appendix 1: Recommended Workflow for Developing Weight Loss Exercise Prescriptions

(Summary of the 9-step process including screening, testing, risk assessment, FITT-VP formulation, and monitoring)

Appendix 2: Baseline for BLIs in Obese Patients

(Summary of assessment tools for weight loss intention, weight management history, and lifestyle influencing factors)

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv – Machine translation. Verify with original.