

## Original Article

# Effects of Dietary and Physical-Cognitive Exercise on Cognitive Function and Cardiometabolic Health in Obese Postmenopausal Women

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## ABSTRACT

**Background:** Obesity in postmenopausal women is associated with increased risk of cardiometabolic diseases and cognitive decline. Addressing these issues through integrated lifestyle interventions may provide significant health benefits.

**Objective:** To evaluate the effects of a combined dietary intervention and physical-cognitive exercise program on cognitive function and cardiometabolic health in postmenopausal women with obesity.

**Methods:** This randomized controlled trial included 68 postmenopausal women with a BMI  $\geq 30$  kg/m<sup>2</sup>. Participants were randomly assigned to either the intervention group (n=34) or the control group (n=34). The intervention group received a 12-week program combining a Mediterranean diet with physical and cognitive exercises. The control group received standard care. Baseline and post-intervention assessments included BMI, memory scores, and executive function tests. Data collection was performed by blinded assessors. Statistical analysis was conducted using SPSS version 25.0, with independent t-tests comparing pre- and post-intervention outcomes between groups, and paired t-tests evaluating within-group changes. A significance level of  $p < 0.05$  was considered statistically significant.

**Results:** The intervention group showed a significant reduction in BMI (mean 29.72 kg/m<sup>2</sup>, SD = 2.01) compared to the control group (mean 31.43 kg/m<sup>2</sup>, SD = 2.14) ( $p = 0.002$ ). Memory scores improved significantly in the intervention group (mean 85.92, SD = 7.68) compared to the control group (mean 75.74, SD = 9.12) ( $p < 0.001$ ). Executive function scores also improved significantly in the intervention group (mean 62.11, SD = 7.42) compared to the control group (mean 49.52, SD = 8.17) ( $p < 0.001$ ).

**Conclusion:** The combined dietary intervention and physical-cognitive exercise program significantly improved both cognitive function and cardiometabolic health in postmenopausal women with obesity. These findings suggest that integrating dietary modifications with physical and cognitive exercises could offer a holistic approach to managing obesity and its associated cognitive decline in this population.

**Keywords:** Postmenopausal women, obesity, cognitive function, cardiometabolic health, dietary intervention, physical exercise, cognitive exercise, Mediterranean diet, randomized controlled trial, BMI, memory improvement, executive function

## INTRODUCTION

Obesity in postmenopausal women presents a unique clinical challenge, given its association with an increased risk of cardiometabolic diseases and cognitive decline (1). This population is particularly vulnerable due to hormonal changes that exacerbate metabolic imbalances and influence cognitive functions. Addressing both physical and cognitive health in these women is essential to improve their overall quality of life and reduce

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the burden of chronic diseases (2,3) Traditional interventions often focus on either dietary modifications or physical exercise, but a combined approach that includes cognitive exercises might offer more comprehensive benefits (4,5). The potential synergistic effects of dietary intervention and physical-cognitive exercises could lead to significant improvements in both cardiometabolic health and cognitive function in postmenopausal women with obesity (6).

Previous research has highlighted the effectiveness of dietary interventions in managing obesity and related cardiometabolic conditions. Diets rich in fruits, vegetables, whole grains, and lean proteins, such as the Mediterranean diet, have been shown to improve metabolic profiles and reduce inflammation (7,8). Concurrently, physical exercise is well-documented to enhance cardiovascular health, insulin sensitivity, and body composition. Aerobic and resistance exercises are particularly beneficial in reducing visceral fat and improving muscle mass, which are critical factors in managing obesity (9). However, the role of cognitive exercises in this context is less explored. Cognitive exercises, including memory tasks and problem-solving activities, have shown promise in enhancing cognitive functions, which are often impaired in individuals with obesity due to chronic inflammation and metabolic dysregulation (10).

Combining dietary intervention with physical-cognitive exercise could address multiple facets of health in postmenopausal women with obesity (11, 12). This multifaceted approach not only aims to reduce body weight and improve metabolic health but also seeks to enhance cognitive function. The hypothesis is that an integrative intervention could provide greater benefits compared to singular approaches by simultaneously targeting the physical and cognitive deficits associated with obesity (13,14). This hypothesis is grounded in the understanding that metabolic health and cognitive function are interlinked, with improvements in one domain potentially facilitating enhancements in the other.

## **MATERIAL AND METHODS**

This randomized controlled trial aimed to evaluate the effects of a combined dietary intervention and physical-cognitive exercise program on cognitive function and cardiometabolic health in postmenopausal women with obesity. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki, and approval was obtained from the institutional review board. Informed consent was obtained from all participants prior to their inclusion in the study. Participants were recruited through advertisements and referrals from primary care clinics. Eligibility criteria included postmenopausal women aged 45-65 years with a body mass index (BMI) of 30 kg/m<sup>2</sup> or higher. Exclusion criteria included pre-existing cognitive impairment, severe cardiometabolic conditions, and other medical conditions that could affect participation. A total of 68 participants were randomly assigned to either the intervention group or the control group, with 34 participants in each group. Randomization was performed using a computer-generated randomization schedule to ensure allocation concealment.

The intervention group received a combined dietary and physical-cognitive exercise program for 12 weeks. The dietary intervention was based on a Mediterranean diet, emphasizing the consumption of fruits, vegetables, whole grains, lean proteins, and healthy fats. Participants received individualized dietary counseling and meal plans to ensure adherence. The physical-cognitive exercise program included aerobic and resistance exercises, as well as cognitive training tasks such as memory exercises and problem-solving activities. Sessions were conducted three times per week under the supervision of qualified trainers.

The control group received standard care, which included general health advice and encouragement to maintain a healthy lifestyle. No specific dietary or exercise interventions were provided to this group. Baseline assessments were conducted for all participants, including measurements of BMI, waist circumference, and body fat percentage. Cognitive function was evaluated using standardized tests for memory, executive function, and attention. Cardiometabolic health was assessed through blood tests measuring glucose levels, lipid profiles, and inflammatory markers.

Data collection was performed by trained research staff who were blinded to group assignments. Follow-up assessments were conducted at the end of the 12-week intervention period using the same protocols as the baseline assessments. Data were entered into a secure database and verified for accuracy. Statistical analysis was performed using SPSS version 25.0. Descriptive statistics were calculated for demographic variables and baseline characteristics. Independent t-tests were used to compare pre- and post-intervention outcomes between the groups. Paired t-tests were used to evaluate within-group changes. A significance level of  $p < 0.05$  was considered statistically significant. The study adhered to rigorous ethical standards, ensuring that all participants were treated with respect and care throughout the research process. Confidentiality was maintained, and participants had the right to withdraw from the study at any time without penalty.

## RESULTS

The study included 68 postmenopausal women with obesity, randomly assigned to either the intervention group or the control group, with 34 participants in each group. The demographic and baseline characteristics of the participants were comparable between the two groups ( $p > 0.05$ ). The mean age of participants in the intervention group was 54.20 years (SD = 5.12), and in the control group, it was 54.46 years (SD = 5.23) ( $p = 0.81$ ). Baseline BMI was also similar between the groups, with a mean of 31.82 kg/m<sup>2</sup> (SD = 2.12) in the intervention group and 32.12 kg/m<sup>2</sup> (SD = 2.25) in the control group ( $p = 0.54$ ) (Table 1).

*Table 1 Demographic and Baseline Characteristics*

Variable	Intervention Group Mean (SD)	Control Group Mean (SD)	p-value
Age	54.20 (5.12)	54.46 (5.23)	0.81
BMI	31.82 (2.12)	32.12 (2.25)	0.54

The primary outcome measures included BMI, memory score, and executive function. At baseline, there were no significant differences between the groups in these measures. However, post-intervention results showed significant improvements in the intervention group compared to the control group.

*Table 2 Outcome Measures*

Variable	Time Point	Intervention Group Mean (SD)	Control Group Mean (SD)	p-value
Memory Score	Pre-intervention	70.79 (10.02)	70.73 (10.04)	0.98
	Post-intervention	85.92 (7.68)	75.74 (9.12)	<0.001
Executive Function	Pre-intervention	51.27 (9.85)	48.79 (9.73)	0.39
	Post-intervention	62.11 (7.42)	49.52 (8.17)	<0.001
BMI	Pre-intervention	31.82 (2.12)	32.12 (2.25)	0.54
	Post-intervention	29.72 (2.01)	31.43 (2.14)	0.002

Post-intervention, the intervention group showed a significant reduction in BMI with a mean of 29.72 kg/m<sup>2</sup> (SD = 2.01) compared to 31.43 kg/m<sup>2</sup> (SD = 2.14) in the control group (p = 0.002). Memory scores improved significantly in the intervention group, with a post-intervention mean of 85.92 (SD = 7.68) compared to 75.74 (SD = 9.12) in the control group (p < 0.001). Executive function scores also improved significantly in the intervention group, with a post-intervention mean of 62.11 (SD = 7.42) compared to 49.52 (SD = 8.17) in the control group (p < 0.001) (Table 2). These findings suggest that the combined dietary intervention and physical-cognitive exercise program led to significant improvements in both cognitive function and cardiometabolic health in postmenopausal women with obesity. The improvements in memory and executive function indicate the potential for such integrated interventions to mitigate cognitive decline associated with obesity in this population.

## DISCUSSION

The findings of this randomized controlled trial demonstrated that a combined dietary intervention and physical-cognitive exercise program significantly improved both cognitive function and cardiometabolic health in postmenopausal women with obesity. These results align with previous studies that have shown the benefits of lifestyle interventions on metabolic and cognitive outcomes. The significant reduction in BMI and the improvements in memory and executive function observed in the intervention group support the hypothesis that an integrative approach can offer more comprehensive benefits than traditional single-component interventions (15).

The Mediterranean diet, which formed the basis of the dietary intervention, has been widely recognized for its positive effects on metabolic health. Its emphasis on fruits, vegetables, whole grains, lean proteins, and healthy fats has been associated with reduced inflammation and improved lipid profiles (16). The inclusion of physical and cognitive exercises further amplified these benefits. Aerobic and resistance exercises have

been well-documented to improve cardiovascular health and insulin sensitivity, while cognitive training has been shown to enhance neuroplasticity and cognitive reserve, particularly in older adults (17). The combination of these interventions likely created a synergistic effect, contributing to the significant improvements observed in the intervention group (18).

This study's strengths included its randomized controlled design, which minimized potential biases and allowed for a robust comparison between the intervention and control groups. Additionally, the use of standardized assessments for cognitive function and cardiometabolic health ensured the reliability and validity of the measurements. The adherence to a well-established dietary pattern and the structured physical-cognitive exercise program provided a clear framework for evaluating the intervention's efficacy (19).

However, several limitations must be acknowledged. The relatively short duration of the intervention (12 weeks) may not fully capture the long-term effects of such lifestyle changes. Longer follow-up periods are necessary to determine the sustainability of the observed benefits. Additionally, the study's sample size, while sufficient to detect significant differences, was relatively small, which may limit the generalizability of the findings. Future research should aim to include larger, more diverse populations to enhance the external validity of the results (20).

Moreover, the study relied on self-reported dietary adherence and exercise compliance, which could introduce reporting biases. Objective measures of adherence, such as biomarkers or wearable activity trackers, could provide more accurate data. Despite these limitations, the study provides valuable insights into the potential of combined lifestyle interventions to improve health outcomes in postmenopausal women with obesity (21). The implications of these findings are significant for clinical practice. Integrating dietary modifications with physical and cognitive exercises could offer a holistic approach to managing obesity and its associated cognitive decline in postmenopausal women. Healthcare providers should consider incorporating such multifaceted interventions into treatment plans to maximize health benefits. Future studies should explore the mechanisms underlying the observed improvements, potentially focusing on the role of inflammation, neuroplasticity, and metabolic regulation in mediating the effects of combined interventions (22).

## CONCLUSION

In conclusion, this study demonstrated that a combined dietary intervention and physical-cognitive exercise program effectively improved cognitive function and cardiometabolic health in postmenopausal women with obesity. These results underscore the importance of a comprehensive approach to addressing the complex interplay between metabolic and cognitive health in this population. Further research is warranted to explore the long-term effects and underlying mechanisms of such interventions, ultimately contributing to the development of effective strategies for promoting health and well-being in postmenopausal women.

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