

# Prevalence of high blood pressure in periodontal patients: A pilot study

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;

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## Abstract

**Background.** Arterial hypertension and periodontal diseases are pathologies with a high prevalence worldwide. Recent evidence suggests a possible causal relationship between them. Patients with moderate or severe periodontitis tend to have higher blood pressure measurements and a 30% to 70% higher likelihood of developing hypertension.

**Objectives.** The aim of this cross-sectional pilot study was to ascertain the prevalence of high blood pressure in patients with periodontitis.

**Material and methods.** The study included 40 patients diagnosed with periodontitis who required non-surgical periodontal treatment. Demographic, periodontal and clinical characteristics, including blood pressure measurements, were registered.

**Results.** Fifteen percent of the patients were classified as hypertensive ( $n = 6$ ), 67.5% as high-normal ( $n = 27$ ) and 17.5% as normotensive ( $n = 7$ ). Recent studies have estimated that the prevalence of high-normal blood pressure in the general population ranges between 30% and 50%. These findings suggest that patients with periodontal disease are more likely to have elevated blood pressure than patients with healthy periodontal tissues.

**Conclusions.** High-normal blood pressure is associated with a 3 times higher likelihood of developing hypertension, so early detection and prevention are crucial public health strategies. Despite the limitations of this pilot study, it highlights the role of dentists in the prevention, diagnosis and blood pressure control to improve health and cardiovascular risk of patients with periodontitis.

**Keywords:** periodontitis, blood pressure, hypertension, cardiovascular risk, high blood pressure

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## Introduction

Arterial hypertension is a significant preventable cardiovascular risk factor that is associated with higher rates of vascular mortality and morbidity.<sup>1</sup> High blood pressure affects approx. 30–40% of the adult population worldwide.<sup>2</sup> It is estimated that 1.39 billion people had hypertension in 2010,<sup>3</sup> and it remains the leading cause of premature death in the world (10.4 million deaths per year).<sup>4</sup> Due to the aging population and a high prevalence of arterial hypertension, the global burden of complications from high blood pressure continues to rise. In this scenario, the control of blood pressure and identification of hypertensive patients is an essential public health goal.

The etiopathogenesis of hypertension involves multiple mechanisms, such as environmental and pathophysiological factors, which include autonomic and neurohormonal dysregulations, endothelial dysfunction, oxidative stress, mechanical changes, stiffness in the arterial wall, and local and systemic inflammation.<sup>5,6</sup>

Periodontal disease (gingivitis and periodontitis) is a multifactorial inflammatory condition caused by bacteria that affect soft and hard periodontal tissues. It is found in 20–50% of the world's population<sup>7</sup> and one of its etiological mechanisms is a chronic inflammation response catalyzed by multiple mediators.<sup>8,9</sup>

The high prevalence of hypertension and periodontitis as well as their etiological similarities have been the subject of increased research.<sup>10</sup> Recent articles suggest a possible causal relationship between the two conditions.<sup>11</sup> Patients with moderate or severe periodontitis tend to have higher blood pressure measurements, and there is a 30–70% higher possibility of developing hypertension in this population.<sup>12–14</sup> Furthermore, recent evidence suggests that the treatment of periodontitis could benefit blood pressure levels.<sup>11,15</sup>

This data emphasizes the importance of oral inflammation in high blood pressure and the role that dentists and dental treatments can play in the prevention, detection and management of high blood pressure. High blood pressure is a manageable risk factor, and its control directly affects the cardiovascular risk of patients.

The aim of this study was to ascertain the prevalence of high blood pressure in patients with periodontitis in clinical practice.

## Material and methods

### Definition of hypertension and high-normal blood pressure

Hypertension is defined as a systolic blood pressure (SBP)  $\geq 140$  mmHg and/or diastolic blood pressure (DBP)  $\geq 90$  mmHg in adults older than 18 years diag-

nosed in the office or clinic.<sup>2</sup> There are 3 grades of hypertension: grade 1 hypertension (SBP: 140–159 mmHg and/or DBP: 90–99 mmHg); grade 2 hypertension (SBP: 160–179 mmHg and/or DBP: 100–109 mmHg); and grade 3 hypertension (SBP  $\geq 180$  mmHg and/or DBP  $\geq 110$  mmHg).

Ideally, hypertension should be diagnosed at more than one office visit (2–3 visits at 1- to 4-week intervals), and, if possible, the diagnosis should be confirmed by out-of-office blood pressure measurements. This protocol is intended to prevent white-coat hypertension, defined as elevated blood pressure in the clinic but not in out-of-office measurements. Patients with white-coat hypertension represent 10–30% of the population and are typically at intermediate cardiovascular risk between normotensive patients and those with sustained hypertension.<sup>3,16</sup>

Prehypertension, renamed high-normal blood pressure in the 2018 European Society of Cardiology (ESC) and the European Society of Hypertension (ESH) guidelines,<sup>2</sup> is defined as SBP of 130–139 mmHg and/or DBP of 85–89 mmHg. In this classification,<sup>2</sup> normal blood pressure is defined as SBP of 120–129 mmHg and/or DBP of 80–84 mmHg. Finally, optimal blood pressure is defined as SBP  $< 120$  mmHg and DBP  $< 80$  mmHg.

### Definition of periodontitis

According to the 2017 World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions,<sup>17,18</sup> in the context of clinical care, a patient is considered a periodontitis case if:

- interdental clinical attachment loss (CAL) was detected in 2 or more adjacent teeth;
- buccal or oral CAL  $\geq 3$  mm (caused by non-periodontitis causes) with pocketing  $\geq 3$  mm was detected in 2 or more adjacent teeth.

### Inclusion and exclusion criteria

The patients included in this study were adults with periodontitis who required non-surgical treatment, patients with 10 or more teeth and with the full capacity to provide consent.

Pregnant and breastfeeding women, patients with localized aggressive periodontitis, patients who received periodontal treatment in the last 6 months, and patients with other severe concomitant diseases were excluded from the study.

### Patient information

After screening 50 patients, only 40 met the inclusion criteria. The included individuals were treated at the Department of Periodontology of Hospital Universitari Dexeus in Barcelona, Spain, from 2018 to 2021. They were diagnosed with periodontitis and required non-surgical

periodontal treatment. All patients provided written informed consent to participate in this study and for their data to be used for the purposes of research. The study was approved by the Ethics Committee of Hospital Universitari Dexeus – Grupo Quironsalud, Barcelona, Spain (No. 2018/ODI-2018-01).

During the initial evaluation, the demographic, periodontal and clinical characteristics of the patients were recorded. Collected demographic data included sex, age, height, weight, and body mass index (BMI). According to the BMI values, the standard weight status categories are as follows: underweight ( $<18.5$  kg/m<sup>2</sup>), healthy weight ( $18.5$ – $24.9$  kg/m<sup>2</sup>), overweight ( $25$ – $29.9$  kg/m<sup>2</sup>), and obesity ( $\geq 30$  kg/m<sup>2</sup>).<sup>19</sup>

A periodontogram, including the data on periodontal pocketing, CAL, bleeding on probing, tooth mobility, furcation lesions, number of teeth present, and plaque index, was created for each patient. All individuals completed a dental habits questionnaire, which included questions about the frequency and type of toothbrush used, interdental hygiene practices (dental floss, interproximal brushes, or none), whether there is bleeding on brushing, and the regularity of dental appointments.

Collected clinical data included blood pressure measurements (SDP, DBP and heart rate). As recommended by the ESC/ESH guidelines, these measurements were taken by a trained operator using a validated electronic upper-arm cuff device (boso Medicus Family 4; Bosch+Sohn GmbH & Co. KG, Jungingen, Germany), with the cuff appropriately sized for the patient's arm. Blood pressure measurements were taken in both arms after 5 min of rest. If there was a consistent difference between the obtained values, the arm with the higher blood pressure value was used. Three measurements were taken at 2-min intervals, and the average of the last 2 measurements was used. The patient was seated with their back supported, feet flat on the floor, and the arm bare and resting at heart level. The patient was instructed not to talk during and between the measurements as well as not to smoke, drink coffee or exercise for 30 min prior to the visit.<sup>3</sup> In order to perform the study, blood pressure measurements were taken during the first 2 visits. The presented results are the average of the first- and second-visit blood pressure measurements. Additionally, cardiovascular risk factors, such as diagnosed hypertension (or antihypertensive medication prescribed), diabetes mellitus, dyslipidemia, systemic diseases, and family history were recorded. Toxic habits, including smoking (the number of cigarettes per day or years after quitting), alcohol consumption (the number of drinks per day) or the consumption of sugar drinks (the number of drinks per day), as well as healthy habits such as physical activity and healthy diet were noted.

The data was recorded manually and converted to an electronic data sheet. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement was followed throughout the entire process.<sup>20</sup>

## Data analysis

In this descriptive study, data analysis was performed using the IBM SPSS Statistics for Windows software, v. 25.0 (IBM Corp., Armonk, USA). Blood pressure level was described as a quantitative variable and expressed in mmHg. The mean and standard deviation ( $M \pm SD$ ) were calculated and followed a normal distribution.

The remaining important variables were categorical. Gender was dichotomous (male and female). Age was considered a quantitative variable, but it was divided into 3 groups (patients under 35 years, patients between 36 and 59 years, and patients aged 60 years or older). Smoking habit was also a dichotomous variable (smoker or non-smoker). Former smokers were included in the non-smoker group. Body mass index was calculated as a quantitative variable, but it was divided into 2 groups: values between  $18.5$  and  $25$  kg/m<sup>2</sup> were classified as healthy weight, and values above  $25$  kg/m<sup>2</sup> were categorized as overweight and obese.

## Results

Forty Caucasian patients were included in the study: 19 men (47.5%) and 21 women (52.5%). Their mean age was 47.7 years (47.88 for men and 47.7 for women) (Table 1).

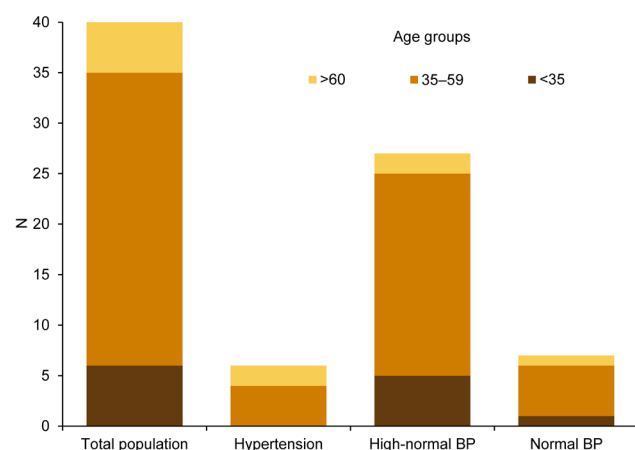
Of these 40 patients, 6 had hypertension (15%). Two individuals were taking medication but were included in this group due to high blood pressure measurements. They were referred to a specialist for a check-up. The other 4 patients went to a doctor after our appointment to confirm the diagnosis. Most of the patients (27; 67.5%) were classified as having high-normal blood pressure, and 7 individuals (17.5%) had blood pressure measurements classified as normal. The hypertensive group had a mean age of 54.3 years; 3 were men (50%) and 3 were women (50%). The high-normal blood pressure group had a mean age of 45.9 years; 15 were men (55.5%) and 12 were women (44.5%). The normotensive group had a mean age of 48.7 years; 1 was a man (14.3%) and 6 were women (85.7%). The mean blood pressure measurements for the hypertensive, high-normal blood pressure and normotensive patients were: SBP:  $140.58$  mmHg  $\pm 10.74$  mmHg and DBP:  $91.16 \pm 6.7$  mmHg; SBP:  $126.9 \pm 6.5$  mmHg and DBP:  $85.83 \pm 6$  mmHg; and SBP:  $111.42 \pm 7.28$  mmHg and DBP:  $73.14 \pm 3.93$  mmHg, respectively (Fig. 1).

Three patients presented with other cardiovascular risk factors: 1 had diabetes (in the high-normal blood pressure group) and 2 had hypercholesterolemia (1 in the normotensive group and 1 in the hypertensive group). In addition, 18 patients (45%) had a BMI above  $25$  kg/m<sup>2</sup>, which is considered overweight or obese. Four of these patients were hypertensive (22.2% of the total in this subgroup), 11 were in the high-normal blood pressure group (61.1%) and 3 were in the normotensive group (16.7%).

**Table 1.** Prevalence of hypertension, high-normal blood pressure and normal blood pressure in patients with periodontitis

Variable		Total population (%) <i>N</i> = 40	Hypertension (15%) <i>n</i> = 6	High-normal blood pressure (67.5%) <i>n</i> = 27	Normal blood pressure (17.5%) <i>n</i> = 7
Gender <i>n</i> (%)	male	19 (47.5)	3 (50)	15 (55.56)	1 (14.29)
	female	21 (52.5)	3 (50)	12 (44.44)	6 (85.71)
Age [years] <i>n</i> (%)	<35	6 (15)	0 (0)	5 (18.6)	1 (14.28)
	35–59	29 (72.5)	4 (66.7)	20 (74)	5 (71.43)
	≥60	5 (15.5)	2 (33.3)	2 (7.4)	1 (14.28)
Blood pressure levels [mmHg] <i>M</i> ± <i>SD</i>	SBP	126.25 ± 11.07	140.58 ± 10.74	126.9 ± 6.5	111.42 ± 7.28
	DBP	84.41 ± 7.96	91.16 ± 6.7	85.83 ± 6	73.14 ± 3.93
Smoking <i>n</i> (%)	yes	20 (50)	2 (33.3)	16 (59.26)	2 (28.57)
	no	20 (50)	4 (66.7)	11 (40.74)	5 (71.43)
BMI <i>n</i> (%)	18.5–25 (healthy weight)	22 (55)	2 (33.3)	16 (59.26)	4 (57.14)
	>25 (overweight or obesity)	18 (45)	4 (66.7)	11 (40.74)	3 (42.86)

*M* – mean; *SD* – standard deviation; BMI – body mass index; SBP – systolic blood pressure; DBP – diastolic blood pressure.

**Fig. 1.** Distribution of the patients' age by blood pressure (BP) values

Fifty percent (*n* = 20) of the patients were smokers; among the non-smoking individuals, 9 were ex-smokers. Of the smoking patients, 13 (65%) smoked more than 10 cigarettes per day. Regarding the blood pressure groups, 2 of the smokers were in the hypertensive group (33.3% of the hypertensive patients), 16 of the smokers were in the high-normal blood pressure group (59.2% of the high-normal blood pressure patients), and 2 of the smokers were in the normotensive group (28.6% of the normotensive patients).

Regarding alcohol consumption, 3 patients reported consuming more than 2 alcoholic drinks per day (7.5%), 32 reported occasional alcohol consumption (e.g., weekends and holidays) (80%) and 5 patients indicated that they did not consume alcohol (12.5%). Among the 3 patients who reported no alcohol consumption, 1 was in the hypertensive group, another was in the normotensive group, and the 3<sup>rd</sup> was in the high-normal blood pressure group.

Evaluating physical activity (more than 3 workouts per week), 9 patients (22.5%) declared that they had regular

physical activity, 19 patients (47.5%) reported occasional physical activity, and 12 (30%) declared no physical activity. Of these 12 sedentary patients, 25% were in the hypertensive group (*n* = 3), 58.3% were in the high-normal blood pressure group (*n* = 7) and 16.7% were in the normotensive group (*n* = 2).

The majority of patients (92.5%; *n* = 37) declared that they consumed a healthy diet based on the Mediterranean diet, with no consumption of carbonated and sugar-sweetened beverages or junk food.

Regarding oral hygiene habits, 50% (*n* = 20) of the patients used an electric toothbrush, 35% (*n* = 14) used a manual toothbrush, and 15% (*n* = 6) used both types of toothbrush. The average time spent brushing their teeth was 2.125 min per day. Only 37.5% (*n* = 15) of the patients performed interproximal hygiene with either dental floss or interproximal toothbrushes, with an average of 1.4 uses per day. There were no differences between the groups.

## Discussion

Recent studies have shown that the prevalence of high-normal blood pressure in the general population is 30–50%.<sup>21–24</sup> Patients with periodontal disease often present with hypertension, which may include individuals in the early stages, such as those with high-normal blood pressure.

In our study, only patients with periodontitis were included, and 67.5% had high-normal blood pressure. While the relationship between periodontal disease and arterial hypertension is well documented, there is limited research on prehypertensive states. Our findings may suggest that patients with periodontal disease are more likely to have high-normal blood pressure than patients with healthy periodontal tissues.

High-normal blood pressure is associated with a 3 times greater likelihood of developing hypertension.<sup>4</sup> Moreover, a strong association has been found between this status, coronary artery disease and cardiovascular mortality.<sup>21,24</sup> High-normal blood pressure is also associated with a worse cardiovascular risk profile and a high prevalence of metabolic disorders.<sup>25</sup> Thus, it is essential to implement early detection, prevention and treatment strategies, not only for hypertensive patients, but also for those in prehypertensive states.<sup>23,24</sup>

Some hypertension risk factors are gender (men are more likely to have hypertension than women), age (older people have a higher risk of hypertension), heart rate (>80 beats/min), smoking habits, diabetes, hypercholesterolemia, overweight or obesity, early onset of menopause, and family history of cardiovascular diseases or hypertension.<sup>23</sup>

The majority of patients with high-normal blood pressure (69%) do not qualify for drug therapy and are advised to make lifestyle changes.<sup>26</sup> These changes include salt reduction, healthy food and drink consumption, moderation of alcohol consumption, weight reduction, smoking cessation, regular physical activity, and stress reduction. The findings of this study suggest that the oral and periodontal status of prehypertensive patients should be assessed and periodontal treatment performed if necessary. Moreover, dentists may play an important role in the management and follow-up of high-normal blood pressure patients. During the course of the study, 4 patients had repeatedly high blood pressure measurements and were unaware of their hypertension status. These patients were referred to general practitioners for a check-up, and in all 4 cases, hypertension was diagnosed and treated pharmacologically.

This observational pilot study has some limitations, the most important being the small sample size. The low number of hypertensive and normotensive patients may have been a source of potential bias. In addition, there was no control group of healthy periodontal patients. It is also important to note the possible overestimation of blood pressure levels due to white-coat hypertension. To confirm the diagnoses, it would be necessary to obtain 24-hour blood pressure measurements of the patients.

Our results emphasize the importance of identifying the underdiagnosed patients who do not meet strict criteria for hypertension. These patients have more cardiovascular risk factors and can benefit from early preventive measures.

Further research with a larger population and prospective clinical trials is necessary to confirm the findings of this study. Additional investigation is needed to establish whether periodontal treatment could help control blood pressure levels in patients with prehypertension.

## Conclusions

This descriptive and observational study suggests that there is a high prevalence of high-normal blood pressure

among patients with periodontal disease. Additionally, we highlighted the role of dentists in the process of prevention, diagnosis, control, and treatment of this state prior to the development of established arterial hypertension in order to improve patients' health and reduce their cardiovascular risk.

## Ethics approval and consent to participate

The study was approved by the Ethics Committee of Hospital Universitari Dexeus – Grupo Quironsalud, Barcelona, Spain (No. 2018/ODI-2018-01). All participants provided written informed consent.

## Data availability


The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.


## Consent for publication

Not applicable.

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