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Effects of Omega-3, Vitamin E, Zinc, and Vitamin C on Cardiovascular Risk in Postmenopausal Women with Type 2 Diabetes.

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Abstract

Background:

Postmenopausal women with (T2DM) are at an increased risk of cardiovascular disease (CVD) due to hormonal changes, insulin resistance, dyslipidemia, and oxidative stress. Nutritional supplements such as Omega-3, Vitamin E, Zinc, and Vitamin C have shown potential in mitigating cardiovascular risk factors; however, evidence remains inconsistent. Understanding the comparative efficacy of these supplements may offer insights into non-pharmacological approaches for cardiovascular risk reduction in this high-risk population.

Aim:

In postmenopausal women with type 2 diabetes, the purpose of this study was to assess and compare the effects of omega-3, vitamin E, zinc, and vitamin C supplements on cardiovascular risk factors, such as blood pressure, lipid profile, and fasting blood glucose.

Methods:

A randomized observational study was conducted on 110 postmenopausal women with T2DM. Participants were allocated into four groups: Omega-3 (n=28), Vitamin E (n=27), Zinc (n=28), and Vitamin C (n=27). Baseline and post-intervention measurements of systolic and diastolic blood pressure (SBP, DBP), lipid profile (triglycerides, total cholesterol), and fasting blood

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glucose (FBG) were recorded over a 12-week period. Data were analyzed using SPSS version 23.0, with statistical significance set at $p < 0.05$.

Results:

Omega-3 supplementation significantly reduced triglyceride levels (-20.3 mg/dL; p=0.001) and SBP (-6.7 mmHg; p=0.001) compared to baseline. Vitamin E demonstrated moderate reductions in SBP (-5.3 mmHg; p=0.004) and triglycerides (-11.2 mg/dL; p=0.02). Zinc showed the most significant improvement in FBG (-7.2 mg/dL; p=0.001), while Vitamin C had minimal impact on cardiovascular parameters. No significant adverse events were reported.

Conclusion:

Omega-3 was most effective in improving lipid profiles and blood pressure, while Zinc showed significant benefits in glycemic control. These findings suggest that targeted nutritional supplementation could be a valuable adjunct in managing cardiovascular risk factors in postmenopausal women with T2DM. However, larger and longer-term studies are recommended to confirm these results.

Recommendations:

Larger, longer-term randomized controlled trials should be the main focus of future studies to investigate the supplements' potential long-term cardiovascular benefits. Therapeutic results may be improved by customized supplementation plans that take into account each patient's unique metabolic profile.

Keywords:

Postmenopausal women, Type 2 diabetes, Cardiovascular risk, Omega-3, Nutritional supplements.

Introduction

For postmenopausal women with type 2 diabetes, cardiovascular disease (CVD) continues to be the primary cause of morbidity and mortality [1]. Hormonal changes, insulin resistance, dyslipidemia, and elevated oxidative stress all raise the risk of cardiovascular disease, making postmenopausal women especially susceptible [2]. The function of dietary supplements in

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modifying metabolic and inflammatory pathways linked to cardiovascular health is gaining attention due to the limits of pharmaceutical therapies in lowering the risk of CVD [3].

The cardioprotective qualities of several dietary supplements, including Omega-3 fatty acids, Vitamin E, Zinc, and Vitamin C, have been well investigated. Omega-3 polyunsaturated fatty acids (PUFAs), which are mostly included in fish oil, have been shown to have positive effects on endothelial function, blood pressure, and triglyceride levels [4]. Omega-3 supplementation dramatically lowers the risk of severe cardiovascular events in patients with diabetes and metabolic syndrome, according to several randomized controlled trials [5]. However, there are contradictory findings about how it affects lipid profile modulation and glycemic control, which calls for more research [6].

Strong antioxidant vitamin E has been researched for its potential to reduce lipid peroxidation and lower oxidative stress, two major causes of atherosclerosis and endothelial dysfunction in diabetics [7]. According to certain research, vitamin E supplements enhance lipid metabolism and vascular function, which reduces the risk of CVD [8]. Its possible pro-oxidant effects at higher doses have drawn criticism, nevertheless, highlighting the necessity of exact dosage calculation in therapeutic applications.

The immune system, insulin function, and glucose metabolism are all significantly impacted by zinc, an essential trace metal. Zinc supplementation may improve lipid profiles, lower inflammation, and increase insulin sensitivity in diabetes individuals, according to studies. Additionally, zinc has been linked to decreased arterial stiffness and enhanced endothelial function, two important aspects of lowering cardiovascular risk [9].

Vitamin C, another potent antioxidant, has been widely recognized for its role in reducing oxidative stress and inflammation in cardiovascular disease. Epidemiological studies suggest that higher dietary intake or supplementation of Vitamin C is correlated with lower blood pressure and improved arterial function in diabetic individuals. Despite its theoretical benefits, clinical evidence remains inconclusive, with some studies reporting negligible effects on cardiovascular outcomes [10]. In postmenopausal women with type 2 diabetes, the purpose of this study was to assess and compare the effects of omega-3, vitamin E, zinc, and vitamin C supplements on cardiovascular risk factors, such as blood pressure, lipid profile, and fasting blood glucose.

Methodology

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Study Design

This study was a prospective observational design.

Study Setting

The study was conducted at a reputable hospital in a metropolitan area, with access to appropriate facilities for medical testing, participant recruitment, and data collection. The hospital's diabetes clinic served as the main site for recruitment, and the study utilized its patient care resources for medical assessments and consultations. The setting ensured a diverse sample of postmenopausal women with type 2 diabetes, representing typical clinical populations.

Participants

The study comprised 110 postmenopausal women with a diagnosis of type 2 diabetes. The diabetic clinic was the source of the participants, who were chosen in accordance with the inclusion criteria. Written consent forms and an explanation of the study's objectives were given to each participant.

Inclusion Criteria

- Women aged 50–70 years
- Diagnosed with T2DM for at least one year
- Postmenopausal (absence of menstruation for at least 12 months)
- Willing to comply with the study procedures and provide informed consent
- No history of cardiovascular disease (e.g., heart attack, stroke)

Exclusion Criteria

- Current use of other supplements affecting cardiovascular risk (e.g., statins, blood pressure medications)
- Severe comorbidities (e.g., cancer, severe renal disease, or chronic liver disease)
- Pregnancy or breastfeeding
- Allergy to any of the study supplements (Omega-3, Vitamin E, Zinc, Vitamin C)
- Active participation in other clinical trials

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Bias

To minimize bias, the study employed random assignment to supplement groups and ensured blinding of outcome assessors. Participants were unaware of the specific supplement they received, and the healthcare professionals assessing cardiovascular outcomes were blinded to the treatment allocation. Furthermore, confounding variables such as age, BMI, and baseline cardiovascular risk were adjusted for in the statistical analysis to reduce potential biases in interpreting the data.

Data Collection

Data were collected at baseline (before supplementation began) and at the end of the 12-week supplementation period. The primary data points included blood pressure, lipid profiles (e.g., cholesterol levels), fasting blood glucose, and biomarkers related to cardiovascular risk. Additionally, anthropometric measurements (weight, height, waist circumference) were recorded. Participants kept a diary documenting their supplement intake and any side effects they experienced. Data were recorded in standardized forms, and laboratory tests were conducted at the hospital's pathology department.

Procedure The participants were randomized to one of four groups after fulfilling the eligibility requirements: Supplementing with omega-3, vitamin E, zinc, or vitamin C. Each group received daily doses of the designated supplement for 12 weeks. Regular follow-up visits occurred every 4 weeks to monitor participant compliance and adverse events. At each visit, cardiovascular risk assessments were repeated to track changes over time. All procedures were conducted in compliance with ethical guidelines.

Statistical Analysis

The SPSS version 23.0 was used to analyze the data. The baseline characteristics of the individuals were compiled using descriptive statistics (mean, standard deviation, frequency, and percentage). To compare the effects of the supplements on cardiovascular risk factors, paired t-tests were employed for within-group analysis, while between-group comparisons were conducted using one-way ANOVA. Adjustments for confounding factors such as age and baseline measurements were made through multivariate analysis. P-values below 0.05 were regarded as statistically noteworthy.

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Results

A total of 110 postmenopausal women with T2DM were enrolled in the study. Participants were randomly assigned to four supplementation groups: Omega-3 (n=28), Vitamin E (n=27), Zinc (n=28), and Vitamin C (n=27). All participants completed the 12-week study period, and no significant adverse events were reported.

The baseline characteristics of the participants were comparable across the four groups. There were no statistically significant differences in age, BMI, blood pressure, lipid profile, or fasting blood glucose levels ($p > 0.05$), indicating homogeneity across the groups.

Table 1: Baseline Characteristics of Participants (n=110)

Variable	Omega-3 (n=28)	Vitamin E (n=27)	Zinc (n=28)	Vitamin C (n=27)	p-value
Age (years)	62.4 ± 5.2	61.8 ± 4.9	62.1 ± 5.1	61.5 ± 5.4	0.82
BMI (kg/m²)	28.7 ± 2.3	28.2 ± 2.5	28.5 ± 2.4	28.1 ± 2.6	0.75
SBP (mmHg)	142.3 ± 8.1	141.5 ± 7.8	142.8 ± 8.2	141.2 ± 7.6	0.68
DBP (mmHg)	85.2 ± 4.5	84.7 ± 4.8	85.5 ± 4.6	84.8 ± 4.7	0.71
Fasting Glucose (mg/dL)	142.7 ± 15.4	141.9 ± 14.9	142.5 ± 15.2	141.7 ± 15.1	0.89
Total Cholesterol (mg/dL)	198.4 ± 20.6	197.8 ± 19.9	198.1 ± 20.3	197.5 ± 20.2	0.93
Triglycerides (mg/dL)	172.6 ± 18.2	171.4 ± 17.9	172.1 ± 18.0	171.9 ± 17.8	0.85

- *No significant differences were observed across baseline variables ($p > 0.05$).*

Effect on Blood Pressure

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When compared to baseline, the Omega-3 and vitamin E groups showed significant decreases in both systolic (SBP) and diastolic blood pressure (DBP). There were slight, non-statistically significant differences in the zinc and vitamin C groups.

Table 2: Effect of Supplementation on Blood Pressure (mmHg)

Blood Pressure (mmHg)	Baseline (Mean ± SD)	12 Weeks (Mean ± SD)	Mean Change	p-value
Omega-3 (SBP)	142.3 ± 8.1	135.6 ± 7.2	-6.7	0.001*
Vitamin E (SBP)	141.5 ± 7.8	136.2 ± 7.5	-5.3	0.004*
Zinc (SBP)	142.8 ± 8.2	141.5 ± 7.9	-1.3	0.18
Vitamin C (SBP)	141.2 ± 7.6	140.4 ± 7.3	-0.8	0.24

- *Omega-3 showed the greatest reduction in SBP with statistical significance ($p < 0.01$).*

Effect on Lipid Profile

Omega-3 supplementation resulted in a significant reduction in triglycerides (TG) and total cholesterol (TC). Vitamin E also showed a moderate decrease in lipid parameters. Zinc and Vitamin C groups had minimal or no significant changes.

Table 3: Effect of Supplementation on Lipid Profile (mg/dL)

Lipid Profile (mg/dL)	Baseline (Mean ± SD)	12 Weeks (Mean ± SD)	Mean Change	p-value
Omega-3 (TG)	172.6 ± 18.2	152.3 ± 15.8	-20.3	0.001*
Vitamin E (TG)	171.4 ± 17.9	160.2 ± 16.7	-11.2	0.02*
Zinc (TG)	172.1 ± 18.0	170.8 ± 17.6	-1.3	0.64
Vitamin C (TG)	171.9 ± 17.8	171.1 ± 17.4	-0.8	0.71

- *Omega-3 showed a statistically significant reduction in triglycerides ($p < 0.001$).*

Effect on Fasting Blood Glucose (FBG)

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All groups showed a reduction in fasting blood glucose, but the most notable improvement was observed in the Zinc group.

Table 4: Effect of Supplementation on Fasting Blood Glucose (mg/dL)

FBG (mg/dL)	Baseline (Mean ± SD)	12 Weeks (Mean ± SD)	Mean Change	p-value
Omega-3	142.7 ± 15.4	138.2 ± 14.9	-4.5	0.03*
Vitamin E	141.9 ± 14.9	138.7 ± 14.5	-3.2	0.05
Zinc	142.5 ± 15.2	135.3 ± 14.7	-7.2	0.001*
Vitamin C	141.7 ± 15.1	139.8 ± 14.9	-1.9	0.12

- *Zinc showed the most significant reduction in fasting blood glucose ($p < 0.01$).*

Summary of Findings

- **Omega-3** significantly improved triglyceride levels and blood pressure.
- **Vitamin E** showed moderate improvements in blood pressure and triglycerides.
- **Zinc** was most effective in reducing fasting blood glucose.
- **Vitamin C** had minimal impact on cardiovascular risk parameters.

Discussion

Over a 12-week period, the study assessed how supplements of Omega-3, Vitamin E, Zinc, and Vitamin C affected cardiovascular risk variables in postmenopausal women with type 2 diabetes. The baseline characteristics of participants were comparable across all groups, ensuring the validity of the observed changes in clinical parameters. Overall, significant improvements were noted in blood pressure, lipid profiles, and fasting blood glucose, with varying degrees of effectiveness among the four supplements.

Omega-3 supplementation resulted in the most pronounced reduction in both systolic and diastolic blood pressure. Participants in this group experienced an average systolic blood pressure (SBP) decrease of 6.7 mmHg (p=0.001), suggesting a significant cardioprotective effect. Vitamin E also contributed to a moderate reduction in SBP (-5.3 mmHg, p=0.004), while Zinc and Vitamin C had minimal impact on blood pressure. These findings indicate that

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Omega-3 and Vitamin E may have antihypertensive properties, possibly through mechanisms such as improved endothelial function and reduced inflammation.

Regarding lipid metabolism, Omega-3 was the most effective in lowering triglycerides (TG), with a significant mean reduction of 20.3 mg/dL (p=0.001). Vitamin E also showed a moderate TG reduction (-11.2 mg/dL, p=0.02), but Zinc and Vitamin C did not significantly alter lipid levels. The ability of Omega-3 to reduce triglycerides aligns with existing literature, which attributes this effect to its role in modulating lipid metabolism and reducing hepatic triglyceride production.

In terms of glycemic control, Zinc supplementation demonstrated the greatest effect, reducing fasting blood glucose (FBG) by 7.2 mg/dL (p=0.001). This suggests a potential role of Zinc in improving insulin sensitivity or enhancing pancreatic β-cell function. Although Omega-3 and Vitamin E also showed slight reductions in FBG (-4.5 mg/dL and -3.2 mg/dL, respectively), their effects were less pronounced than those of Zinc. Vitamin C had the least impact on glucose metabolism, with a non-significant mean reduction of 1.9 mg/dL (p=0.12).

Overall, the findings suggest that Omega-3 is particularly beneficial for improving lipid profiles and blood pressure, while Zinc plays a crucial role in glycemic control. Vitamin E demonstrated moderate benefits in both blood pressure and lipid regulation, whereas Vitamin C had minimal impact on cardiovascular risk factors. These results highlight the potential of targeted micronutrient supplementation as an adjunct to conventional diabetes management in postmenopausal women. Mahmoodi et al. showed in a double-blind controlled trial that in postmenopausal women with diabetes for ≤7 years, supplementing with omega-3 plus vitamin E significantly decreased blood pressure and triglyceride levels, while zinc plus vitamin C improved fasting blood sugar and HDL cholesterol. These results suggest that the length of diabetes may affect how well these micronutrient therapies work, with zinc and vitamin C having a stronger effect on metabolic parameters and omega-3 and vitamin E demonstrating significant cardiovascular benefits [11].

Omega-3 fatty acid supplementation was linked to a significant decrease in cardiovascular mortality (relative risk [RR]: 0.93), myocardial infarction (RR: 0.85), and coronary heart disease events (RR: 0.86), according to a comprehensive meta-analysis conducted by An et al. that examined 884 randomized controlled trials. Vitamins E and C, on the other hand, had no

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discernible impact in lowering the risk of CVD or Type 2 diabetes. While the function of antioxidant vitamins is still unknown, these results imply that omega-3 may be crucial in supporting cardiovascular health [12].

Vitamin C, however, has shown promise in improving glycemic control. Mason et al. conducted a systematic review that included 28 randomized controlled trials with 1,574 participants. The review reported that vitamin C supplementation significantly reduced systolic blood pressure (mean difference: −6.27 mmHg) and HbA1c levels (−0.54%), suggesting its potential as an adjunct therapy for glycemic management in Type 2 diabetes [13].

Aruoah & Al-Jowari further demonstrated the positive effects of zinc and vitamin C on glycemic profiles by demonstrating that supplementation dramatically reduced fasting blood sugar, HbA1c, and insulin levels in patients with Type 2 diabetes. The potential of combined micronutrient supplementation to enhance glucose metabolism and lower the risk of problems connected to diabetes is highlighted by this study [14].
Furthermore, a six-month study conducted by Aruoah assessed the results of daily zinc and vitamin C supplementation. The findings revealed significant changes in blood pressure, lipid profiles, HbA1c, and fasting blood glucose. Furthermore, the study found that diabetic foot ulcers typically healed completely without the need for antibiotics. These results highlight the wider metabolic advantages of long-term zinc and vitamin C supplementation in the treatment of complications from Type 2 diabetes [15].

Conclusion

Supplementing with omega-3 fatty acids showed the greatest benefits in blood pressure and lipid profiles, indicating that it may help lower cardiovascular risk in postmenopausal women with type 2 diabetes. The effect of zinc on glycemic control was considerable. It is advised that these results be confirmed by larger sample size and extended study periods in the future.

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