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The Comparative Effect of Extra Virgin Olive Oil or Palm Oil on Ambulatory Blood Pressure: A Randomized Controlled Trial

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Abstract. The global burden of cardiovascular disease underscores the critical importance of addressing modifiable risk factors, particularly dietary composition. This randomized, crossover trial examined the impact of extra virgin olive oil (EVOO) or palm oil (PO) on ambulatory blood pressure (ABP) over a two-week intervention period. Consumption of the EVOO diet was associated with significantly improved ABP profiles, including reductions in 24-hour systolic BP, 24-hour mean arterial pressure, day-time systolic BP, night-time diastolic BP, and night-time mean arterial pressure relative to the PO diet. These findings suggest that substituting PO with EVOO in the diet is a beneficial strategy for improving blood pressure parameters and supporting cardiovascular health.

Keywords: Extra virgin olive oil, Palm oil, Ambulatory blood pressure, Randomized controlled trial, Cardiovascular health

1. Introduction

Cardiovascular Disease (CVD) remained the leading cause of mortality worldwide in 2019, attributing for an estimated 18.6 million deaths [1]. Numerous factors contribute to the development of CVD, among which dietary habits stand out as a major modifiable risk factor. The specific types of dietary fats consumed play an important role in cardiovascular health and significantly influence risk factors including hypertension. However, numerous variations of fat sources available commercially presents a challenge for consumers seeking to make informed dietary choices.

Major cardiology societies such as the European Society of Cardiology (ESC) and the American Heart Association (AHA) have established dietary guidelines for CVD prevention. The ESC guidelines from 2021 advise replacing saturated fats with unsaturated fats to reduce CVD risk [2]. Similarly, the 2021 AHA scientific statement advocates for liquid plant oils over tropical oils to lower low-density lipoprotein (LDL) cholesterol concentrations and CVD risk [3]. This evidence indicates that reducing palm oil consumption and replacing with unsaturated oils like extra virgin olive oil (EVOO) may offer better cardioprotective benefits [4-7].

The health-promoting effects of olive oil, especially those of the extra virgin variety, are well-documented in both population studies and clinical trials. Nutritional experts recommend incorporating EVOO into healthy dietary patterns to maximize cardiovascular benefit [8]. EVOO's

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protective properties are derived from two primary mechanisms: its high concentration of monounsaturated fatty acids (MUFAs), mainly oleic acid (55-83%), and its diverse array of bioactive micronutrients. These micronutrients include antioxidant phenolic compounds like hydroxytyrosol, which are associated with preventing atherosclerosis [9], as well as phytosterols [10], triterpenes [11], polar lipids [12], and alpha-tocopherol. Through these mechanisms, EVOO plays a role in improving key risk factors like blood lipids and blood pressure, therefore correlates with a significant reduction in CVD incidence and mortality. Given this evidence, this study aims to compare the effects of an EVOO diet with a PO diet on blood pressure control in adult males.

2. Methods

2.1. Criteria and study settings

This study was conducted using a crossover Randomized Controlled Trial (RCT) methodology. Participant assignment to the two treatment sequences was balanced using a 1:1 allocation ratio: one group initiated the dietary protocol with EVOO, while the other commenced with PO. The randomization sequence was concealed through the use of sequentially numbered, opaque, and sealed envelopes to ensure allocation concealment and prevent selection bias. Due to the inherent differences in the sensory properties of the two dietary oils, participants were not blinded.

Subject recruitment: men from Jiangnan University, Wuxi, Jiangsu, China was offered study participation. Written informed consent was obtained from every participant before enrollment. Recruitment strategies included the dissemination of digital advertisements through student and faculty online group chats. All study appointments and procedures were conducted on the university campus.

Eligible participants were self-reported healthy, young adult Chinese men who were students or employees of Jiangnan University residing in the Wuxi area. All participants confirmed they followed an omnivorous diet and had no need or interest for a therapeutic or weight-loss diet. Exclusion criteria were established to include: regular consumption of dietary supplements; diagnosed diabetes, hypertension (>140/90 mmHg), hypercholesterolemia, or any cardiovascular condition; a Body Mass Index (BMI) ≥ 25 kg/m^2; or a reported allergy to the intervention oils.

2.2. Sample size

A power analysis was conducted beforehand (a priori) with G*Power software version 3.1.9.7 [13] to estimate the sample size necessary for detecting a significant effect in the primary endpoint (Systolic Blood Pressure). The calculation was based on a two-tailed paired t-test. Power analysis indicated that a sample of 34 participants would provide 80% power at an α-level of 0.05 to detect a clinically relevant mean difference of 6 mmHg (effect size $d = 0.5$). The principal investigator (PI) aimed to recruit 45 male adults to account for a potential drop-out rate up to 20%.

2.3. Diets intervention

Diets compared: 1) EVOO diet; and 2) PO diet, both are two isocaloric diets formulated by the study PI. In the intervention arm, each participant required to consume both diets for a period of two weeks each, consuming 30 mL of the assigned oil per day. Participants were instructed to incorporate the provided oil into their main lunch and dinner meals, effectively replacing their usual cooking fats and oils. 2-week washout period was established between the dietary intervention.

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Study appointments were at baseline, following the first two-week intervention period, and after the second two-week period.

2.4. Study outcome and assessment procedures

The primary endpoint for this analysis was the change from baseline in ambulatory blood pressure (ABP) measurements. Prior to the intervention, all participants completed 3-day food records (including two weekdays and one weekend day). During the first period, participants were required to maintain a food record to track their intake. Then they were instructed to replicate this dietary pattern as closely as possible during the second period to maintain a consistent nutritional intake across both periods, with the type of intervention oil as the only variable. Furthermore, participants were explicitly required to keep their usual physical activity patterns and sodium consumption stable during entire study duration.

2.5. Statistical analysis

Data normality was evaluated for all variables using the Shapiro-Wilk test. In compliance with best practices for crossover trials, potential carryover and period effects were evaluated using the statistical method described by Wellek and Blettner [14]. The primary analysis for comparing the effects of the EVOO and PO diets on continuous outcome variables was performed using paired t-tests.

3. Results

The participant recruitment and study procedures were conducted between April 2025 and August 2025. Of the initially enrolled subjects, 34 participants successfully completed the entire trial protocol (Figure 1). All participants had a high compliance with the dietary intervention, with all subjects reporting full adherence to the consumption of the study meals. The interventions were found to be safe and well-tolerated, with an absence of any reported adverse effects during the study. In a post-intervention survey, all participants indicated a positive behavioral intention to continue incorporating EVOO into their regular diet after completing the study.

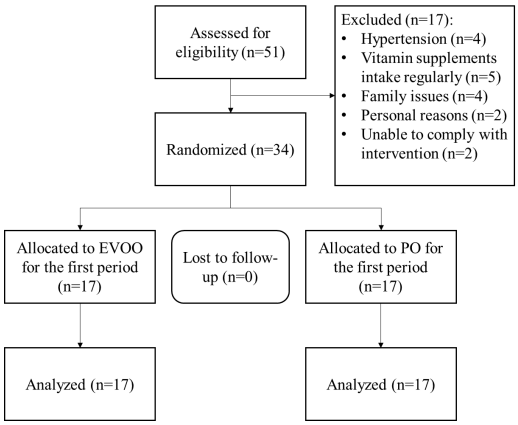


Figure 1. CONSORT flow diagram

Table 1 summarizes the participants' baseline characteristics. Participants were young adult males, with an age range of 25-30 years old. The group was characterized by a normal body weight, normal resting blood pressure, and a body composition within healthy parameters.

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Table 2 outlines the comparative resting and ABP results across the entire cohort. A statistical assessment for carryover effects was conducted, and no significant evidence of such an effect was detected. Significant differences were observed for multiple parameters when comparing the EVOO and PO interventions. Specifically, consumption of EVOO resulted in a significantly lower values for 24-h SBP ($p = 0.02$) and 24-h MAP ($p = 0.04$). furthermore, highly significant reductions were observed during day-time SBP ($p < 0.00$), as well as night-time DBP ($p < 0.00$) and night-time MAP ($p < 0.00$).

Table 1. Summary of participant characteristics upon enrollment in the trial

Baseline Characteristics	All Participants (n = 34)
Age (year)	28.00 ± 1.71
BMI (kg/m²)	21.84 ± 1.62
Resting SBP	115.50 ± 6.03
Resting DBP	68.47 ± 2.83
Resting HR (bpm)	68.30 ± 6.40
24-h SBP	118.68 ± 6.02
24-h DBP	69.06 ± 4.73
24-h MAP	86.12 ± 4.63
Day-time ABP	
SBP	122.52 ± 6.05
DBP	70.03 ± 2.80
MAP	87.33 ± 2.83
Night-time ABP	
SBP	111.06 ± 6.09
DBP	64.41 ± 2.87
MAP	80.05 ± 2.89

Mean ± SD. All blood pressure reported as mmHg. Abbreviations: BMI: Body Mass Index; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart Rate; MAP: Mean Arterial Pressure; ABP: Ambulatory Blood Pressure.

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Table 2. Blood pressure in participants (n=34) after EVOO and PO consumption

Variable	EVOO	PO	p
Resting SBP	117.06 ± 5.89	118.56 ± 6.03	0.36
Resting DBP	69.56 ± 2.67	68.34 ± 2.83	0.47
Resting HR (bpm)	72.73 ± 6.11	72.50 ± 6.40	0.91
24-h ABP			
24-h SBP	118.63 ± 5.75	122.99 ± 6.02	0.02
24-h DBP	68.75 ± 4.33	70.97 ± 4.73	0.09
24-h MAP	85.42 ± 4.40	88.03 ± 4.63	0.04
Day-time ABP			
SBP	122.59 ± 5.86	128.36 ± 6.05	<0.00
DBP	72.66 ± 2.12	74.52 ± 2.80	0.28
MAP	89.90 ± 2.57	92.49 ± 2.83	0.11
Night-time ABP			
SBP	111.38 ± 5.63	114.96 ± 6.09	0.06
DBP	63.14 ± 2.45	67.04 ± 2.87	<0.00
MAP	79.49 ± 2.52	83.45 ± 2.79	<0.00

Mean ± SD. All blood pressure reported as mmHg.

4. Discussion

This RCT demonstrates that a short-term diet incorporating EVOO brings to significant improvements in 24-h ABP parameters in healthy adult men, compared to an isocaloric diet incorporating PO. In particular, EVOO consumption results in significant reduction in 24-h SBP, 24-h MAP, day-time SBP, night-time DBP, and night-time MAP.

The magnitude of blood pressure reduction observed in this study, especially the 24-h SBP has important clinical implications. Previous epidemiological research suggests that a scale of this sustained reduction can decrease stroke-related mortality by 13-14% and 9% reduction in CVD mortality [15,16]. The night-time blood pressure reduction also worthy, since it consistently has been shown to be a stronger predictor of cardiovascular morbidity and mortality than day-time measurements [17]. This pattern suggests that EVOO may influence the fundamental regulatory mechanisms governing circadian blood pressure rhythms, potentially through modulation of autonomic nervous system activity or enhanced endothelial function during night-time period.

The impact of EVOO on blood pressure regulation has causality effect with its unique biochemical composition. Although both oils provide dietary fats, EVOO contains diverse bioactive compounds that may confer specific cardiovascular benefits. It has high MUFAs content, particularly oleic acid, likely contributes to improved vascular reactivity and endothelial function through nitric oxide-mediated vasodilation and reduced oxidative stress [18]. Additionally, EVOO is rich in polyphenolic compounds such as hydroxytyrosol and oleuropein, which demonstrate antioxidant and anti-inflammatory properties [9]. These bioactive components may work synergistically and at the end are able to contribute to the blood pressure improvements observed in the results.

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Careful consideration is necessary regarding the underlying physiological mechanisms influencing the differential effects observed between day-time and night-time blood pressure data, which exist as other factors. The natural circadian rhythm of blood pressure is regulated by autonomic nervous system activity, which characterize by a 10%-20% nocturnal decline known as the “dip” [19]. This dipping phenomenon relies on the equilibrium relation between sympathetic and parasympathetic activity, and its absence happens in hypertensive patients, possibly because of the reduction of parasympathetic function [19]. Furthermore, factors not measured in the present study such as sleep quality and individual sleep patterns [20] may have contributed to the observed night-time blood pressure results. Therefore, while the dietary intervention was the primary variable, these inherent physiological and lifestyle factors represent important considerations when interpreting ABP outcomes.

Strengths: the crossover design used in this study represents a significant methodological strength, as it allowed for controlling inter-individual variability by having each participant serve as their own control. This design enhanced the ability to detect the true intervention effect despite the relatively modest sample size. The use of 24-h ABP monitoring rather than isolated clinic measurements provides a more comprehensive and reliable assessment of blood pressure patterns throughout daily activities and sleep, capturing the clinically important nocturnal period.

Limitations: while two-week dietary intervention is sufficient to demonstrate significant effects, it leaves unanswered questions about the sustainability and long-term trajectory of these blood pressure improvements. Longer intervention periods would be valuable to establish the durability of the response. The study population, consisting exclusively of young, healthy, normotensive Chinese men, necessarily limits the generalizability of our findings to other demographic groups, including women, older individuals, hypertensive patients, and other ethnic populations. The inherent nature of the dietary intervention prevented blinding of participants to the oil type, which introducing potential for performance bias, though the objective nature of ABP monitoring measurements mitigates some concern regarding subjective outcome assessment. Finally, the absence of mechanistic biomarkers limits the ability to definitely clarify the physiological pathways through which EVOO exerted its blood pressure-lowering effects.

5. Conclusion

This study provides evidence that dietary supplementation with EVOO, compare to PO, significantly improves 24-h ABP parameters in healthy young men, with particularly notable effects on nocturnal blood pressure. The clinically relevant magnitude of these improvements supports the consideration of EVOO as a valuable dietary component for cardiovascular health maintenance. Future research should prioritize several directions, including long-term intervention studies to establish the sustainability of the blood pressure-lowering effects and determine optimal maintenance dosing; mechanistic investigations incorporating biomarkers of endothelial function, oxidative stress, and autonomic regulation to understand the physiological pathways through which EVOO influences blood pressure; expansion to diverse population including hypertensive individuals, older adults, women, and different ethnic groups to establish the broad application of these findings, and dose-response studies to determine the optimal intake of EVOO for cardiovascular benefit and establish evidence-based dietary recommendations.

The consistent evidence supporting EVOO's cardiovascular benefits, combined with the findings of this study, suggests that simple dietary modifications incorporating EVOO could serve as an effective non-pharmacological approach to cardiovascular risk reduction at both individual and population levels.

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