



Opinion

Precision nutrition for medical weight-loss: a new approach for the collaborative intervention of lifestyle management and nutritional therapy

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Abstract: Obesity, a major global public health issue, has become an increasingly urgent health crisis that cannot be ignored in recent decades. Unfortunately, conventional weight-loss methods suffer from poor compliance owing to the scarcity of scientific guidance, whereas medical weight-loss enables obese individuals to attain weight-loss and metabolic improvement through scientific precision medical methods. Lifestyle management and nutritional therapy are currently recognized as the basic treatments of the medical weight-loss, which possess the advantages of safety and effectiveness. Nonetheless, the crucial factor affecting weight-loss results included nutritional metabolism and compliance with significant individual differences. Herein, we proposed and elucidated a new approach to achieve sustainable weight management in accordance with the precise lifestyle interventions, personalized nutrition customization and comprehensive behavior management. Compared with those existing models, the “Medical Assessment-Nutritional Intervention-Behavioral Correction-Traditional Chinese Medicine Regulation” proposed in this paper has made a significant breakthrough in the core mechanism and practical effect.

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1 The collaborative intervention mechanism for metabolic function repair

1.1 Nutritional metabolism-targeted regulation

The effectiveness of lifestyle management and nutritional therapy is highly dependent on long-term adherence of patients. Therefore, poor adherence directly undermines the precision of nutritional intervention plans, such as arbitrarily increasing intake of high-sugar, high-fat foods, failing to complete exercise as scheduled, and skipping doses of multivitamin supplements. Given these challenges, nutritional metabolism-targeted regulation achieves precise weight-loss and metabolic optimization through scientifically designed and personalized nutritional plans. It not only precisely matches individual metabolic needs but also reduces implementation difficulty through personalized plans. These plans focus on the nutritional and metabolic characteristics of foods, on the one hand, we choose foods such as oats and chia seeds that are plentiful in dietary fiber to prolong gastric emptying time and increase satiety. On the other hand, functional components, conjugated linoleic acid and L-carnitine, are utilized to activate lipase activity and accelerate the oxidation and decomposition of fat. Additionally, composite nutrient supplements are formulated on the basis of basal metabolic rate, body composition, and

biochemical indicators of the individual. For instance, combining the role of vitamin B in improving energy metabolism with that of probiotics in regulating the gut microbiota and improving lipid absorption, a dual-regulation model of “food + supplements” is formulated to fulfill the homeostasis between targeted fat loss and functional maintenance. We can further enhance patient adherence through these following three approaches in clinical practice. We primarily develop personalized plans based on occupational characteristics, dietary restrictions and taste preferences of patient to minimize implementation barriers. Furthermore, applications (Apps) deliver meal and exercise check-in reminders while breaking down workout sessions into manageable segments. Additionally, in-person consultations are conducted biweekly to provide counseling for emerging issues, thereby preventing patients from discontinuing treatment due to psychological burdens.

1.2 Multi-dimensional lifestyle integration

We adopt a multidisciplinary collaborative model involving “Medical Assessment-Nutritional Intervention-Behavioral Correction-Traditional Chinese Medicine Regulation” in clinical practice. A 25-year-old female patient with simple obesity weighing 82 kg achieved weight-loss improvement through this model. Based on bioelectrical impedance analysis (BIA)

measurement of 45% body fat, a low-energy, low glycemic index (GI) and high-quality protein diet plan was developed. Low-GI carbohydrates were selected that energy intake was controlled at 45%, combined with high-quality protein and green leafy vegetables, supplemented with special medical protein components, prebiotics, probiotics, vitamin and mineral tablets. Concurrently, traditional Chinese medicine meridian regulation techniques were applied, targeting acupoints such as Zusanli and Sanyinjiao through moxibustion or acupoint implantation to regulate digestive functions and enhance metabolic efficiency of spleen and stomach. For instance, moxibustion has been proven to regulate blood lipids, its mechanism may be related to regulating the activity of enzymes associated with liver metabolism and improving insulin resistance. This is consistent with the nutritional therapy of a low-GI diet that lowers insulin levels. Both work together from different perspectives to improve insulin resistance and create a healthy internal environment for fat metabolism. The body fat percentage of the patient decreased to 36% and weight-loss of 14 kg (with a muscle loss of 0.6 kg) after three months. Subsequently, the patient paused weight-loss and entered a self-management phase with a balanced diet: weight-loss was 0.4 kg one year later. After another two months of intensive management, weight was maintained at 59 kg and body fat percentage at 29%, indicating that this multidisciplinary collaborative model is not only effective for weight-loss but also sustainable in the long term.

2 The intelligent-driven of clinical nutrition weight-loss intervention

The development of digital technology exerts essential influence on individual precision management. Based on a series of results of individual's health status, physical indicators and dietary risk assessment, a personalized program for nutrition is utilized through Apps to collect information of patients such as diet, exercise, sleep, behavior and psychology by nutritionists and case managers. This program will be phased by preparation, rapid weight-loss, transition and maintenance period. Wearable devices and Apps are extremely acclimatized to collect behavioral information of patients such as diet, exercise and sleep. When collecting data from wearable devices, we focus on foundational physical metrics such as basal metabolic rate and body fat percentage; exercise-related metrics including energy expenditure during activity, step count and workout duration; sleep-related metrics encompassing sleep duration and quality. Not only can the information determine whether behavioral patterns of individuals are consistent with the weight-loss target, but also it contributes to assessing patients whether there is a phenomenon in decreased compliance and behavioral deviation, thereby emitting targeted intervention reminders and plan adjustments in virtue of artificial intelligence (AI) algorithms. For instance, this system detects that the underwhelmed amount of exercise while it guides the patient to choose a suitable exercise. Moreover, it collects individual dietary information including food types, intake amounts and eating frequency, then combines with professional nutritional knowledge and algorithms to precisely analyze potential risks within dietary pattern such as nutritional imbalance, excessive fat or sugar intake. If irrational dietary pattern is detected, the system recommends adjustment advice and suitable recipes. In addition to predicting users' behavioral trends in daily life and formulating relevant preventive strategies, the behavioral intelligence management system supports the

plateau periods to assist users for solving problem and provides psychological intervention as well. The behavioral intelligence management provides data support for precise lifestyle intervention and personalized nutrition customization. Meanwhile, it contributes significantly to maintain healthy behaviors and effects of weight-loss through intelligent feedback. The effect is to evaluate nutritional status and health management of patients by demanding body composition and biochemical indicators during follow-up visits (Fig. 1).

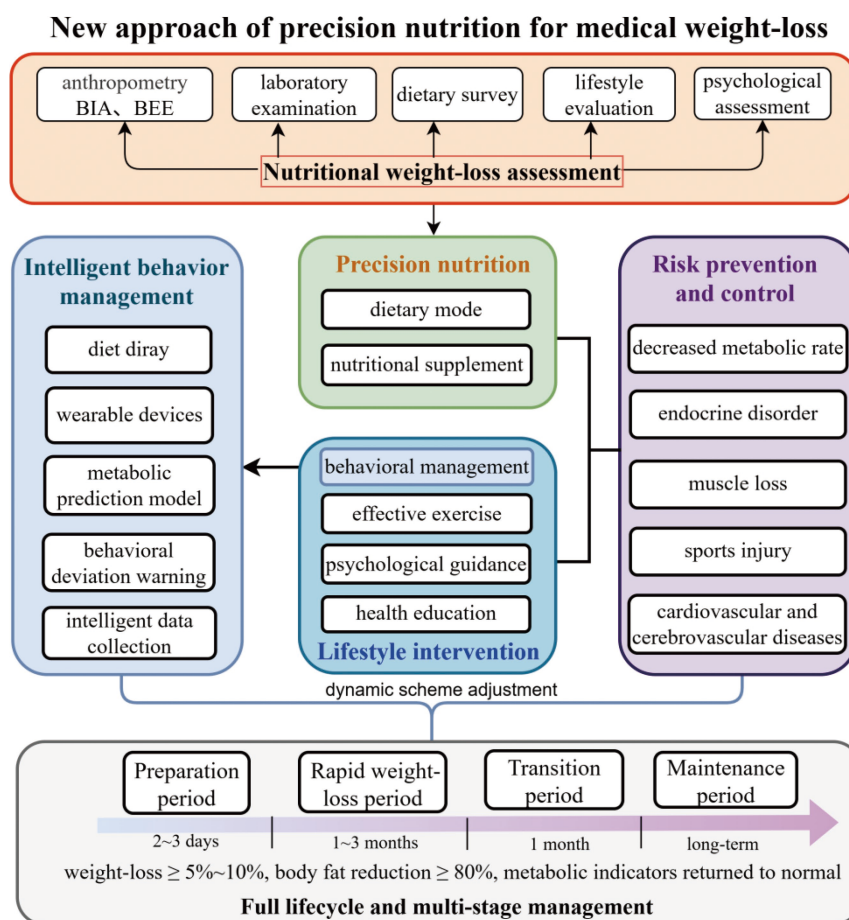
3 The risks in weight-loss clinical practice

A multitude of risks associated with nutritional weight-loss therapy have been observed in clinical practice. For instance, the excessive energy deficits and rapid weight-loss due to deviations in dietary schedules, the metabolic imbalances of reduced basal metabolic rate, hormonal disorders, abnormal blood glucose and lipid levels could be manifested. Besides, the excessive muscle loss and insufficient fat loss lead to minimal reductions in body fat percentage for the reason that the inadequate protein intake or ineffective exercise. Exercise-related injuries are stemmed from inadequate warm-ups, mismatched exercise methods or excessive intensity, including joint, muscle and ligament damage. In addition, the heavy cardiovascular burden and sudden increases of exercise intensity in obese patients is associated with cardiovascular risks, such as palpitations and chest tightness.

In response to the above risks, we propose the following targeted mitigation strategies based on clinical practice. Basal metabolic rate (BMR) and fasting blood glucose (FBG) were dynamically monitored by smart devices, for example, we automatically adjust the energy deficit to 300~400 kcal/d when BMR decreases by more than 3%. Meanwhile, vitamin B and magnesium supplementation are compulsorily included in personalized regimens to reduce metabolic disorder risk, such as 1.4 mg vitamin B₆ and 300 mg magnesium daily. Furthermore, setting a minimum protein intake of 1.6~2.0 g/kg/d and recording intake through the application, which triggered alerts when intake falls below 80% of the target. In addition, the three 20 minutes of basic strength training of resistance training requirements are incorporated into the exercise schedule and remotely monitored completion rates. Concerning safety management in exercise, we set initial intensity level on the basis of the patient's joint weight-bearing capacity and exercise history, increasing by no more than 10% in 2 weeks. Through Apps feature a built-in 10 minutes standardized warm-up video to mandatory warm-up protocol that patients must complete before recording exercise data, reducing the risk of muscle and ligament injuries. Resting heart rate and blood pressure are measured at enrollment. The exercise thresholds are adjusted in coordination with cardiologists for hypertensive patients. Besides, wearable devices trigger heart rate alerts (automatic vibration when exceeding 80% of maximum heart rate), with abnormal data synchronized to physician consoles to initiate phone follow-ups.

4 Comparative analysis with existing precision nutrition models

The current precision nutrition models mainly included three categories: gene-oriented precision nutrition model, single-behavior intervention model and traditional digital nutrition model. Firstly, the gene-oriented model takes gene detection as the core to guide the selection of dietary components. Compared with



the gene-oriented model, this new model does not depend on single gene data, despite through multi-dimensional evaluation of “basal metabolic rate + body composition + biochemical indicators + real-time behavioral data”, which avoided the deviation of between gene prediction and actual metabolism. Secondly, the single-behavioral intervention model only focuses on a single dimension of diet or exercise. By contrast, the model proposed in this manuscript combines nutrition, lifestyle and behavior, which solved the limitations that diet alone lead to muscle loss and exercise alone lead to metabolic imbalance. Finally, Traditional digital nutrition model relies on basic data to make static diet plan. However, the dynamic adjustment function of AI algorithms and the metabolic assistance effect of traditional Chinese medicine conditioning have achieved accuracy and safety. For instance, the current digital models can only alert for excessive diet, but the new model have the ability to analyze the reasons for excessive diet, recommend suitable low-GI recipes and combine acupoint regulation to improve the absorption of the spleen and stomach, upgrading from “passive reminder” to “active problem-solving”.

In summary, compared with previous medical weight-loss of on the basis of experience, it is imperative to urgently combine the Internet and AI-assisted to develop a new model of collaborative intervention of “precise lifestyle intervention, personalized nutritional therapy and intelligent behavioral management”, which is synergistic mutually. This model fundamentally solves the problems of impoverished individual suitability and low adherence to the traditional weight-loss solution; moreover, it makes the enormous upgrade of medical weight-loss from universal standardization to individual precision management. Additionally, metabolic analysis of nutrients and individualized formulation of supplements, development of intelligent monitoring and intervention tools, and construction of management models for multidimensional data integration also deserve to be prospectively investigate.

Conflicts of interest

The authors declare that there are no conflicts of interest in this work.