Rocz Panstw Zakl Hig 2025;76(4):323-333

https://roczniki.pzh.gov.pl/ https://doi.org/10.32394/rpzh/220651

ORIGINAL ARTICLE

HEALTH STATUS, RISK FACTORS AND EFFECTS OF OLIVE LEAF EXTRACT INFUSION (*OLEA EUROPAEA* L.) ON BLOOD PRESSURE IN A HYPERTENSIVE POPULATION

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ABSTRACT

Background. Hypertension is a major global public health concern and a leading contributor to cardiovascular morbidity and mortality. Despite pharmacological treatment, blood pressure (BP) control remains inadequate in many patients, highlighting the need for complementary, non-pharmacological approaches.

Objective. The aim of the study was to evaluate the effect of olive leaf infusion consumption on systolic (SBP) and diastolic (DBP) in hypertensive adults and to explore associated cardiometabolic and lifestyle factors.

Material and Methods. A preliminary dietary survey was conducted to assess the daily salt intake of hypertensive patients recruited at the Mohammed Boudiaf Public Hospital Relizane, Algeria. Only patients with a comparable daily salt intake (6 to 8 g/day) (220 patients) were selected to participate in a six-week prospective observational study, after being divided into two groups: a control group A (n = 110) and an experimental group B (n = 110) consuming an olive leaf infusion twice a day at fixed times before meals (once in the morning and once in the evening), in addition to the same diet. BP was measured weekly. Anthropometric, clinical, and lifestyle data were collected through structured interviews. Temporal changes in BP were analyzed using repeated-measures ANOVA with Greenhouse-Geisser correction, and correlation analyses were performed to assess associations between variables. Baseline characteristics, including age and hypertension severity, were comparable between groups.

Results. Olive leaf infusion consumption was associated with a significant reduction in SBP and DBP from the second week onward. Repeated measures ANOVA demonstrated a significant main effect of time on SBP ($p < 0.001$) and a significant time and group interaction ($p < 0.001$). DBP showed similar effects (time and group interaction, $p < 0.001$), with BP reductions plateauing after week four. Correlation analyses identified significant associations between BP, salt intake, obesity indices, and sleep disturbances. Short-term consumption of olive leaf infusion was associated with clinically meaningful reductions in SBP and DBP in hypertensive adults.

Conclusion. These findings support olive leaf infusion as a potential complementary, non-pharmacological strategy within integrated hypertension management. Standardized phytochemical characterization is needed to confirm efficacy and guide clinical implementation.

Keywords: *health status, risk factors, olive leaf, Olea europaea L., blood pressure, hypertension*

INTRODUCTION

High blood pressure (BP) constitutes a major global public health challenge. It rarely occurs alone and is a leading contributor to cardiovascular morbidity and mortality, including myocardial infarction, chronic kidney disease, and stroke. A continuous and linear relationship exists between BP levels and cardiovascular risk, irrespective of age [1-3].

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Publisher: National Institute of Public Health NIH - National Research Institute

In 2024, hypertension affected approximately 1.4 billion adults aged between 30 to 79 years worldwide, representing nearly 33% of this age group. Projections indicate that this number will reach 1.56 billion individuals by the end of 2025, with an estimated 7.5 million deaths annually, accounting for approximately 12.8% of global mortality [3]. The burden of hypertension has more than doubled since 1990, when approximately 650 million adults were affected, largely due to population growth and population ageing [3].

In Algeria, hypertension represents a significant public health concern. In 2024, the prevalence among adults aged between 30 to 79 years was estimated at 7.7 million individuals (17% of the population), of whom approximately 6.4 million had uncontrolled BP, highlighting substantial gaps in diagnosis, treatment, and effective disease management [3].

Hypertension is clinically defined as a systolic BP ≥ 140 mmHg and/or a diastolic BP ≥ 90 mmHg, measured on at least two separate occasions on different days, or by the current use of antihypertensive medication [3]. The development of hypertension is multifactorial and insidious, often progressing asymptomatically. It results from complex interactions between non-modifiable factors, such as genetic predisposition, sex, age, and family history. And modifiable environmental, lifestyle factors and eating habit who can be influenced by multiple factors [4]. Including overweight and obesity, diabetes mellitus, physical inactivity, psychosocial stress, and dietary habits, particularly excessive sodium intake [5].

The management of hypertension encompasses both pharmacological and non-pharmacological approaches. Lifestyle modification and dietary interventions include sodium restriction through a low-sodium (hypo-sodium) diet (< 5 g/day), increased consumption of vegetables, fresh fruits, fish, nuts, and unsaturated fatty acids (olive oil), low consumption of red meat, and consumption of low-fat dairy products, are recommended as the first-line strategy and offers several advantages in BP control and cardiovascular risk reduction [6-9].

However, lifestyle interventions alone are frequently insufficient, necessitating long-term pharmacological treatment. Indeed, antihypertensive drugs are essential for treating hypertension, although their use can be costly and are often associated with adverse effects, which may contribute to poor treatment adherence, patient dissatisfaction, and suboptimal BP control [10]. Consequently, the use of foods from natural sources, such as marines or plants by-products [11-16], could prove beneficial when combined with pharmacological treatment to counteract the adverse effects of this medication. Moreover, the World Health Organization encourages research into alternative and complementary strategies for hypertension management, including the integration of traditional and herbal medicine practices [17].

Among phytotherapeutic approaches, the olive tree (*Olea europaea* L.) has attracted growing scientific interest. Widely cultivated in the Mediterranean region, the olive tree holds considerable economic, cultural, and social importance [18]. Its by-products, particularly olive leaves, have long been used in traditional medicine in European and Mediterranean countries such as Greece, Spain, Italy, France, Turkey, Morocco, and Tunisia [19-21]. Their chemical composition varies according to many factors such as olive variety, climatic conditions, tree age, and wood content [22]. Olive leaves contain variable levels of organic matter (76.4-92.7 g/100 g dry matter), low levels of crude protein (6.31-10.9 g/100 g dry matter), a significant amount of amino acids (89.9 g/100 g total nitrogen), and the nitrogen attached to the cell walls is high but variable (49.2 and 35.4 g/100 g total nitrogen). Crude fat content also varies in olive leaves (2.28-9.57 g/100 g dry matter) [22]. Mannitol and glucose are the two most abundant soluble carbohydrates in olive leaves, contributing 27.1-30.8%, with mannitol levels fluctuating from season to season [22]. Moreover, olive leaves have been shown to be rich in certain bioactive compounds, notably a wide variety of phenolic compounds, such as secoiridoids (oleuropein, ligstroside, dimethyloleuropein), hydroxytyrosol, tyrosol, caffeic and ferulic acids, and flavonoids (apigenin, luteolin, luteolin-7-*O*-glucoside, etc.) [23]. Furthermore, a recent study compared the chemical composition of certain Algerian and Tunisian varieties of olive leaves (*Olea europaea* L.) by identifying nineteen compounds in extracts by HPLC (high-performance liquid chromatography), with oleuropein being the predominant compound, followed by hydroxytyrosol and verbacoside [24].

Olive leaf extracts are recognized for their nutritional, hypolipidemic, antioxidant, and anti-inflammatory properties and have been employed in the management of several chronic conditions, including hypertension [25-27]. They are commonly consumed as herbal infusions or as powdered dietary supplements [20, 26, 28].

To date, clinical evidence from Algeria regarding the effects of olive leaf infusion on blood pressure in hypertensive patients remains scarce. Therefore, the present study aims, first, to assess cardiometabolic comorbidities, particularly overweight and obesity commonly associated with hypertension, and second, to evaluate the effects of a six-week intervention with olive leaf infusion on blood pressure parameters in a randomly selected sample of hypertensive patients recruited from Mohamed Boudiaf Public Hospital in the Wilaya of Relizane.

MATERIAL AND METHODS

Study design

This study was carried out during a six-week period in February and March 2025. A structured questionnaire was sent to a randomly selected sample of hypertension patients recruited at Mohammed Boudiaf Public Hospital, located in the Wilaya of Relizane, Algeria. All participants were informed of the study's aims and methods, and their informed consent was obtained.

Eligibility criteria

The inclusion criteria were as follows: adults aged 18 years and older, regardless of sex or ethnicity, with elevated blood pressure (≥ 140/90 mmHg; classified as hypertension according to the World Health Organization [6]. Patients already receiving at least one antihypertensive medication (prescribed by their doctors), such as calcium antagonists, beta-blockers, angiotensin II receptor antagonists (also known as sartans), and diuretics, were also included. Patients with other complications associated with high blood pressure were also taking other medications, including for the treatment of type II diabetes (hypoglycemic sulfonamides (gliclazide, glimepiride) and GLP-1 receptor antagonists (aGLP-1)), type I diabetes (insulin therapy: rapid-acting insulins and long-acting or slow-acting insulins), hypercholesterolemia (statins and inhibitors of intestinal cholesterol absorption), etc.

To assure the research population's reliability and homogeneity, a preliminary dietary survey was undertaken to assess daily salt intake among hypertension patients admitted to hospital. Patients having a salt consumption of less than 6 g/day or more than 8 g/day were excluded from the research. Only patients with a moderate and steady daily salt consumption of 6 to 8 g were eligible for participation.

Participant characteristics and group allocation

A total of 220 hypertension individuals who met the inclusion criteria were included. Participants varied in age range from 18 to 94 years and included both sexes. The study population was divided randomly into two groups of equal size (n = 110 each), with age and gender distributions matched. The control group (A), participants had a normosodic diet and without olive leaf infusion consumption. Experimental group (B) following a normosodic diet and with olive leaf infusion consumption twice daily, once in the morning and once in the evening with meals, throughout a six-week period.

Olive leaf infusion preparation protocol

Throughout the experiment, between February and March 2025, olive leaves (*Olea europaea* L.) were collected from a local farm located in the Olive Groves region (a geographically identified cultivation area under this name, located in the immediate vicinity of the city of Relizane and the Bourmadia area). They were brought to the experimental site to be rinsed with clean water (to remove all impurities) and spread out on grids (to allow homogeneous air circulation) and turned regularly, thus allowing drying at an ambient temperature (approximately 25°C) and protected from light (to prevent oxidation of sensitive compounds) according to the standards of the European Pharmacopoeia 9.0 (PhEur, 2017) [29]. There is no fixed minimum time in days for drying; the leaves are considered dry when they become brittle and break easily under the pressure of the fingers, they are then mechanically ground into fine pieces [29], and weighed in small quantities of 5 g per dose [20, 30], and placed in small opaque plastic bags and vacuum-sealed and stored in a dry place at room temperature (between 15°C and 25°C) and away from light to be ready for use [29]. During each day of the six weeks of the experiment, each patient prepared two infusions of olive leaves (*Olea europaea* L.) per day, which they consumed at fixed times before meals, one in the morning and one in the evening [19, 30]. They brought drinking water to a boil and poured 150 mL into a glass containing a 5 g dose of olive leaves (prepared for them beforehand), let it steep for 10 minutes, then strained it through a sieve and consumed it [20, 30].

Data collection and assessment methods

A structured questionnaire was developed and pre-tested prior to implementation to ensure clarity, relevance, and comprehensiveness. The bioethics committee of the University Ahmed Zabana of Relizane gave its approval under reference (01/E.C.A.E/F.N.L.S/U.A.Z.R/2025). Data were collected through face-to-face interviews conducted by teachers specializing in the field of nutrition and health, in a private setting at Mohammed Boudiaf Public Hospital. Each interview lasted approximately 30 minutes.

The questionnaire was divided into three main sections:

- General health status and socioeconomic characteristics: this section collected information on demographic and socioeconomic variables, as well as anthropometric and health-related parameters by studying the various complications related to high blood pressure, including: Overweight and obesity (grade I and grade II obesity), type I and type II diabetes, cardiovascular diseases (left ventricular hypertrophy, heart failure and myocardial infarction), renal problems (renal lithiasis (or kidney stones), benign nephroangiosclerosis and chronic renal failure), cholesterol (high LDL), thyroid problems (hyperthyroidism), colon problems (irritable bowel syndrome), and other diseases (e.g., osteoarthritis, gout). We measured the body weight (kg) [using Beurer MS 01: a mechanical scale with a capacity ranging from 1 kg to 120 kg and a finer graduation of 100 g], the height (m) [using Seca 213: a stadiometer with a measuring range of 20 cm to 205 cm and a graduation of 1 mm], the waist circumference and the hip circumference (cm) [using Seca 201: an ergonomic perimeter measuring tape that allows measurement from 0 to 205 cm, graduated every 1 mm and with an accuracy of 5 mm], of each patient at the beginning of the experiment to calculate their body mass index [BMI (kg/m^2) = weight (kg)/height ($m)^2$], their waist-to-hip ratio [WHR = waist circumference (cm)/hip circumference (cm)], and their body fat index [BFI (%) = (1.20 x BMI) + (0.23 x age) – (10.8 x sex (males = 1, females = 0)) – 5.4] according to Deurenberg et al. (1991) [31].

- Assessment of dietary salt intake: assessment of sodium consumption, data were compiled and analyzed using Microsoft Excel to estimate daily salt consumption levels and potential excessive intake according to Monntoya et al. (2019) [7].
- Blood pressure measurement: On the first day of each subsequent week of the experiment, i.e. days 1, 7, 14, 21, 28, 35 and 42, patients take their blood pressure at home using an oscillometric device or a calibrated manual sphygmomanometer, following the various recommendations of the ESC guidelines 2024 [8], that they were taught, as follows: Two consecutive measurements are taken in the morning (1 to 2 minutes apart) at the same time, immediately after waking, on fasting, and before taking any medication, and two consecutive measurements are taken in the evening (1 to 2 minutes apart) at the same time, before bedtime and after dinner. At the end of each weekly measurement period, the average of all daily values is calculated for each patient.

Statistical analysis

Data were organized in Microsoft Excel for initial processing. Statistical analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Data distribution was assessed for normality using the Shapiro-Wilk test. To evaluate within-subject changes in BP over time, repeated-measures analysis of variance (ANOVA) was applied. The assumption of sphericity was tested using Mauchly's test; when violated, the Greenhouse-Geisser correction was employed. Between-subject factors included sex, age category, and treatment group, and interaction effects were examined to identify differential responses between groups.

Associations between continuous and categorical variables were assessed using correlation coefficient (ρ). All statistical tests were two-tailed, and a p-value < 0.05 was considered statistically significant.

RESULTS

Description of the study population

Baseline characteristics of the study population are summarized in Table 1. The mean age of participants in the control group A was 56.7 ± 17.6 years, while experimental group B was 58.6 ± 14.5 years. In both groups, adults aged between 40 to 65 years constituted the predominant age category, accounting for 52.7% and 59.1% in groups A and B respectively.

Regarding socio-professional status, most female participants in both groups were housewives (40.9% in group A and 49.1% in group B). In total, 30% of group A had liberal professions, whereas retired represented 30% of group B. Physical activity was very reduced, reported by 19.1% of participants in group A and 10% in group B (Table 1). Regarding physical activity, 31.8% of men (28 out of 88) reported engaging in regular sport, compared to only 3% of women (4 out of 132).

Regarding hypertension length, approximately 8.2% of participants in group A and 9.1% in group B had been recently diagnosed with high blood pressure. A duration of less than five years was reported by 25.4% of group A and 50.9% of group B, whereas durations exceeding five years were reported by 30.9% and 25.5% of participants in group A and B, respectively. In addition, the durations exceeding ten years were reported by 30.9% and 43.6% of participants in group A and group B, respectively.

At baseline (day 1), mean systolic and diastolic BP values were 168.8 ± 11.3 mmHg and 103.0 ± 10.4 mmHg in group A, and 171.2 ± 7.4 mmHg and 99.9 ± 7.6 mmHg in group B. All participants were receiving at least one antihypertensive medication, administered as monotherapy, for the management of hypertension and associated conditions.

Estimated daily salt intake at baseline was comparable between groups, with values of 6.8 ± 0.8 g/day in group A and 6.5 ± 0.7 g/day in group B. The mean reported sleep duration was 5.8 ± 1.2 hours in group A and 8.2 ± 1 hours in group B. Sleep disturbances were more frequently reported in group A (65.4%) compared with group B (25.4%). Lifestyle-related variables differed significantly between groups. Sleep duration showed a significant difference ($p < 0.001$), with shorter sleep durations (3.5-7 h) predominating in group A and longer durations (7-9 h) in group B.

Anthropometric measurements of the study population

Participants in the control group A had a mean body weight of 82.9 ± 15.8 kg, a mean body mass index (BMI) of 28.9 ± 5.5 kg/m², a waist-to-hip ratio (WHR) of 0.8 ± 0.1, and a body fat index (BFI) of 40.2 ± 8.4%. In comparison, participants experimental group B exhibited lower mean anthropometric values, with a body weight of 75.1 ± 11.8 kg, BMI of 26.9 ± 4.1 kg/m², WHR of 0.9 ± 0.1, and BFI of 37.9 ± 6.6%.

Table 1. Study population description

Variables	Control group A	Experimental group B
Average age (years)	56.74 ± 17.6	58.64 ± 14.5
Age group classification (%)		
Young adults [18-40 years]	17.3	10
Adults [41-65 years]	52.7	59.1
Seniors [> 65 years]	30	30.9
Socio-professional category (%)		
Civil servant/liberal profession	30	15.5
Unemployed/job seeker	7.3	5.5
Retired	21.8	30
Housewife	40.9	49.1
Lifestyle		
Physical activity	19.1%	10%
Mean sleep duration	5.8 ± 1.2 h	8.2 ± 1 h
Daily salt intake	6.8 ± 0.8 g/day	6.5 ± 0.7 g/day
Anthropometrics		
Mean body weight	82.9 ± 15.8 kg	75.1 ± 11.8 kg
Body mass index (BMI)	28.9 ± 5.5 kg/m^2	26.9 ± 4.1 kg/m^2
Body fat index (BFI)	40.2 ± 8.4%	37.9 ± 6.6%

Prevalence of chronic diseases associated with hypertension:

The prevalence of comorbid conditions associated with hypertension is summarized in Table 2. The majority of participants reported at least one additional chronic condition, affecting 95.4% of individuals in group A and 83.6% in group B. Overweight (with a BMI ≥ 25 and < 30) was the most frequently reported condition (33.6% in group A and 38.2% in group B). Followed by grade I obesity (with a BMI ≥ 30 and < 35) (29.1% in group A and 26.6% in group B). Grade II obesity (with a BMI ≥ 35 and < 40) was significantly more prevalent in group A (12.7%) than in group B (1.8%) (p = 0.002). While hypercholesterolemia (17.3%) and renal disorders (10.9%; p < 0.001) were observed only in group A. Cardiovascular disease differed significantly between groups (p = 0.019), group B had a high prevalence (13.6%) compared to group A (4.6%).

Correlation analysis (Figure 1) showed that age was positively associated with hypertension duration (r = 0.501, p < 0.001), BFI (r = 0.309, p < 0.001), and sleep disorders (r = 0.341, p < 0.001).

Correlations confirmed strong interrelationships among anthropometric indices, while SBP and DBP showed no significant association with adiposity measures. Physical activity was inversely associated with adiposity indicators, and sleep duration was

Table 2. Overview of other chronic diseases associated with hypertension

Variables	Group A	Group B	χ^2 value (df)	p-value
Other chronic diseases (%)				
Yes	95.5	83.6		
No	4.6	16.4		
Hypotension	0	4.6	5.116 (1)	0.024
Overweight	33.6	38.9		
Grade I obesity	29.1	23.6		
Grade II obesity	12.7	1.8	9.706 (1)	0.002
Type 1 diabetes	33.6	30		
Type 2 diabetes	0	3.6	4.074 (1)	0.044
CVD	4.6	13.6	5.500 (1)	0.019
Renal problems	10.9	0	12.692 (1)	< 0.001
Cholesterol	17.3	0	20.796 (1)	< 0.001
Thyroid	1.8	13.6	10.774 (1)	0.001
Colon	40.9	0	56.571 (1)	< 0.001
Others	23.6	11.8	5.267 (1)	0.022

	Gender	Age	BP Period	Hours of sleep	Sleep disorders	SBP (Day 1)	DBP (Day 1)	BMI	Job	Weight	Size	Waist_size	HIP	WHR	Sport
Gender	1														
Age	0.062	1													
BP Period	-0.025	0.515	1												
Hours of sleep	-0.088	-0.003	-0.296	1											
Sleep disorders	0.056	0.331	0.449	-0.42	1										
SBP (Day 1)	0.046	0.062	0.034	0.026	-0.072	1									
DBP (Day 1)	-0.037	-0.025	0.048	-0.104	0.037	0.456	1								
BMI	-0.246	-0.123	0.007	-0.124	-0.087	0.064	0.085	1							
Job	-0.538	0.403	0.205	0.219	0.106	-0.003	-0.036	0.1	1						
Weight	0.205	-0.091	0.014	-0.186	-0.018	0.076	0.097	0.803	-0.142	1					
Size	0.729	0.033	0.007	-0.112	0.092	0.019	0.019	-0.283	-0.392	0.333	1				
Waist_size	0.15	-0.051	0.142	-0.419	0.203	-0.001	0.092	0.571	-0.138	0.703	0.233	1			
HIP	0.146	-0.01	0.21	-0.471	0.271	-0.029	0.073	0.463	-0.111	0.618	0.272	0.944	1		
WHR	0.079	-0.094	-0.154	0.075	-0.168	0.061	0.044	0.382	-0.098	0.36	-0.031	0.313	-0.01	1	
Sport	-0.4	0.206	0.065	0.174	-0.115	0.097	-0.037	0.161	0.464	-0.024	-0.289	-0.137	-0.141	-0.02	1

-1
-0.25
-0.5
0
0.25
0.5
1

Figure 1. Association between anthropometric measurements

negatively correlated with sleep disorders and hypertension duration ($p < 0.05$).

Age was strongly associated with hypertension duration ($r = 0.52$, $p < 0.001$) and sleep disorders ($r = 0.45$, $p < 0.001$). Adiposity indicators were highly interrelated, with BMI showing strong positive correlations with waist and hip circumferences ($p < 0.001$).

Evolution of blood pressure

The temporal evolution of systolic and diastolic BP over the six-week period is illustrated in Figures 2 and 3. In group B, a progressive reduction in both SBP and DBP was observed from the second week (day 14) onward. Compared with group A, reductions of 8.1% (SBP) and 10.5% (DBP) were observed on day 14. On day 28, SBP and DBP decreased by 12.5% and 18.8%, respectively, in group B compared with group A. By the end of the intervention (day 42), reductions reached 17.2% for SBP and 22.7% for DBP relative to the control group.

Systolic Blood Pressure

Mauchly's test indicated a violation of the sphericity assumption for the within-subjects factor day ($W = 0.701$, χ^2 (20) = 70.40, $p < 0.001$); therefore, the Greenhouse-Geisser correction ($\varepsilon = 0.890$) was applied. A repeated-measures ANOVA revealed a significant main effect of time on systolic BP (F (5.34, 1067.53) = 109.02, $p < 0.001$, partial $\eta^2 = 0.353$). A significant interaction between time and treatment group was also observed (F (5.34, 1067.53) = 36.41, $p < 0.001$, partial $\eta^2 = 0.154$), indicating differential BP changes over time between groups. However, no

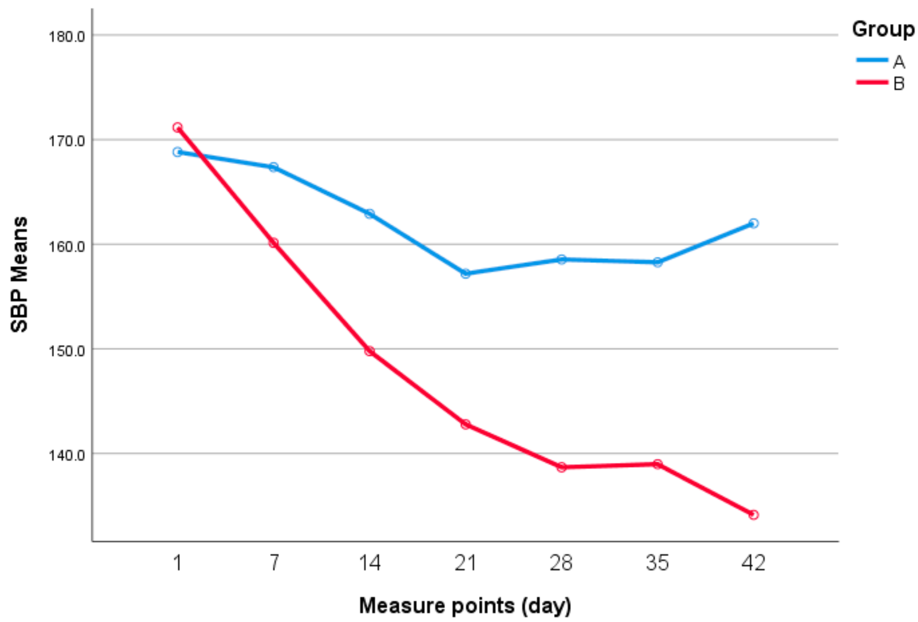

Figure 2. Systolic blood pressure evolution

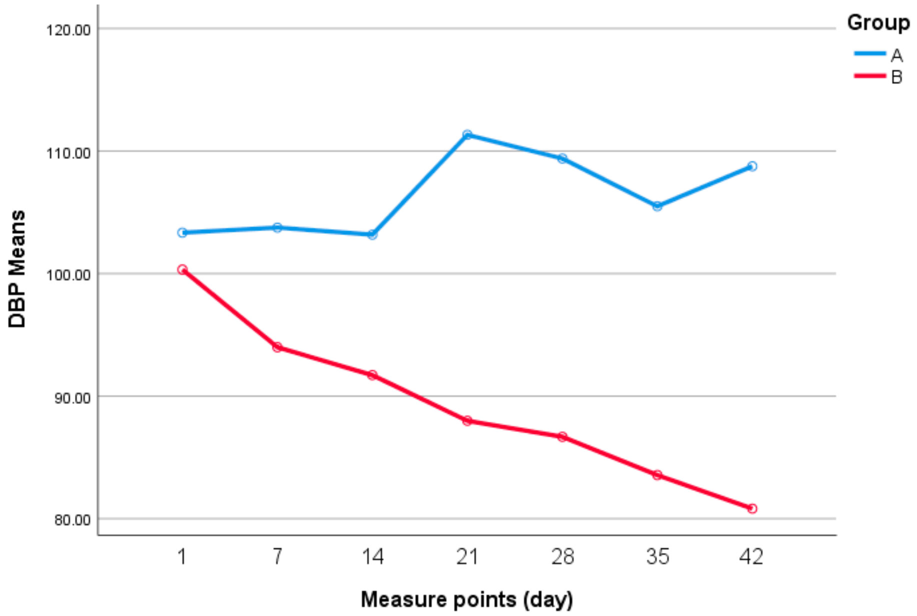

Figure 3. Diastolic blood pressure evolution

statistical significance was observed between time and sex interaction or time and age interaction.

Bonferroni-adjusted post hoc comparisons showed that SBP at day 1 was significantly higher than at all subsequent time points ($p < 0.001$). The largest reductions occurred between day 1 and day 28 (mean difference = 23.1 mmHg) and day 1 and day 21 (20.9 mmHg). No significant differences were observed among days 21-42, indicating a plateau effect.

Diastolic blood pressure

For DBP, Mauchly's test again indicated a violation of sphericity ($W = 0.619$, χ^2 (20) = 94.87, $p < 0.001$), and the Greenhouse-Geisser correction was applied ($\varepsilon = 0.861$). A significant main effect of time was observed (F (5.16, 1032.64) = 10.22, $p < 0.001$, partial $\eta^2 = 0.049$), with DBP decreasing progressively from day 1 (M = 101.83 mmHg) to day 42 (M = 94.79 mmHg). Pairwise comparisons confirmed that DBP values on days 35 and 42 were significantly lower than those on days 1-14 ($p < 0.05$).

A significant main effect of treatment group was also identified, with olive leaf infusion consumers showing lower mean DBP values (M = 89.3 ± 0.8) compared with non-consumers (M = 106.5 ± 0.7; $p < 0.001$). Neither sex nor age range significantly influenced DBP trajectories over time ($p > 0.05$).

DISCUSSION

The present study provides a comprehensive clinical and lifestyle characterization of hypertensive adults and demonstrates a significant blood pressure (BP) lowering effect associated with short term consumption of olive leaf infusion. The predominance of adults aged over 40 years in our sample aligns with epidemiological data reported by the World Health Organization, which indicates that hypertension affects most individuals between 30 and 79 years of age worldwide [3]. This age distribution reflects the cumulative impact of metabolic, behavioural, and vascular risk factors that increase with advancing age [3].

Women were more frequently represented among hypertensive participants, particularly within the housewife category. This finding is consistent with previous reports indicating higher healthcare utilization among women, which may contribute to increased diagnosis rates [32]. Additionally, sociocultural factors [33], lower levels of structured physical activity, and hormonal influences particularly those related to pregnancy and menopause may contribute to hypertension risk among women [34]. Comparable sex distributions have been reported by González et al. (2024) [35], who observed a predominance of female hypertensive patients (66.3%) and identified sedentary lifestyle and family history as major contributing factors.

A substantial proportion of participants had a long-standing history of hypertension, with nearly one-third diagnosed for more than five years and a notable subgroup exceeding ten years of disease duration. All participants reported current antihypertensive pharmacotherapy, often combined with non-pharmacological measures. These findings contrast with those of Guillén et al. (2025) [36], who reported suboptimal treatment adherence in a comparable population, highlighting regional and contextual differences in disease management. The frequent use of combined pharmacological and lifestyle interventions observed in our cohort is consistent with reports among older hypertensive populations [33, 35] and reflects current guideline-based recommendations [8].

Comorbidity burden was high, with most participants presenting at least one chronic condition associated with hypertension. Overweight and obesity were the most prevalent comorbidities, followed by type 2 diabetes, dyslipidemia, and cardiovascular disease. These observations are consistent with extensive evidence identifying excess adiposity as a major modifiable risk factor for hypertension. The strong interrelationships observed between body mass index, central adiposity, and metabolic disorders reinforce the central role of obesity in hypertension pathophysiology) [37]. Data from the Framingham Heart Study further support these findings, demonstrating a markedly increased risk of hypertension with increasing BMI and estimating that a substantial proportion of hypertension cases are attributable to excess body weight [36].

Beyond BMI, central adiposity indicators such as waist-to-hip ratio have been shown to better predict cardiovascular and mortality risk. Malik and Adoubi (2019) [39] reported nearly a twofold increase in hypertension prevalence among individuals with abdominal obesity, underscoring the clinical relevance of fat distribution. In addition, hypertension frequently coexisted with diabetes, dyslipidemia, renal dysfunction, and cardiovascular disease in our population, consistent with previous epidemiological studies [40]. Sleep disorders were also common and showed significant associations with hypertension duration and adiposity, supporting emerging evidence that sleep disturbances constitute an independent risk factor for elevated BP [41].

A key finding of this study is the significant and progressive reduction in systolic and diastolic BP among participants consuming olive leaf infusion over six weeks. BP reductions became apparent from the second week of intervention and were sustained through the end of the study, with a clear divergence from the control group. These results are consistent with previous interventional studies demonstrating antihypertensive effects of olive leaf preparations [26, 28]. Basuny et al. (2020) [20] reported clinically meaningful reductions in BP after eight weeks of olive leaf tea consumption, with more pronounced effects observed in hypertensive individuals compared with normotensive controls.

Olive leaf has long been used in traditional Mediterranean medicine for cardiovascular conditions, and its antihypertensive properties are increasingly supported by clinical evidence [26, 28]. Proposed mechanisms include enhanced diuresis, vasodilation, and modulation of vascular tone [26, 28]. Experimental and clinical studies have shown that aqueous olive leaf extracts exert antihypertensive effects comparable to conventional treatments, particularly when used as adjunctive therapy [26, 27].

The biological activity of olive leaf is largely attributed to its rich content of polyphenolic compounds, notably oleuropein and hydroxytyrosol, which possess potent antioxidants and anti-inflammatory properties [25]. These compounds may improve endothelial function, reduce oxidative stress, and attenuate low-grade inflammation, a key mechanism implicated in hypertension [26]. Olive leaves also contain flavonoids, triterpenoids (including oleanolic, ursolic, and maslinic acids), minerals, and squalene, which may contribute synergistically to BP regulation through mechanisms that extend beyond nitric oxide-mediated vasodilation [27]. Notably, olive leaf extracts exhibit exceptionally high antioxidant capacity, exceeding that of green tea and vitamin C, which may further support vascular protection [27].

At the end of our experiment, our patients reported experiencing no adverse effects after consuming the olive leaf infusion. A systematic review and meta-analysis have demonstrated that consuming olive leaf (*Olea europaea* L.) extract poses no risk to hypertensive patients [42, 28]. Moreover, a recent study by Basuny et al. (2020) [20] showed that consuming a daily dose of 10 g of olive leaf (*Olea europaea* L.) infusion for 8 weeks in both hypertensive and healthy patients resulted in no toxicity or other adverse health effects. Even better, this infusion improves their liver functions by decreasing ALT (alanine aminotransferase) and AST (aspartate aminotransferase) (markers of liver inflammation), on the one hand, and on the other hand, this infusion improves the renal functions of these patients by a significant decrease in serum creatinine and urea levels [20].

CONCLUSION

This study provides evidence that short term consumption of olive leaf infusion is associated with a significant reduction in systolic and diastolic blood pressure in hypertensive adults. These findings support the relevance of integrated hypertension management strategies that combine pharmacological treatment with lifestyle and dietary interventions, including the use of natural, non-invasive plant-based products. Although exploration in nature, the observed blood pressure lowering effects were consistent, clinically meaningful, and concordant with existing experimental and clinical evidence, reinforcing the biological plausibility of olive leaf derived bioactive compounds in cardiovascular regulation. Olive leaf infusion therefore appears to represent a promising complementary, non-pharmacological approach for supporting blood pressure control in hypertensive populations. The present findings provide a strong rationale for further investigation. Standardized phytochemical characterization is needed to confirm efficacy, establish dose response relationships, and clarify the role of olive leaf-based formulations in the development of functional foods and evidence-based adjunct therapies for hypertension prevention and management.

Conflict of interest

The authors declare that they have no conflicts of interest.

Informed consent

The study was conducted in accordance with the ethical principles outlined in the World Medical Association's Declaration of Helsinki (Sections 25-32; WMA, 2024). Participation was entirely voluntary, and informed consent was obtained from all respondents before completing the enrolment in the study. Participants were clearly informed about the study objectives, data confidentiality, and their right to withdraw at any time without providing a reason.

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Received: 31.12.2025
Revised: 30.03.2026
Accepted: 14.04.2026
Published online first: 30.04.2026