Evaluating the Impact of Personalized Digital Weight Loss Program: A Study on Overweight Individuals with the Implementation of Intermittent Fasting, Carbohydrate Reduction, and Meal Image Monitoring

Research Article

Panwar B*, Indana R, Bhagyasri A, Bharadwaj A, Prabhu MU, Duggani M and Kattika S

Department of Nutrition and Dietetics, Mfine Bengaluru. India

*Corresponding author: Bhawi Panwar, Department of Nutrition and Dietetics, Mfine Bengaluru. India Email Id: bhawi.panwar@mfine.co

Abstract

Global obesity, marked by excess body fat, poses severe health risks, straining healthcare systems. Effective weight management strategies that are practical and sustainable are crucial to combat this growing health crisis. One such approach involves the utilization of digital interventions to provide structured and personalized weight loss programs. This study focuses on evaluating the effectiveness of the digital solution, Mfine's Weight Loss Program (WLP), targeted at overweight individuals as defined by Body Mass Index (BMI) criteria. The primary objective of this research is to evaluate the effectiveness of Mfine's digital Weight Loss Program in overweight individuals by determining the average weight reduction achieved through the implementation of intermittent fasting and carbohydrate reduction. Furthermore, the study aims to evaluate the benefits of digitally monitoring recommended diets through meal images. This study involved 180 participants within a wide age range of 18 to 80 years with overweight conditions. Participants received personalized support from health coaches, dietitians, and fitness trainers along with adjustments to their daily lifestyles. The study assessed effectiveness by comparing participant's initial and final weight measurements over 90 days.

Results revealed a significant (p<0.001) reduction in weight for both genders, with promising outcomes in terms of weight reduction. Among the 180 participants (76 females, 104 males), the average initial weight for females was 77 kg and males were 90 kg. At the program's end, the average weight reduction for females was (72.2±3.91) kg and for males was (85±3.95) kg.

In conclusion, the study has offered a simplified lifestyle intervention with a focus on behavior through mobile health monitoring demonstrating feasibility and positive reception. It indicates positive outcomes in weight reduction. Importantly, the incorporation of meal image monitoring effectively records dietary habits, allowing timely personalized advice and tailored nutritional approaches that result in improved participant outcomes.

Keywords: Obesity; Mfine app; Meal images; Digital nutrition; Weight loss program; Intermittent fasting; Carbohydrate reduction

Introduction

The prevalence of overweight and obesity is on the rise worldwide, affecting both developed and developing nations and it is a global concern [1]. With over 1 billion individuals affected, including 650 million adults, 340 million adolescents, and 39 million children. Unfortunately, this number continues to rise, and the World Health Organization predicts that by 2025, around 167 million individuals, both adults and children, may experience adverse health outcomes due to excess weight [2]. In India, obesity is one of the major health concerns, resulting in a significant financial and medical burden on the country's healthcare system. The statistical analysis of 2019 showed that the prevalence of obesity has doubled in the last decade [3]. A higher prevalence of obesity in India is attributed to changes in dietary habits, urbanization, sedentary lifestyle, socio-economic status, and lack of healthcare facilities and financial support [4, 5]. There has been an increasing trend in the availability of high-calorie

foods at a lower cost across rural and urban areas, as a result of which the consumption of higher-calorie low nutrient-dense foods has been observed in many surveys [6]. Urbanization and decreased physical activity have led to a significant shift in lifestyle, resulting in a decline in overall quality of life alongside the rapid increase in health issues in recent years. Public health interventions are needed to prevent and manage obesity and its associated complications in India such as diabetes, hypertension, dyslipidemia, cardiovascular issues, and cancer [6,7].

In the past years, two popular therapeutic strategies that have gained attention are therapeutic carbohydrate reduction and intermittent fasting. Both of these dietary interventions have shown promising results in promoting weight loss and improving health [9]. Further, adhering to the weight loss diet and maintenance is a persisting challenge [10]. Thus, there is a need for a feasible, sustainable, long-term, and effective weight loss approach. Since weight management requires sustainable behavioral change, adhering to lifestyle changes could be infrequent and difficult without the proper support from a healthcare provider and peer. Thus, the use of mobile applications and digital tools for weight management is becoming prevalent as it is easy to access, helps to eradicate issues, and allows real-time tracking of dietary habits [11]. Using the plate method as a nutrition educational tool has demonstrated superior efficacy in fostering positive dietary changes and enhancing health outcomes for individuals with interventions centered around carbohydrate counting or calorie counting [12]. Tracking the meal images and analyzing the root cause of nutritional deficiencies provide valuable insights into individuals dietary habits and contribute to a comprehensive understanding of their nutritional needs [13].

Thus we propose a Mfine digital therapeutic program that provides personalized lifestyle management support for people with overweight. This program consists of the initial application of continuous meal image monitoring, a multidisciplinary care team of experts comprising clinical dietitians, dedicated health coaches, and fitness coaches to deliver tailor-made nutrition plans, progressive fitness routines, and behavioral modification strategies for effective and holistic weight management. A key aspect of the program is the encouragement of meal image sharing, where participants can showcase their meals and receive real-time dietary suggestions. Additionally, participants are guided to follow intermittent fasting and to reduce carbohydrate-rich foods.

The current study aims to evaluate the effectiveness of Mfine's digital "weight loss program" by determining the average weight reduction in overweight individuals through the implementation of intermittent fasting and carbohydrate reduction. Additionally, the objective is to assess the benefit of digitally monitoring the recommended diet through meal images.

Materials and Methods

Study Design

This is a retrospective study which is conducted over 90 days based on the analysis of the deidentified data of participants enrolled in the Mfine's WLP. Participants were recruited through direct referrals by the treating physician on the Mfine application, via a social media campaign offering a weight loss program, through corporate tie-ups, and through webinars. The data was collected based on the characteristics of an individual, such as dietary habits, total carbohydrate intake, number of fasting hours in a day and physical activity.

Inclusion and exclusion criteria

The following were the Inclusion Criteria of the study:

1. BMI > 23

2. Age >18 years at the time of enrollment.

3. Having a smartphone and being willing to utilize the application.

4. Participants enrolled in the Mfine weight loss program from April 2021 to April 2022.

The following were the exclusion criteria of the study, as the primary focus was to analyze the impact of the intervention on overweight individuals:

1. BMI <23

2. Age <18 years at the time of enrollment.

3. Presence of underlying health conditions or comorbidities that require specialized medical management.

Ethical consideration

Consent was obtained on the Mfine application as per the telemedicine guidelines released by the government of India in the year 2020. The privacy policy of the Mfine application also mentioned "data would be used for research purposes". All the participants had voluntarily enrolled for the Mfine weight loss program. Mfine maintains the protection of privacy and confidentiality of participants by ensuring that the study data are de-identified. Participants were not provided any compensation for study participation.

Duration of the Study

From April 2021 to April 2022, 90 days were counted from the date of enrollment. Data collection was done after the ethical clearance from the IEC (Institutional Ethics Committee).

Data Collection

In this research study, we utilized a combination of the Structured Interview technique and a questionnaire method conducted in the English language, where among the enrolled participants, no one was suffering from diabetes. Through these methods, we gathered information on various aspects, such as family history, medical records, stress levels, sleep duration, screen time, diet recall, and physical activity. These details were collected during the initial call with each participant and carefully documented. Additionally, all subjects were individually contacted and interviewed using the questionnaire.

Anthropometric measurements, such as self-entered data provided by the participants regarding their weight in kilograms, height in centimeters, and age in years, were collected. With this information, the Body Mass Index was calculated (BMI is derived from a person's weight in kilograms divided by the square of the person's height in

meters square - kg/m^2) [14]. Furthermore, a customized diet plan was provided to the participants, focusing on reducing overall calorie intake from carbohydrate-rich foods and implementing intermittent fasting for 12-16 hours. Participants were encouraged to share meal images depicting their food intake to aid in assessing and monitoring their dietary adherence. The number of hours of fasting was determined based on the mentioned meal timings in the diet plan.

Selection of Samples - The samples were selected from the inclusion and exclusion criteria.

Program Design

WLP is a personalized intervention program that leverages technology-enabled management, dedicated health coaches, clinical dietitians and experts to offer customized nutrition, progressive fitness, and behavioral modification for holistic weight management. As an integral part of the program, WLP also emphasizes the significance of meal image sharing, allowing participants to showcase their meals. Participants were instructed to monitor their body weight every week. Body weight was recorded at the baseline (enrollment) and the end of the study (90th day). Additionally, age, gender, BMI, food preference, food allergy, and physical activity levels were also recorded for each participant at enrollment. Participants were given unlimited access to their health coaches through the application and via telephone, and on-demand dietician consultations for the entire duration of the program. All participants were asked to share their meal images after getting a customized diet plan from their dietitian.

Wellness and fitness session - The weekly virtual fitness session under the weight loss program aims to provide individuals with an accessible and convenient platform to engage in regular exercise and support their weight loss goals. Participants join the weekly virtual sessions from the comfort of their own homes, utilizing video conferencing tools and guided workout videos. The sessions typically include a combination of cardiovascular exercises, breathing exercises, strength training, and flexibility exercises, tailored to promote calorie burning and overall fitness. With the guidance of qualified fitness instructors, participants receive instruction, motivation, and feedback to ensure proper form and maximize their workout intensity. Overall, the weekly virtual fitness sessions provide an effective and convenient platform for individuals to engage in regular exercise and work towards their weight loss objectives. Participants were suggested to attend every wellness session to track their progress and if they failed to join the session live recorded sessions from the application were shared with them. The coaches encouraged the participants to be physically active rather than sedentary during one-on-one sessions and ensured consistent participation.

Personalized nutrition - Dietary intake plays a major role in achieving weight loss; hence, making food choices that help achieve ideal body weight is important. In this context, in WLP, each participant was assigned a careteam dietitian to assess nutritional needs and create a meal plan personalized to the individual's lifestyle, resources, and food preferences. The dietitians provide a diet plan having the optimal nutrient combination concentrating on carbohydrate reduction, moderate protein, and high fiber diet along with time-restricted eating (intermittent fasting). Through one-on-
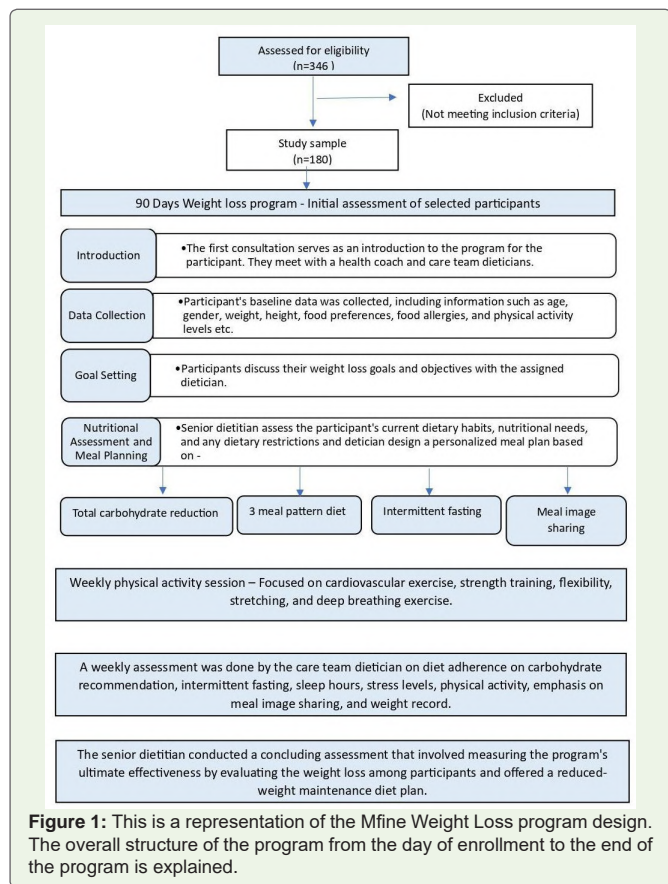

Figure 1: This is a representation of the Mfine Weight Loss program design. The overall structure of the program from the day of enrollment to the end of the program is explained.
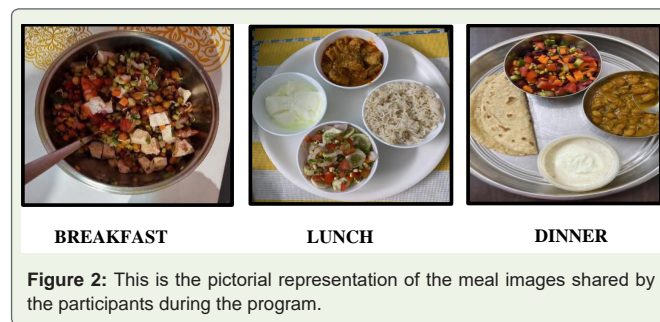

Figure 2: This is the pictorial representation of the meal images shared by the participants during the program.

Figure 3: This is the representation of the dietary guidelines of Mfine's Weight loss program

one nutritional counseling, the participants were guided to avoid specific foods that cause weight gain. Reduction of total carbohydrate-rich foods such as cereals, starchy vegetables, all forms of sugar, and commercial foods was suggested after considering the 24-hour recall data and intermittent fasting of 12-16 hours. Personalized nutrition counseling was conducted, and intermittent fasting recommendations were gradually adjusted according to participants' adherence, along with a reduction in carbohydrate intake to <120g [15].The meal plate method is used to recommend the incorporation of a meal plate image to potentially decrease carbohydrate intake, enhance nutritional balance, and foster healthier eating habits. Meal logs created by the participants were reviewed by the clinical dietitian and the team made regular calls to assess the goals achieved by the participants and keep them on track and motivated. Remote health coaches provide support to participants by addressing their queries and resolving any issues they may encounter through messaging and phone calls.

Lifestyle modification

Lifestyle modification is a fundamental aspect of weight management that includes self-management through behavioral change, mindfulness, and improved sleep quality. With this focus in mind, in WLP, the participants were assigned personalized health coaches. The health coaches provided behavior change strategies to help participants achieve positive health outcomes and live healthier and happier lives.

Overall, the WLP is a team-based care and a person-centered approach, assisted by technology to deliver one-on-one guidance and personalized interventions. The participants and the coaches interacted through multiple modes like chat, voice, and video calls throughout the 90-day program, which minimized the chances of non-adherence, poor insights, and unpredictable outcomes.

Statistical analysis

The significance of the change in the weight from baseline to 90 days after enrolment was assessed using a t-test.

Results

For the present retrospective study, a convenient sampling method was used. With a sample size of 180 participants who enrolled and adhered to the mfine's weight loss program for 90 days.

Data is represented as Mean±SD. ***: $p<0.001$. The mean weight loss of the study group is 5.2 kg with SD (3.9 kg) after 90 days into the intervention. The comprehensive outcomes of the study are presented in detail. Among 180 participants, 88 participants showed a significant reduction in weight of 0-5 kg, 66 participants reduced their weight between 5-10kg, 16 participants lost 10-15kg of weight, 5 participants experienced a reduction in weight of 15-20 kg and 1 participant showed 20-25 kg of weight reduction.

Among 180 participants, 16 females and 23 males were in the age group of < 30 years, and 32 females and 49 males were in the age group of 30-40 years. 16 females and 25 males were in the age group of 40-50 years and 12 females and 7 males were in the age group of >50 years
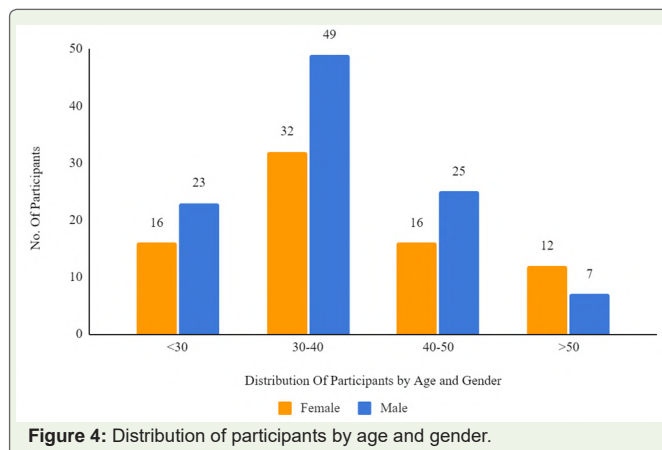

Figure 4: Distribution of participants by age and gender.

The participants were categorized into age buckets. In our research, we categorized participants into age groups (<30 years, 30-40 years, 40-50 years, and >50 years) based on scientific reasons. Age influences weight management and metabolic processes, with variations in metabolism and hormonal changes [16]. This categorization helps assess the program's effectiveness across different life stages and provides insights for tailored interventions. Additionally, it enhances statistical analysis by allowing subgroup comparisons, aiding in understanding age-specific trends and informing personalized weight management strategies in clinical practice.

From this figure, it is observed that 3 females and 2 males were in the category of overweight 23-24.9 kg/m², 32 females and 47 males were in the category of Obesity grade I (25-29.9 kg/m²) 24 females and 32 males were in the category of Obesity grade II (30-34.9 kg/m²), 14 females and 14 males were in the category of Obesity grade III (>35 kg/m²).
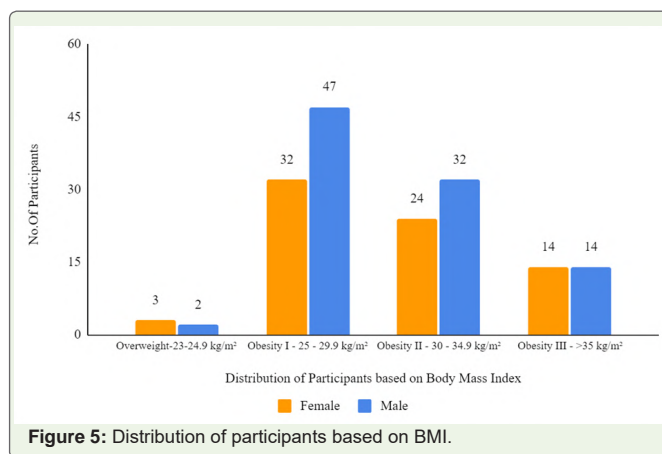

Figure 5: Distribution of participants based on BMI.

In this figure, among the 180 participants, 76 were females and 104 were males, Before starting Mfine's Weight Loss program, the average weight of the female and male participants was 77 kg and 90.6 kg respectively. By the end of the program, their average weight had decreased to 72.2 kg and 85 kg. The weight reduction in females was 4.83 Kg with a standard deviation of 3.91 Kg and in males was 5.60

Kg with a standard deviation of 3.93 kg with the introduction of total carbohydrate reduction. The total carbohydrate intake was monitored by assessing the meal images.
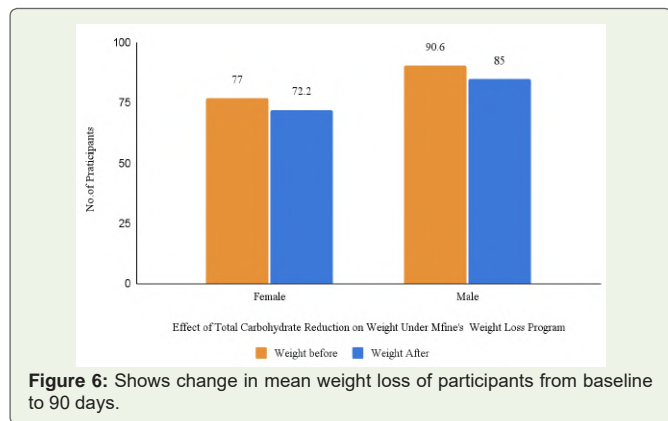

Figure 6: Shows change in mean weight loss of participants from baseline to 90 days.

There was a significant reduction of 3.9kg in females and 5.4kg in male participants following <14 hrs of intermittent fasting. There was a notable decrease of 5.1kg in females and 6 kg of weight in male participants following >14 hrs of intermittent fasting. Participants who engaged in fasting periods exceeding 14 hours experienced greater reductions in comparison to those fasting for less than 14 hours.
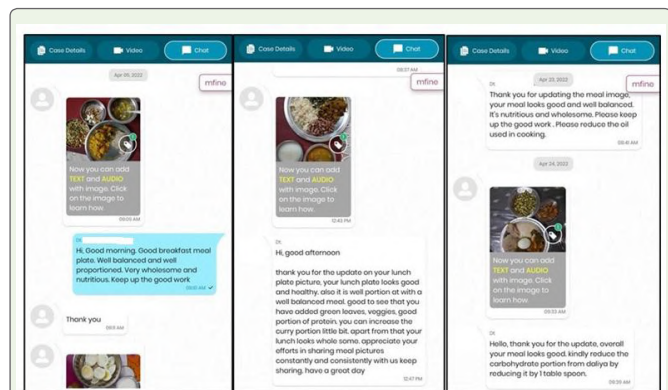

Figure 7: Screenshot of real-time interaction between Care Team Dietitians with the patients enrolled in the care program weight loss on the meal images shared by them as a part of portioning and correcting the macronutrient intake.
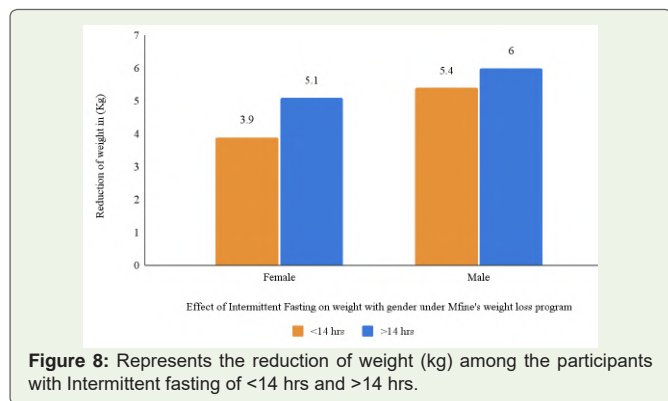

Figure 8: Represents the reduction of weight (kg) among the participants with Intermittent fasting of <14 hrs and >14 hrs.

The field faces a significant issue due to the absence of standardized terminology for characterizing various intermittent energy restriction methodologies. [17]

The decision to choose fasting window periods of <14 hours and >14 hours was also influenced by observing the participants' current eating and fasting habits. Initially, participants were predominantly following fasting windows ranging from 10-12 hours and 12-14 hours. To gradually extend beyond these typical durations, we encouraged participants from both groups to increase their fasting periods.

This approach was based on the principle of gradual adaptation, aiming to minimize potential discomfort or challenges associated with transitioning to longer fasting periods. By building upon participants' existing fasting habits, we aimed to facilitate a smoother transition to the extended fasting durations examined in our study. This methodology allowed for a practical and feasible implementation of the chosen fasting window periods, ensuring participant compliance and facilitating meaningful comparisons between the two groups.

By incorporating participants' initial habits into the study design, we enhanced the relevance and applicability of our findings to real-world intermittent fasting practices, contributing valuable insights for clinical implementation.

The association between weight reduction and food preference. In the category of vegetarians, they showed 3.9 kg of weight reduction. Among the eggetarians 4.5 kg of weight reduction was seen. In the non-vegetarian category, a 5.88kg reduction in weight was seen.

There was a correlation between physical activity and weight reduction. There was a significant reduction in weight of 5.3kg with the heavy exercise. With moderate exercise reduction of 5kg weight was noted and 4.8kg of weight reduction was seen with light exercise and less than 3kg of weight reduction was noted with little or no exercise.

There was no correlation between the screen hours and sleep hours with weight reduction.

Discussion

The Weight Loss Program (WLP) is a comprehensive, technology-enabled coaching program led by dietitians and closely monitored by health coaches throughout the study's entirety. The care team dietitians collected data at specified intervals on participants' dietary choices, physical activity, sleep quality, and weight. This data was leveraged to create personalized lifestyle interventions, including custom meal plans, progressive fitness routines, and lifestyle adjustments, resulting in significantly improved weight loss outcomes [18].

Intermittent fasting, which involves fasting for 12 to 16 hours and subsequently eating during an 8 to 10 hour window and low-carbohydrate diets has shown its ability to reduce body fat percentage in overweight or obese individuals [19]. For optimal results, individuals should combine it with physical activity and lifestyle modifications, which hold significant promise as beneficial nutritional strategies for addressing obesity and associated metabolic disorders [20-22].

The present study aimed to evaluate the effectiveness of Mfine's Weight Loss Program, which incorporates carbohydrate reduction and

intermittent fasting into participants' daily diets. The results indicated a significant change in the BMI of both male and female participants after completing the Mfine weight loss program. Previous studies have emphasized the importance of tracking dietary intake and physical activity as they help individuals take responsibility for their habits, a fundamental aspect of behavioral intervention. Participants in the Mfine Weight Loss Program were encouraged to provide images of their meals, aiding in the assessment of adherence to the diet. Fasting duration was calculated based on specified meal timings in the diet plan.

Earlier studies have highlighted the positive impact of personalized interventions involving nutrition, physical activity, and behavioral modifications on weight loss. While very low-calorie, low-carbohydrate, and ketogenic diets have been shown to decrease weight and improve metabolic conditions in various intervention studies [23], these studies often neglect the crucial aspect of behavioral modification, making long-term adherence challenging [24]. In contrast, the present research stands out due to its individualized, comprehensive intervention plan, addressing diet, physical activity, and behavioral adjustments, resulting in significant weight loss improvements over 90 days without adverse health effects. It's important to note that the study's limitations include a relatively small sample size and the short duration of the intervention.

Conclusion

WLP demonstrated that weight loss is possible using a multi-interventional approach involving expert dieticians and health coaches emphasizing personalized nutrition, physical activity, behavioral modifications, and the convenience of digital tools. The participants who adhered to WLP for 90 days significantly improved their weight. The study findings clarify that multiple components synergistically contributed to reducing the weight risk factors.

References

1. Stevens GA, Singh GM, Lu Y, Danaei GZ, Lin JK, et al.(2012) National, regional, and global trends in adult overweight and obesity prevalences. Popul Health Metrics 10: 22.

2. World Obesity Day (2022) Accelerating action to stop obesity.

3. Aiyar A, Rahman A, Pingali P (2021)India's rural transformation and rising obesity burden,World Development 138: 105258.

4. Tsukru V (2023) Prevalence and Socio-Demographic Determinants of Obesity and Hypertension in a Rural Tribal Community in Northeast India. Online Journal of Health and Allied Sciences 22:1.

5. Verma M, Aggarwal R, Nath B, Kakkar R.(2023) Exploring the influence of food labels and advertisements on eating habits of children: a cross-sectional study from Punjab, India. BMC Public Health 23: 311.

6. Ghosh S, Paul M, Mondal KK, Bhattacharjee S, Bhattacharjee P (2023) Sedentary lifestyle with increased risk of obesity in urban adult academic professionals: an epidemiological study in West Bengal, India. Scientific reports 13: 4895.

7. Upadhyay J, Farr O, Perakakis N, Ghaly W, Mantzoros C (2018). Obesity as a Disease. The Medical clinics of North America, 102: 13-33.

8. Nachiket M (2019) Addressing the Obesity Epidemic in India.

9. Kim JY (2021) Optimal Diet Strategies for Weight Loss and Weight Loss Maintenance. Journal of obesity & metabolic syndrome, 30: 20-31.

10. Dounavi K, Tsoumani O (2019) Mobile Health Applications in Weight Management: A Systematic Literature Review, American Journal of Preventive Medicine, 56: 894-903.

11. Bouchaud CC, Chriqui JR, Slim M, Gouin JP, Plourde H, et al.(2023) A Qualitative Evaluation of a Plate-Method Dietary Self-Monitoring Tool in a Sample of Adults Over 50, Current Developments in Nutrition,7: 101975.

12. Whitelock V, Kersbergen I, Higgs S, Aveyard P, Halford JC, et al. (2020) User Experiences of a Smartphone-Based Attentive Eating App and Their Association With Diet and Weight Loss Outcomes: Thematic and Exploratory Analyses From a Randomized Controlled Trial. JMIR mHealth and uHealth, 8: e16780.

13. BMI ref - Zierle-Ghosh A, Jan A (2023)Physiology, Body Mass Index. [Updated 2022 Sep 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from:

14. Oh R, Gilani B, Uppaluri KR (2023) Low-Carbohydrate Diet. [Updated 2023 Aug 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from:

15. Pataky MW, Young WF, Nair KS (2021) Hormonal and Metabolic Changes of Aging and the Influence of Lifestyle Modifications. Mayo Clinic proceedings, 96: 788-814.

16. Rynders CA, Thomas EA, Zaman A, Pan Z, Catenacci VA, et al. (2019) Effectiveness of Intermittent Fasting and Time-Restricted Feeding Compared to Continuous Energy Restriction for Weight Loss. Nutrients 11: 2442.

17. Rippe JM (2018) Lifestyle Medicine: The Health Promoting Power of Daily Habits and Practices. American journal of lifestyle medicine, 12: 499-512.

18. Chawla S, Tessarolo Silva F, Amaral Medeiros S, Mekary RA, Radenkovic D (2020) The Effect of Low-Fat and Low-Carbohydrate Diets on Weight Loss and Lipid Levels: A Systematic Review and Meta-Analysis. Nutrients. 2020;12: 3774.

19. Rynders CA, Thomas EA, Zaman A, Pan Z, Catenacci VA, et al. (2019) Effectiveness of Intermittent Fasting and Time-Restricted Feeding Compared to Continuous Energy Restriction for Weight Loss. Nutrients 11: 2442.

20. Salis S, Shefa S, Sharma N, Vora N, Anjana RM et al.(2022) Effects of Intermittent Fasting on Weight Loss in Asian Indian Adults with Obesity. J Assoc Physicians India 70: 11-12.

21. Zhu S, Surampudi P, Rosharavan B, Chondronikola M. (2020) Intermittent fasting as a nutrition approach against obesity and metabolic disease. Curr Opin Clin Nutr Metab Care 23: 387-394.

22. Bueno NB, de Melo IS, de Oliveira SL, da Rocha Ataide T.(2013) Very-low-carbohydrate ketogenic diet v. low-fat diet for long-term weight loss: a meta-analysis of randomized controlled trials. Br J Nutr110: 1178-1187.

23. Wing RR, Blair E, Marcus M, Epstein LH, Harvey J (1994)Year-long weight loss treatment for obese patients with type II diabetes: does including an intermittent very-low-calorie diet improve outcome?. Am J Med 97: 354-362.