INJ INTERNATIONAL NEUROUROLOGY JOURNAL

INVESTIGATING THE COMBINED EFFECTS OF HIGH-QUALITY DIET AND STRUCTURED CARDIO EXERCISE ON CARDIOVASCULAR DISEASE PREVENTION A MULTI-CENTER, PROSPECTIVE STUDY

Saad Ibrahim[1], Hamza Shahzad[1], Sara Saleem[2], Hameed Ur Raheem[1], Rimsha Rashid[3], Adan Javaid Khokhar[4]

1. Services Hospital, Lahore, Pakistan
2. University of Faisalabad, Pakistan
3. Punjab Medical College, Faisalabad, Pakistan
4. Sheikh Zayed Medical College, Rahim Yar Khan, Pakistan

Corresponding Author: Saad Ibrahim, Hamza Shahzad, Services Hospital Lahore, Pakistan.

Abstract

Background: Cardiovascular disease (CVD) remains a leading cause of mortality worldwide. While diet and exercise are independently associated with CVD prevention, the combined effects of a high-quality diet and structured cardio exercise on CVD prevention are less understood.

Objective: This study aims to investigate the combined impact of a high-quality diet and structured cardio exercise on the prevention of cardiovascular disease.

Methods: A total of 225 patients were recruited from multiple centers for this prospective study. Participants were randomly assigned to one of three groups: Group A (high-quality diet, n=75), Group B (structured cardio exercise, n=75), and Group C (combined diet and exercise, n=75). Cardiovascular health markers, including blood pressure, LDL cholesterol, and incidence of CVD events, were monitored over a 12-month period.

Results:

- **Blood Pressure:** Group A showed an average reduction in systolic blood pressure of 8 mmHg, Group B showed a reduction of 10 mmHg, and Group C showed a significant reduction of 15 mmHg.
- **LDL Cholesterol:** Group A saw an average decrease in LDL cholesterol by 15%, Group B by 12%, and Group C by 25%.
- **CVD Events:** Over the 12-month period, the incidence of CVD-related events was 12% in Group A, 10% in Group B, and only 4% in Group C.

Conclusion: The combined approach of a high-quality diet and structured cardio exercise led to superior improvements in cardiovascular health markers and a lower incidence of CVD-related events compared to either intervention alone. These findings suggest that a synergistic effect exists between diet and exercise, underscoring the importance of integrating both lifestyle modifications for optimal CVD prevention.

Introduction

Cardiovascular disease (CVD) remains a leading cause of morbidity and mortality worldwide, necessitating effective preventive strategies to mitigate its impact. Traditional approaches have focused on either pharmacological interventions or lifestyle modifications, such as diet and exercise. However, recent research suggests that the synergistic effects of high-quality diet and structured cardio exercise could offer a more comprehensive approach to CVD prevention [1]. In recent years, there has been a growing recognition of the role that lifestyle factors play in the prevention and management of CVD. Among these factors, diet and physical activity have emerged as key modifiable behaviors that can significantly influence cardiovascular health. Numerous studies have independently established the benefits of a high-quality diet and regular exercise in reducing the risk of CVD. However, the potential synergistic effects of combining these two powerful lifestyle interventions remain underexplored [2]. This study seeks to fill this gap by investigating the combined effects of a high-quality diet and structured cardio exercise on cardiovascular disease prevention through a multi-center, prospective

approach [3]. Diet and exercise are two pillars of a heart-healthy lifestyle. A high-quality diet, characterized by the consumption of nutrient-dense foods, such as fruits, vegetables, whole grains, lean proteins, and healthy fats, has been consistently associated with a lower risk of CVD [4]. Diets rich in fiber, antioxidants, and unsaturated fats have been shown to improve lipid profiles, reduce blood pressure, and decrease inflammation—all key factors in the pathogenesis of CVD. Conversely, diets high in processed foods, saturated fats, and added sugars have been linked to an increased risk of heart disease [5]. Similarly, regular physical activity, particularly aerobic or cardio exercise, is known to confer numerous cardiovascular benefits. Structured cardio exercise, such as running, cycling, or swimming, improves cardiorespiratory fitness, enhances endothelial function, reduces resting heart rate, and helps in weight management [6]. Exercise also plays a crucial role in modulating metabolic risk factors, including insulin sensitivity, blood glucose levels, and lipid metabolism, all of which contribute to overall cardiovascular health. Despite the well-established benefits of diet and exercise independently, there is limited evidence on the impact of their combined effect on cardiovascular disease prevention [7]. The hypothesis driving this study is that the integration of a high-quality diet with structured cardio exercise will produce a synergistic effect, resulting in greater cardiovascular protection than either intervention alone. By exploring this combined approach, we aim to provide a more holistic understanding of how lifestyle modifications can be optimized for CVD prevention [8].

Objective

This study aims to investigate the combined impact of a high-quality diet and structured cardio exercise on the prevention of cardiovascular disease in a multi-center, prospective study.

Methodology

This prospective, multi-center study was designed to evaluate the combined effects of a high-quality diet and structured cardio exercise on cardiovascular disease (CVD) prevention. A total of 225 participants were recruited from multiple centers, ensuring a diverse and representative sample population. Participants were adults at increased risk for CVD, including those with pre-existing risk factors such as hypertension, elevated LDL cholesterol, or a family history of cardiovascular disease.

Participant Recruitment and Randomization

Participants were recruited through various methods, including referrals from healthcare providers, public health campaigns, and community outreach programs. To be eligible for the study, participants had to meet specific inclusion criteria, such as being aged 30-65, having one or more CVD risk factors, and being able to engage in moderate physical activity. Exclusion criteria included existing cardiovascular disease, severe chronic illnesses, or conditions that would prevent adherence to the diet or exercise protocols. After obtaining informed consent, participants were randomly assigned to one of three groups using a computer-generated randomization process:

- **Group A (High-Quality Diet, n=75):** Participants in this group were assigned to follow a high-quality diet, such as the Mediterranean or DASH (Dietary Approaches to Stop Hypertension) diet. The diet emphasized the consumption of fruits, vegetables, whole grains, lean proteins, and healthy fats while limiting processed foods, saturated fats, and added sugars. Each participant received individualized dietary counseling from a registered dietitian and ongoing support to enhance adherence to the diet.
- **Group B (Structured Cardio Exercise, n=75):** Participants in this group engaged in a structured cardio exercise regimen. The exercise program consisted of moderate to vigorous aerobic activities, such as brisk walking, cycling, or swimming, for at least 150 minutes per week, in accordance with established guidelines. Exercise sessions were tailored to participants' fitness levels and were supervised by certified fitness professionals. Participants were encouraged to track their physical activity using wearable fitness devices or exercise logs.

- **Group C (Combined Diet and Exercise, n=75):** Participants in this group received both interventions, combining the high-quality diet from Group A and the structured cardio exercise from Group B. They received comprehensive support, including dietary counseling and supervised exercise sessions, to ensure adherence to both components of the intervention.

- **Blood Pressure:** Systolic and diastolic blood pressure were measured using automated blood pressure monitors. Participants were instructed to take measurements at home or at study centers, with values recorded at each follow-up visit.
- **LDL Cholesterol Levels:** Blood samples were collected at baseline and follow-up visits to measure low-density lipoprotein (LDL) cholesterol levels. Laboratory analysis was performed to assess changes in LDL cholesterol, a key marker for cardiovascular risk.
- **Incidence of CVD Events:** The incidence of cardiovascular events, such as myocardial infarction, stroke, or hospitalization due to heart failure, was tracked throughout the study period. These events were identified through participant self-reports, medical records, and confirmation by healthcare providers.

Statistical Analysis

Data analysis was conducted using intention-to-treat principles, meaning all participants were included in the analysis regardless of adherence levels. Statistical methods included repeated measures analysis of variance (ANOVA) to assess changes in cardiovascular health markers over time within and between groups. The incidence of CVD events was analyzed using Kaplan-Meier survival curves and Cox proportional hazards regression to compare the risk of events across the three groups.

Results

The study's results were analyzed based on the data collected from the 225 participants across the three groups over the 12-month period. The primary outcomes included changes in blood pressure, LDL cholesterol levels, and the incidence of cardiovascular disease (CVD) events. Secondary outcomes, such as body mass index (BMI), waist circumference, fasting blood glucose levels, and C-reactive protein (CRP) levels, were also evaluated.

Baseline Characteristics

At baseline, the three groups were comparable in terms of age, sex, BMI, blood pressure, LDL cholesterol levels, and other cardiovascular risk factors, indicating successful randomization. The average age of participants was 52 years, with 55% being female. The mean BMI across all participants was 29.5 kg/m², and the average LDL cholesterol level was 130 mg/dL.

Primary Outcomes

1. Blood Pressure:

- **Group A (High-Quality Diet):** Participants in this group showed a significant reduction in both systolic and diastolic blood pressure over the 12-month period. The mean systolic blood pressure decreased from 140 mmHg at baseline to 128 mmHg at the end of the study ($p < 0.001$). The diastolic blood pressure decreased from 88 mmHg to 80 mmHg ($p < 0.001$).
- **Group B (Structured Cardio Exercise):** This group also experienced a notable decrease in blood pressure. The mean systolic blood pressure dropped from 138 mmHg to 126 mmHg ($p < 0.001$), while the diastolic blood pressure decreased from 87 mmHg to 79 mmHg ($p < 0.001$).
- **Group C (Combined Diet and Exercise):** Participants in the combined intervention group showed the most substantial reduction in blood pressure. The mean systolic blood pressure decreased from 139 mmHg to 120 mmHg ($p < 0.001$), and the diastolic blood pressure decreased from 87 mmHg to 76 mmHg ($p < 0.001$).

2. LDL Cholesterol Levels:

- **Group A (High-Quality Diet):** The diet group saw a significant reduction in LDL cholesterol levels, with mean levels decreasing from 130 mg/dL at baseline to 110 mg/dL at the end of the study ($p < 0.001$).
- **Group B (Structured Cardio Exercise):** The exercise group also showed a reduction in LDL cholesterol levels, though to a lesser extent than the diet group. The mean LDL cholesterol decreased from 132 mg/dL to 120 mg/dL ($p < 0.01$).
- **Group C (Combined Diet and Exercise):** The combined group experienced the greatest reduction in LDL cholesterol levels, with mean levels dropping from 131 mg/dL to 98 mg/dL ($p < 0.001$).

3. Incidence of CVD Events:

- Over the 12-month period, the incidence of CVD events was lowest in the combined intervention group (Group C), with only 2 participants (2.7%) experiencing an event, compared to 5 participants (6.7%) in the diet group (Group A) and 4 participants (5.3%) in the exercise group (Group B). The differences in event rates were statistically significant ($p = 0.03$).

Secondary Outcomes

1. Body Mass Index (BMI):

- **Group A (High-Quality Diet):** The average BMI decreased from 29.6 kg/m² to 28.1 kg/m² ($p < 0.01$).
- **Group B (Structured Cardio Exercise):** The exercise group saw a reduction in BMI from 29.4 kg/m² to 27.9 kg/m² ($p < 0.01$).
- **Group C (Combined Diet and Exercise):** The combined group experienced the most significant reduction in BMI, with levels decreasing from 29.5 kg/m² to 27.2 kg/m² ($p < 0.001$).

2. Waist Circumference:

- **Group A (High-Quality Diet):** Waist circumference decreased by an average of 3.2 cm from baseline ($p < 0.01$).
- **Group B (Structured Cardio Exercise):** The exercise group saw a reduction of 4.0 cm ($p < 0.01$).
- **Group C (Combined Diet and Exercise):** The combined group experienced the largest reduction, with an average decrease of 5.5 cm ($p < 0.001$).

3. Fasting Blood Glucose Levels:

- **Group A (High-Quality Diet):** Fasting blood glucose levels decreased from 105 mg/dL to 99 mg/dL ($p < 0.01$).
- **Group B (Structured Cardio Exercise):** The exercise group showed a similar reduction, with levels decreasing from 106 mg/dL to 100 mg/dL ($p < 0.01$).
- **Group C (Combined Diet and Exercise):** The combined group experienced the most significant reduction, with levels dropping from 105 mg/dL to 95 mg/dL ($p < 0.001$).

4. C-Reactive Protein (CRP) Levels:

- **Group A (High-Quality Diet):** CRP levels decreased by an average of 0.8 mg/L ($p < 0.01$).
- **Group B (Structured Cardio Exercise):** The exercise group showed a reduction of 0.9 mg/L ($p < 0.01$).

- **Group C (Combined Diet and Exercise):** The combined group experienced the most substantial decrease in CRP levels, with a reduction of 1.5 mg/L ($p < 0.001$).

Adherence and Compliance

Adherence to the interventions was generally high across all groups, with the combined group (Group C) showing the highest compliance rates. Participants in Group C reported 85% adherence to the diet and 80% adherence to the exercise regimen. Group A reported 80% adherence to the diet, while Group B reported 78% adherence to the exercise regimen.

Table 1: Baseline Characteristics of Study Participants

Characteristic	Group A (Diet, n=75)	Group B (Exercise, n=75)	Group C (Combined, n=75)	Overall (n=225)
Age (years)	52.3 ± 8.5	52.1 ± 8.7	52.2 ± 8.6	52.2 ± 8.6
Female (%)	54%	56%	55%	55%
BMI (kg/m²)	29.6 ± 2.5	29.4 ± 2.7	29.5 ± 2.6	29.5 ± 2.6
LDL Cholesterol (mg/dL)	130 ± 15	132 ± 16	131 ± 15	131 ± 15
Systolic BP (mmHg)	140 ± 10	138 ± 11	139 ± 10	139 ± 10
Diastolic BP (mmHg)	88 ± 8	87 ± 9	87 ± 8	87 ± 8
Fasting Glucose (mg/dL)	105 ± 10	106 ± 11	105 ± 10	105 ± 10

Table 2: Primary Outcomes Over 12 Months

Outcome	Group A (Diet)	Group B (Exercise)	Group C (Combined)	p-value
Systolic BP (mmHg)	128 ± 9	126 ± 8	120 ± 7	<0.001
Diastolic BP (mmHg)	80 ± 6	79 ± 5	76 ± 5	<0.001
LDL Cholesterol (mg/dL)	110 ± 12	120 ± 13	98 ± 10	<0.001
CVD Events (%)	6.7% (5/75)	5.3% (4/75)	2.7% (2/75)	0.03

Table 3: Secondary Outcomes Over 12 Months

Outcome	Group A (Diet)	Group B (Exercise)	Group C (Combined)	p-value
BMI (kg/m²)	28.1 ± 2.4	27.9 ± 2.3	27.2 ± 2.1	<0.001
Waist Circumference (cm)	-3.2 ± 0.5	-4.0 ± 0.6	-5.5 ± 0.7	<0.001
Fasting Glucose (mg/dL)	99 ± 8	100 ± 8	95 ± 7	<0.001
CRP (mg/L)	-0.8 ± 0.3	-0.9 ± 0.4	-1.5 ± 0.5	<0.001

Table 4: Adherence Rates by Group

Group	Adherence to Diet (%)	Adherence to Exercise (%)	Combined Adherence (%)
Group A (Diet)	85%	N/A	N/A
Group B (Exercise)	N/A	82%	N/A
Group C (Combined)	80%	78%	75%

Discussion

This study aimed to investigate the combined effects of a high-quality diet and structured cardio exercise on cardiovascular disease (CVD) prevention. The results demonstrate that both interventions, individually and combined, significantly improved cardiovascular health markers, with the most pronounced benefits observed in the group that combined both interventions (Group C). The significant reduction in both systolic and diastolic blood pressure across all groups underscores the effectiveness of dietary modifications and exercise in managing hypertension, a key risk factor for CVD [9]. The most substantial reduction was seen in the combined group (Group C), which supports the hypothesis that integrating diet and exercise offers synergistic benefits. This finding aligns with previous studies that have shown combined lifestyle interventions to be more effective than single interventions in lowering blood pressure [10]. The study also found significant reductions in LDL cholesterol levels across all groups, with the combined group showing the most marked decrease. High LDL cholesterol is a well-established risk factor for CVD, and the ability of both diet and exercise to lower LDL levels is well-documented. The greater reduction in the combined group suggests that the combination of dietary improvements, which directly impact lipid metabolism, and exercise, which enhances lipid clearance from the bloodstream, works more effectively together than individually. The lower incidence of CVD events in the combined group (2.7%) compared to the diet (6.7%) and exercise (5.3%) groups is a critical finding [11]. While the diet and exercise interventions alone were effective in reducing CVD risk, the combination provided a superior protective effect. This result is consistent with the idea that lifestyle modifications should be multifaceted to maximize their preventive potential. The reduced event rate in Group C suggests that combining these lifestyle changes could potentially reduce the overall burden of CVD in at-risk populations [12]. The significant reductions in BMI and waist circumference across all groups indicate improvements in body composition, which is closely linked to cardiovascular health. The combined group showed the greatest reductions, which likely contributed to the enhanced cardiovascular outcomes observed. These findings reinforce the importance of addressing both diet and physical activity in interventions aimed at reducing obesity and central adiposity, both of which are major risk factors for CVD [13]. The reductions in fasting glucose and CRP levels suggest improvements in metabolic health and inflammation, respectively. Elevated fasting glucose is a marker of insulin resistance and a precursor to type 2 diabetes, while CRP is an inflammatory marker associated with increased cardiovascular risk. The significant decreases in these markers in the combined group indicate that the dual intervention not only improves cardiovascular health but also mitigates metabolic and inflammatory conditions that often accompany and exacerbate CVD [14]. The findings of this study have important implications for clinical practice and public health. The superior outcomes observed in the combined intervention group highlight the need for comprehensive lifestyle modification programs that include both dietary improvements and structured exercise. Clinicians should consider recommending combined lifestyle interventions to patients at high risk for CVD, as this approach appears to offer the greatest protective effect.

Conclusion

It is concluded that the combination of a high-quality diet and structured cardio exercise provides superior benefits in preventing cardiovascular disease compared to either intervention alone. The study highlights significant improvements in key cardiovascular health markers, suggesting that a holistic approach to lifestyle modification is essential for effective CVD prevention.

References

1. Al-Mhanna SB, Rocha-Rodriguesc S, Mohamed M, Batrakoulis A, Aldhahi MI, Afolabi HA, Yagin FH, Alhussain MH, Gülü M, Abubakar BD, Ghazali WSW, Alghannam AF, Badicu G. Effects of combined aerobic exercise and diet on cardiometabolic health in patients with obesity and type 2 diabetes: a systematic review and meta-analysis. BMC Sports Sci Med Rehabil. 2023 Dec 4;15(1):165. doi: 10.1186/s13102-023-00766-5. PMID: 38049873; PMCID: PMC10696788.
2. Kausar, M. A. ., Shahid, S. ., Anwar, S. ., Kuddus, M. ., Khan, M. K. A. ., Khalifa, A. M. ., Khatoon, F. ., Alotaibi, A. D. ., Alkhodairy, S. F. ., Snoussi, M. ., & Arif, J. M. . (2022).

Identifying the alpha-glucosidase inhibitory potential of dietary phytochemicals against diabetes mellitus type 2 via molecular interactions and dynamics simulation. *Cellular and Molecular Biology*, *67*(5), 16–26. https://doi.org/10.14715/cmb/2021.67.5.3

3. Aguiar EJ, et al. Efficacy of interventions that include diet, aerobic and resistance training components for type 2 diabetes prevention: a systematic review with meta-analysis. *Int J Behav Nutr Phys Act*. 2014;11:2. doi: 10.1186/1479-5868-11-2
4. Batrakoulis A, et al. High intensity, circuit-type integrated neuromuscular training alters energy balance and reduces body mass and fat in obese women: a 10-month training-detraining randomized controlled trial. *PLoS ONE*. 2018;13(8). doi: 10.1371/journal.pone.0202390.
5. Zhao X, et al. Effectiveness of combined exercise in people with type 2 diabetes and concurrent overweight/obesity: a systematic review and meta-analysis. *BMJ Open*. 2021;11(10). doi: 10.1136/bmjopen-2020-046252.
6. Pan B, et al. Exercise training modalities in patients with type 2 diabetes mellitus: a systematic review and network meta-analysis. *Int J Behav Nutr Phys Act*. 2018;15(1):72. doi: 10.1186/s12966-018-0703-3.
7. Verheggen RJ, et al. A systematic review and meta-analysis on the effects of exercise training versus hypocaloric diet: distinct effects on body weight and visceral adipose tissue. *Obes Rev*. 2016;17(8):664–90. doi: 10.1111/obr.12406.
8. Costanzo P, et al. The obesity paradox in type 2 diabetes mellitus: relationship of body mass index to prognosis: a cohort study. *Ann Intern Med*. 2015;162(9):610–8. doi: 10.7326/M14-1551.
9. Bersaoui M, et al. The effect of exercise training on blood pressure in African and Asian populations: a systematic review and meta-analysis of randomized controlled trials. *Eur J Prev Cardiol*. 2020;27(5):457–72. doi: 10.1177/2047487319871233.
10. Pappachan JM, et al. Management of hypertension and diabetes in obesity: non-pharmacological measures. *Int J Hypertens*. 2011;2011:398065. doi: 10.4061/2011/398065.
11. Magalhães JP, et al. Impact of combined training with different exercise intensities on inflammatory and lipid markers in type 2 diabetes: a secondary analysis from a 1-year randomized controlled trial. *Cardiovasc Diabetol*. 2020;19(1):1–11. doi: 10.1186/s12933-020-01136-y.
12. Neuenschwander M, et al. Impact of different dietary approaches on blood lipid control in patients with type 2 diabetes mellitus: a systematic review and network meta-analysis. *Eur J Epidemiol*. 2019;34(9):837–52. doi: 10.1007/s10654-019-00534-1.
13. Zou Z, et al. Influence of the intervention of exercise on obese type II diabetes mellitus: a meta-analysis. *Prim Care Diabetes*. 2016;10(3):186–201. doi: 10.1016/j.pcd.2015.10.003.
14. Swift DL, et al. The effects of exercise and physical activity on weight loss and maintenance. *Prog Cardiovasc Dis*. 2018;61(2):206–13. doi: 10.1016/j.pcad.2018.07.014.