Full Title: Metabolic Responses of Diet–Exercise Combinations in Women with Obesity: A Comparative Lifestyle Intervention Study with Different Diet Types

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## Participants

Sample size was calculated using G*Power 3.1.9.2 software based on data from Abbenhardt et al. (2013), with $\alpha = 0.05$ and $1–\beta = 0.95$. The analysis revealed that 108 participants, consisting of nine groups with 12 individuals each, would ensure adequate statistical power. Accordingly, 108 homemakers aged 19–45 years were recruited, including 96 with obesity and 12 with normal weight, none of whom had engaged in dietary interventions during the preceding 3 months. Participation was voluntary, and all participants obtained medical clearance from a healthcare institution confirming no contraindications to exercise (mean age: 37.4 years; height: 162.3 cm; body weight: normal-weight group, $56.72 \pm 4.38$ kg, group with obesity, $102.5 \pm 3.75$ kg). Inclusion criteria comprised medical and psychological fitness for exercise, no participation in dietary programs within the previous 3 months, or lack of orthopedic limitations. Exclusion criteria included pregnancy or lactation, chronic conditions such as cancer or renal/hepatic failure, psychiatric disorders, history of adverse reactions to venipuncture, or inability to adhere to the intervention protocol (Figure 1).

## Home-Based Exercise Protocol

The 6-week exercise protocol was conducted 3 days per week, with each session conducted at 10:00 a.m. under online supervision by a qualified specialist. Each session comprised warm-up, main exercise, and cool-down phases; warm-up activities were designed to minimize injury risk, and cool-down exercises facilitated recovery. Each set was followed by a 1-min rest interval. The program incorporated movements aimed at enhancing cardiorespiratory endurance, muscular strength, and overall fitness. The exercise program included high knees, heel-to-glute kicks, leg raises, squats, push-ups, walking lunges, planks, jumping jacks, and sit-ups, performed in predetermined sets and repetitions, with total session durations of 25–35 min (Table SM-1). Weekly progressions were systematically planned to ensure balanced muscle engagement and adherence to the progressive overload principle, while exercise order and combinations were modified each week to promote adaptation and sustain training intensity throughout the intervention (Table SM-2).

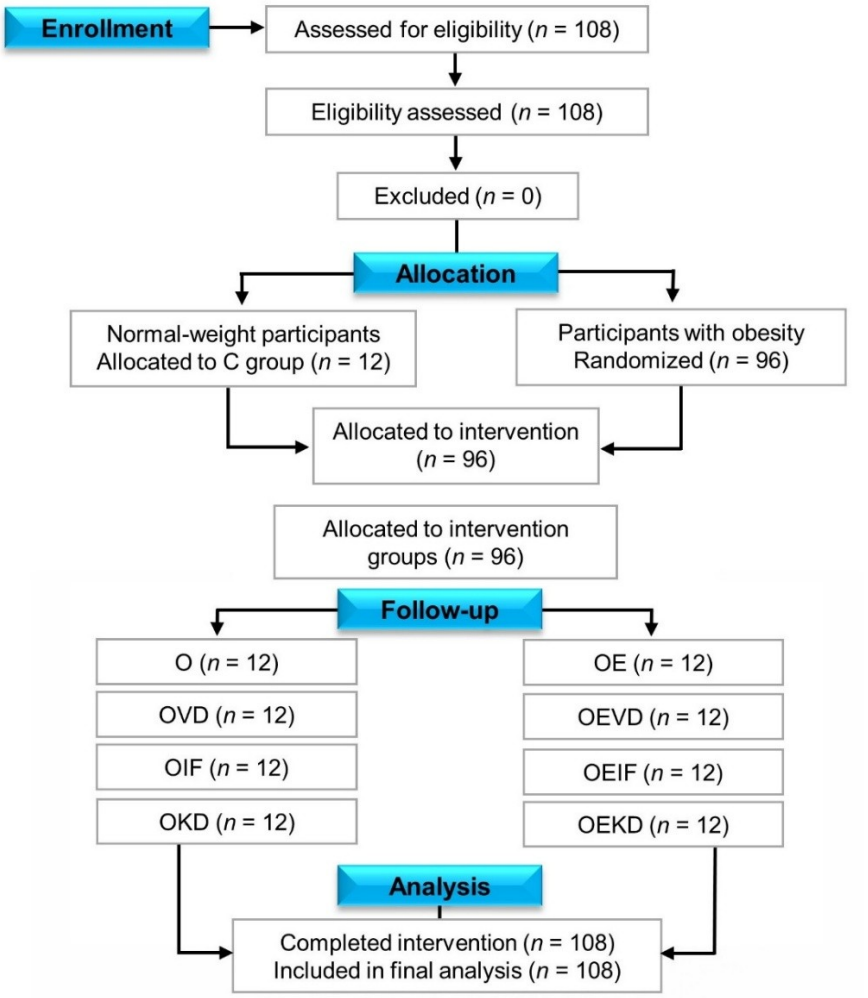



**Figure 1.** Participant flow diagram illustrating enrollment, group assignment, follow-up, and data analysis. C: control, O: control with obesity, OE: exercise with obesity, OVD: semi-vegetarian diet with obesity, OEVD: exercise semi-vegetarian diet with obesity, OIF: intermittent fasting with obesity, OEIF: exercise intermittent fasting with obesity, OKD: ketogenic diet with obesity, OEKD: exercise ketogenic diet with obesity.

## Diet Protocols

Dietary plans were developed on an individual basis by a registered dietitian, taking into account basal metabolic rate (BMR) and total daily energy expenditure (TDEE), with the objective of inducing a moderate caloric deficit. Accordingly, daily energy intake was tailored to individual metabolic requirements and generally ranged between 1400 and 1700 kcal/day across intervention groups.

Three dietary models were applied to the intervention groups according to the experimental design. The vegetarian diet followed a semi-vegetarian model emphasizing grains, legumes, soy products, vegetables, fruits, and oilseeds as primary food sources. Red meat was completely excluded, while poultry and fish intake were limited; eggs, milk, and dairy products were permitted without restriction. This dietary pattern was designed to provide approximately 15–20% of total energy from protein, 50–55% from carbohydrates, and 25–30% from fat. The IF regimen (16:8) consisted of a daily 8-hour feeding window comprising two main meals (breakfast and dinner), followed by a 16-hour fasting period that included overnight sleep. During fasting periods, participants refrained from consuming solid foods and were allowed only non-caloric beverages, including water, plain mineral water, unsweetened tea, and black

coffee. Despite the time-restricted structure of the IF regimen, total daily energy intake was aligned with individualized caloric targets, with a macronutrient distribution corresponding to approximately 20–25% protein, 40–45% carbohydrates, and 30–35% fat. The ketogenic diet followed the standard ketogenic model, with an approximate macronutrient distribution of 75% fat, 20% protein, and 5% carbohydrates. Grains, starchy vegetables, and most fruits were restricted, while red meat, poultry, fish, eggs, and cheese were allowed in controlled amounts. Low-carbohydrate vegetables, including leafy greens, broccoli, cauliflower, and zucchini, were unrestricted, and consumption of natural fats such as olive oil, butter, ghee, avocado, and oilseeds was encouraged (Table SM-3). Dietary adherence was monitored throughout the intervention period using daily food records, reviewed by a registered dietitian either daily or at intervals of 2–3 days, depending on participant availability. Adherence support was provided through weekly or biweekly dietitian consultations, supplemented by communication via telephone or WhatsApp when necessary. Compliance was operationally defined as adherence to ≥80% of the prescribed dietary protocol, and substantial deviations were promptly identified and addressed through individualized dietary counseling. The C group did not receive a structured dietary intervention and was provided only with general healthy eating advice at baseline, without individualized meal planning or dietary monitoring.