# Oral Hygiene Practices, Dental Service Utilization and Treatment Needs of Hypertensive Patients attending a Nigerian Tertiary Hospital – A Cross-Sectional Study

** Grace Onyenashia ALADE, Esosa OGBEBOR

*1 Department of Community Dentistry and Periodontology, Faculty of Dentistry, College of Health Sciences, University of Port Harcourt, Rivers State. Nigeria*

*2. Department of Preventive Dentistry. University of Port Harcourt Teaching Hospital, Port Harcourt Rivers State, Nigeria.*

*Correspondence*
**Grace Onyenashia Alade.*
*Department of Community Dentistry and Periodontology, Faculty of Dentistry, College of Health Sciences, University of Port Harcourt, Rivers State. Nigeria.*
*Email: graceochos@yahoo.co.uk, grace.alade@uniport.edu.ng.*
*ORCID: https://orcid.org/0000-0002-6901-0130*

ABSTRACT

Background: Recently, hypertension has been linked to periodontitis. This study aims to assess the oral hygiene practices, dental utilisation and treatment needs of hypertensive patients attending the cardiology clinic of the University of Port Harcourt Teaching Hospital (UPTH).
Methods: An interviewer questionnaire was used to collect information from the participants. The questionnaire had two sections. Section A had questions about sociodemographic and Section B had questions on participants' oral health practices, dental service utilisation and treatment needs. Statistical analysis was done using the Statistical Product and Service Solution (IBM SPSS) version 25.0. P values < 0.05 were considered statistically significant.
Results: There were 115 participants (55 [47.8%] males and 60 [52.2%] females). Ninety-seven (84.3%) participants brushed once daily, 93 (80.9%) participants used toothbrushes with fluoride toothpaste, and 4 (3.5%) participants used chewing sticks. Among participants who used toothbrushes as cleaning aids, 53 (47.7%) used medium-textured toothbrushes, while 24 (21.6%) used hard toothbrushes. Ninety (78.3%) participants used interdental cleaning aids, among whom 75 (83.3%) participants used toothpicks. Concerning previous dental visitation, 59 (51.3%) participants visited the dental clinic; among these, 30 (50.8%) participants visited for extractions. Concerning treatment needs of the participants, 31 (27.0%) participants had dental complaints, among these, 15 (48.4%) participants had pain. Concerning gender, 36 (60.0%) females and 23 (41.8%) males visited the dental clinic previously (p = 0.051). Regarding educational status, 8 (72.7%) participants with primary education never attended dental clinic, while 3 (60.0%) participants with tertiary education visited the dental clinic. (p = 0.229).
Conclusion: Most of the participants brushed once daily, using the horizontal brushing technique. A little above half of the participants visited the dental clinic, with the majority visiting for dental pain. The young age group, females, and participants with tertiary education visited the dental clinic more.

**Keywords:** Oral Hygiene. Practices. Utilisation. Treatment needs. Hypertensive patients.

## INTRODUCTION

Hypertension, also known as systemic arterial hypertension (SAH), is a clinical condition characterised by a prolonged increase in blood pressure levels ≥ 140 and/or 90 mm Hg (*World Health Organisation, 2025).* It is classified as primary/essential or secondary to another disease. Primary hypertension, with the cause unknown, found in approximately 90% of hypertensive patients, while it is secondary in only 10% of cases (Rossi et al., 2020). Although the exact cause of primary hypertension is unknown, several risk factors have been associated with the condition. These factors can be categorised into modifiable and non-modifiable risk factors. The non-modifiable risk factors are attributes or characteristics in the individual that cannot be altered; these include age, sex, race, family history, genetic composition. The modifiable risk factors of hypertension are attributes, characteristics, exposures

or lifestyle patterns that can be modified to prevent the development of the disease. These modifiable risk factors include: obesity, excessive salt intake, inactivity or lack of exercise, high-fat diet, tobacco use, alcohol consumption (Ibekwe, 2015; Sood et al., 2024).

Hypertension is found in about 45% of people worldwide, and it is also one of the most common cardiovascular risk factors (Williams et al., 2018). It is also linked to metabolic disorders, functional and/or structural changes in target organs (Piskorz, 2020). According to a 2014 World Health Organisation (WHO) report, arterial hypertension caused 51% of deaths from stroke and 45% of overall cardiovascular mortality. It affected all age groups and ethnic groups (Williams et al., 2018).

Recently, Hypertension was associated with periodontitis (Del Pinto et al., 2020; Surma et al., 2021). Periodontitis is an inflammatory disease caused by a dysbiotic biofilm, affecting the supporting tissues around teeth (Tonetti et al., 2018). It is a chronic disease, and is marked by gingival inflammation with associated alveolar bone loss, which may eventually lead to tooth loss if not arrested and also negatively affects patients' quality of life (Ferreira et al., 2017). Almost 750 million people (aged 15–99 years) worldwide have moderate to severe forms of periodontitis (Frencken et al., 2017). Periodontitis significantly increases the risk of cardiovascular diseases; hence, it is a modifiable non-classical cardiovascular risk factor (Landi et al., 2021).

Arterial hypertension and periodontitis often coexist, especially in the elderly, men, cigarette smokers, overweight/obese people, diabetics, low socioeconomic status, and poor education (Del Pinto et al., 2020). Furthermore, Arterial hypertension occurs in 7–77% of patients with periodontitis (*versus* 4–70% in general population) (Muñoz Aguilera et al., 2020). Inflammation is considered an important driver of vascular dysfunction and is implicated in the development and progression of hypertension (Drummond et al., 2019; Jayedi et al., 2019). The most important factor involved in the pathogenesis of arterial hypertension in patients with periodontitis is dysbiosis of the oral microbiota. Pathological oral bacteria in patients with periodontitis may lead to a reduction in the production of nitric oxide, which leads to increased vascular tone, stiffness and in turn may contribute, to an increase in blood pressure (*Pignatelli et al., 2020; Bryan, Tribble, Angelov, 2017; Alzahrani et al., 2020).* It was reported in a previous study that systolic and diastolic blood pressure increased with increasing bacterial load and the subgingival plaque (Desvarieux et al., 2010). Also, a number of studies have been shown that patients with periodontitis have increased systolic and diastolic blood pressure (Desvarieux, et al., 2010; Arowojolu et al., 2016).

**Citation:** Alade GO, Ogbebor E. Oral Hygiene Practices, Dental Service Utilization and Treatment Needs of Hypertensive Patients attending a Nigerian Tertiary Hospital – A Cross-Sectional Study (2026). Nig J Dent Sci; 9(1):11-18.

Furthermore, a meta-analysis covering 40 studies investigated, inter alia, the effect of periodontitis on systolic and diastolic blood pressure, shown that patients with periodontitis had an increase in systolic and diastolic blood pressure of 4.49 mmHg (95% CI 2.88–6.11 mmHg; $p< 0.00001$) and 2.03 mmHg (95% CI 1.25–2.81 mmHg; $p< 0.00001$) compared to healthy subjects (Muñoz et al., 2020). In another study, periodontitis was significantly associated with about a 20% higher risk of unsuccessful antihypertensive treatment compared with those without periodontitis (Pietropaoli et al., 2018).

Hence, maintaining good oral hygiene and treating periodontitis may contribute to the prevention of arterial hypertension and improve the effectiveness of antihypertensive treatment. Therefore, this study aims to assess the oral hygiene practices, dental utilisation and treatment needs of hypertensive patients attending the cardiology clinic of the University of Port Harcourt Teaching Hospital (UPTH).

## MATERIALS AND METHODS

This was a cross-sectional study conducted among hypertensive patients who attended the Cardiology clinic at the University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt, Rivers State, between June and November 2022. A convenient, non-probability sampling technique was used to recruit subjects who gave consent. Ethical Approval for the study was obtained from the Health Research and Ethics Committee of the University of Port Harcourt Teaching Hospital (UPTH/ADM/90/S.II/VOL.XI/1219). An interviewer questionnaire was used to collect information from the participants. The questionnaire had two sections. Section A had questions about socio-demographic (age, gender, marital status, ethnicity, occupation), and Section B had questions on participants' oral health practices, dental service utilisation and treatment needs. Data were collected by two examiners, and the Cohen's kappa coefficient for inter-examiner variation was 0.84.

Hypertension was defined as systolic blood pressure (BP) of ≥140 mmHg and diastolic was BP of ≥90 mmHg according to the World Health Organization (WHO) guidelines (*World Health Organisation, 2025*). The inclusion criteria were patients diagnosed with hypertension for at least one year, who attended the Cardiology clinic, while the exclusion criteria were hypertensive patients who didn't consent.

Study size determination:

With reference to a previous study (Ramirez-Ortega et al., 2023), the prevalence of hypertensive patients who

visited the dentist for dental consultation was 7.5%. The formula $N = Z^2pq/d^2$ was utilised, and the minimum sample size calculated was 107. However, in this study, 115 questionnaires were retrieved and accurately filled out.

**Statistical Analysis:**

Statistical analysis was done using the Statistical Product and Service Solution (SPSS) version 25.0 (IBM SPSS Inc. Chicago Illinois). Continuous variables were expressed as means and standard deviations, while categorical variables were presented as frequencies and percentages. Differences between groups were compared using the Chi-square tests for categorical variables. P values < 0.05 were considered statistically significant.

## RESULTS

**Sociodemographic of participants**

Table 1 shows that there were one hundred and fifteen participants with an age range of 42 -91 years and a mean age of 64.6 ± 10.9 years. There were 55 (47.8%) males and 60 (52.2%) females with a M: F of 1:1.1. More of the participants (39.1%) were in the 60-69 age groups, 50 (43.5%) participants had tertiary education, 94 (81.7%) were married and 53 (46.1%) participants are from the other groups (e.g. Ikweere, Ijaw)

**Oral hygiene practices of participants**

Table 2 shows that 97 (84.3%) participants brush once daily, while 18 (15.7%) participants brushed twice daily. Regarding the type of cleaning used, 93 (80.9%) participants used toothbrushes with fluoride toothpaste, 12 (10.4%) participants used toothbrushes without fluoride toothpaste, 4 (3.5%) participants used chewing sticks.

Among participants who used toothbrushes as cleaning aids, 33 (29.7%) used soft-textured toothbrushes, 53 (47.7%) used medium-textured toothbrushes, 24 (21.6%) used hard toothbrushes, while one participant (0.9%) did not know the type of toothbrush used. Concerning the brushing methods used, 87 (78.4%) participants used the horizontal brushing technique, 21 (18.9%) participants used vertical brushing method, while 2 (1.8%) participants used the modified bass brushing technique. 90 (78.3%) participants used interdental cleaning aids, among which 75 (83.3%) participants used toothpicks.

**Dental service utilisation and treatment needs of participants**

Table 3 shows that 59 (51.3%) participants had visited the dental clinic previously; among these, 39 (66.1%) participants visited the dentist over 12 months ago, with 30 (50.8%) participants visiting for extractions. Concerning treatment needs of the participants, 31 (27.0%) participants had dental complaints, among these, 15 (48.4%) participants had pain, 5 (16.1%) participants had dental caries and 4 (12.9%) participants had gum bleeding. Regarding how long the participants have had the dental complaints, 11 (35.5%) participants have had the complaints for 1-6 months, while 13 (41.9%) participants have had the complaints for > 12 months. When asked what the participants had done about the dental complaints, 14 (45.2%) participants did nothing, and only 6 (19.4%) participants visited the dentist for treatment.

Table 1: Sociodemographic of participants

| Variables | | Frequency | Percentage |
|---|---|---|---|
| Age group | 40 – 49 | 8 | 7.0 |
| | 50 – 59 | 31 | 27.0 |
| | 60 – 69 | 45 | 39.1 |
| | 70 – 79 | 19 | 16.5 |
| | 80 – 89 | 10 | 8.7 |
| | 90 – 99 | 2 | 1.7 |
| Gender | Males | 55 | 47.8 |
| | Females | 60 | 52.2 |
| Highest educational status | None | 1 | 0.9 |
| | Primary | 11 | 9.6 |
| | Secondary | 47 | 40.9 |
| | Tertiary | 50 | 43.5 |
| | Post graduate | 6 | 5.2 |
| Marital status | Married | 94 | 81.7 |
| | Widow/separated/divorced | 21 | 18.3 |
| Ethnicity | Hausa | 3 | 2.6 |
| | Igbo | 49 | 42.6 |
| | Others | 53 | 46.1 |
| | Yoruba | 10 | 8.7 |
| | **Total** | **115** | **100.0** |

Table 2: Oral hygiene practices of participants

| Variables | | Frequency | Percentages |
|---|---|---|---|
| **Frequency of tooth brushing** | Once | 97 | 84.3 |
| | Twice | 18 | 15.7 |
| **Cleaning aids used** | Toothbrush with fluoride toothpaste | 93 | 80.9 |
| | Toothbrush without fluoride toothpaste | 12 | 10.4 |
| | Chewing stick | 4 | 3.5 |
| | Toothbrush with fluoride toothpaste and chewing sticks | 3 | 2.6 |
| | Toothbrush without fluoride toothpaste with chewing stick | 3 | 2.6 |
| **Type of toothbrush used** | Soft | 33 | 29.7 |
| | Medium | 53 | 47.7 |
| | Hard | 24 | 21.6 |
| | Don't know | 1 | 0.9 |
| **Brushing methods used** | Horizontal | 87 | 78.4 |
| | Vertical | 21 | 18.9 |
| | Modified bass | 2 | 1.8 |
| | Don't know | 1 | 0.9 |
| **How often do you change your toothbrush** | 1-3 months | 66 | 59.5 |
| | ≥ 4 months | 45 | 40.5 |
| **Why did you change your toothbrush?** | It is frayed | 63 | 56.8 |
| | Just feel like changing the toothbrush | 32 | 28.8 |
| | It is not cleaning my teeth properly | 16 | 14.4 |
| **Do you use interdental cleaning aids?** | Yes | 90 | 78.3 |
| | No | 25 | 21.7 |
| **If yes, how often do you use interdental cleaning aids?** | Everyday | 33 | 36.7 |
| | 3-4 times a week | 12 | 13.3 |
| | Occasionally | 45 | 50.0 |
| **If yes, which interdental cleaning aids do you use?** | Interdental brush | 1 | 1.1 |
| | Dental floss | 12 | 13.3 |
| | Toothpick | 75 | 83.3 |
| | Broom | 1 | 1.1 |
| | Fingers | 1 | 1.1 |

Table 3: Dental service utilisation and treatment needs of participants

| Variables | | Frequency | Percentage |
|---|---|---|---|
| **Have you visited the dentist before?** | Yes | 59 | 51.3 |
| | No | 56 | 48.7 |
| **If yes, when did you visit the dentist?** | <6 months | 11 | 18.6 |
| | 6-12 months | 9 | 15.3 |
| | >12 months | 39 | 66.1 |
| **If yes, why did you visit the dentist?** | Routine check-up | 2 | 3.4 |
| | Scaling & polishing | 13 | 22.0 |
| | Dental caries | 11 | 18.6 |
| | Tooth replacement | 3 | 5.1 |
| | Extraction | 30 | 50.8 |
| **Do you need further dental treatment?** | Yes | 31 | 27.0 |
| | No | 84 | 73.0 |
| **If yes, what dental treatment is needed?** | Chewing difficulties | 2 | 6.5 |
| | Poor aesthetics | 1 | 3.2 |
| | Pain | 15 | 48.4 |
| | Gum bleeding | 4 | 12.9 |
| | Tooth fracture | 1 | 3.2 |
| | Dental caries | 5 | 16.1 |
| | Bad breath | 3 | 9.7 |
| **If yes, how long have you had the complaint?** | < 1 month | 3 | 9.7 |
| | 1-6 months | 11 | 35.5 |
| | 7-12 months | 4 | 12.9 |
| | >12 months | 13 | 41.9 |
| **What have you done about the complaints?** | Nothing | 14 | 45.2 |
| | Herbal treatment | 6 | 19.4 |
| | Medications | 5 | 16.1 |
| | Visited a dentist | 6 | 19.4 |

**Dental service utilisation of participants based on age group, gender and educational status** Table 4 shows that 6 (75.0%) participants within the 40-49 age group had never attended a dental clinic, while 24 (53.3%) participants within the 60-69 age group had utilised dental services. This finding is not statistically significant (p = 0.337). Concerning gender, 32 (58.2%) males did not utilise dental care service, while 36 (60.0%) females visited the dental clinic (p = 0.051). Regarding educational status, 8 (72.7%) participants with primary education, never attended dental clinic, while 3 (60.0%) participants with tertiary education had visited the dental clinic. This finding is not statistically significant (p = 0.229).

Table 4: Dental service utilisation of participants based on age group, gender and educational status

| Variables | | Dental Service Utilisation | | P value |
|---|---|---|---|---|
| | | Yes | No | |
| **Age group (years)** | 40-49 | 2 (25.0) | 6 (75.0) | 0.337 |
| | 50-59 | 19 (61.3) | 12 (38.7) | |
| | 60-69 | 24 (53.3) | 21 (46.7) | |
| | 70-79 | 9 (47.4) | 10 (52.6) | |
| | 80-89 | 5 (50.0) | 5 (50.0) | |
| | 90-99 | 0 (0.0) | 2 (100.0) | |
| **Gender** | Male | 23 (41.8) | 32 (58.2) | 0.051 |
| | Female | 36 (60.0) | 24 (40.0) | |
| **Educational status** | None | 1 (100.0) | 0 (0.0) | 0.229 |
| | Primary | 3 (27.3) | 8 (72.7) | |
| | Secondary | 22 (46.8) | 25 (53.2) | |
| | Tertiary | 30 (60.0) | 20 (40.0) | |
| | Postgraduate | 3 (50.0) | 3 (50.0) | |

## DISCUSSION

Poor oral/ periodontal health has been reported to worsen the blood pressure in hypertensive patients (Surma et al., 2021). Hence, this study aims to assess the oral hygiene practices, dental service utilisation and treatment needs of hypertensive patients. In this study, majority of the participants brush their teeth once daily, with toothbrush and fluoridated toothpaste. Fluoride has been documented to improve oral health, by being incorporated into enamel during the time of brushing (dos Santos, Nadanovsky, de Oliveira, 2013), and is also taken up by oral soft tissues and plaque, (Creeth et al., 2009) which boosts its protective effect on enamel.

This finding is in tandem with the finding in a previous study (Sorunke, Soroye, Oyapero, 2025) This finding indicates that the participants were not aware of the requirement for brushing. It was recommended by the American Dental Association that toothbrushing should be done two times daily for about two minutes using a fluoride toothpaste to achieve a remarkable reduction in accumulated plaque and optimised oral hygiene (Petersen, 2009). Regarding the type of toothbrush used, a little above half of the participants utilize medium-textured tooth brushes. However, a few participants used the hard-textured toothbrush, which was reported to be detrimental to the oral health, especially if it is used with abrasive toothpaste, heavy toothbrushing forces (> 3N) and incorrect brushing techniques; these lead to cervical abrasions, gingival recession and eventually dentinal hypersensitivity (Kumar et al., 2025). This points to the fact that the participants need further education concerning their oral health, which is further confirmed by majority of the participants brushing with the horizontal brushing technique.

Regarding how often the participants replace their toothbrushes, most participants change their toothbrushes every 3 months, which is acceptable. It has been documented that toothbrushes become frayed after 3 months of usage, as the toothbrushes become old and can become abrasive to the gingiva and the enamel (Warren et al., 2009). This is corroborated in this study, as most participants changed their toothbrushes because they became frayed.

Food debris and plaque accumulation in interdental spaces are not readily cleansed with routine toothbrush; thus, proximal areas become hotspots for microbes to grow and affect the oral health, leading to periodontal disease or dental caries (Alade & Umana-Edeani, 2025). The efficacy of plaque removal following a brushing exercise average around 50% (Dhage & Chougule, 2019). Interdental plaque biofilm control measures should be used as an adjunct to toothbrushing to complement mechanical cleaning (Kinane, Stathopoulou, Papapanou, 2017). Hence, tooth brushing and interdental cleaning once every 24 hours are the ideal methods for maintaining periodontal health and preventing caries (Claydon, 2008). Common interdental cleaning aids include dental floss, interdental wood sticks, interdental brushes and tapes (Berchier et al., 2008). In this study, most participants used interdental cleanings; however,

only a few participants used the interdental cleaning aids every day as recommended. This finding is similar to that of a previous study, which found that only a few participants used interdental cleaning aids daily (Sorunke, Soroye, Oyapero, 2025). Dental floss was regarded as the "gold standard" for reducing interdental plaque (Yost, Mallatt, Liebman., 2006). It was reported by the American Dental Association that dental floss could remove up to 80% of plaque located in the interdental area (Fleming et al., 2018). In another study, interdental brush was considered the most effective interdental cleaning aid (Gluch, 2012), as it was reported to have high patient acceptance, easier to use and higher efficacy for plaque removal (Imai & Hatzimanolakis, 2011). Additionally, it reduces interdental periodontal pathogens (Bourgeois et al., 2019). In this study, although majority of the participants cited using interdental cleaning aids, most participants used toothpicks, and only a handful used dental floss and interdental brushes. The reason could be that toothpicks are readily available and affordable compared to dental floss or interdental brushes. The use of toothpicks should be discouraged because of their traumatic effect on the gingiva (Ahmed, 2016). It is therefore imperative for dental practitioners to enlighten the patients and the populace on the appropriate interdental cleaning aids and the right method of usage, which will yield good results and not cause damage to the gingiva.

Dental clinic attendance is a fundamental indicator of oral health evaluation and awareness (Mohd et al., 2024); in this study, only a little over half of the participants visited the dental clinic previously. This indicates that most of the hypertensive participants are unaware of the importance of oral health. Among those who had visited the dental clinic, most visited over 12 months ago, this finding follows the trend from a previous study, where more participants visited the dental clinic over a year ago (Olagundoye & Sorunke, 2025). Regarding the reason for visiting the dental clinic, about half of the participants visited for extraction, and only a few visited for routine dental check-up and for scaling and polishing. The finding in the present study corroborates the fact that patients attend the dental clinic for symptom-related treatment rather than preventive treatment (Olajide et al., 2021). Routine check-up/scaling and polishing are preventive oral hygiene measures, which reduces the bacterial plaque and calculus, hence improving oral hygiene. The participants need education on the importance of preventive dental care. This finding is contrary to a previous study, where more participants visited for scaling and polishing (Olagundoye & Sorunke, 2025.)

Concerning the need for further dental treatment, most participants cited that they did not need further treatment. For those who indicated that they need further dental treatment, pain was the most common complaint. Concerning how long they have had the complaints and treatment done for the complaints, most participants reported that they had the complaints for more than a year and have taken no action. Out-of-pocket expenses for dental care could be the reason, with some participants possibly unable to cover the cost of treatment. Policymakers should therefore spearhead the integration of dental care coverage into health packages and universal healthcare systems (Bernabé, Masood, Vujicic, 2017).

Dental attendance behaviour is remarkably related to age and gender (Olajide et al., 2021). It is influenced by factors such as socio-economic status, attitude towards dental care, family structure, cost and time, nature of job, and mental health (Suzuki et al., 2016). In this study, dental service utilisation had a near-significant ($p = 0.051$) association with gender, while there was no statistically significant association between age group, educational status and dental attendance.

This study is not without limitations; these include that it was a cross-sectional study, which prevents causal inferences. Convenience sampling was used, which limits generalizability. The data were self-reported, which has potential for recall and social desirability bias. Furthermore, the sample was limited to individuals attending a single tertiary hospital in Nigeria, which may have introduced selection bias and limited the generalizability of the findings to other populations.

## CONCLUSION

In this study, most of the participants brushed once daily, using the horizontal brushing technique. Concerning dental service utilisation, a little above half of the participants previously visited the dental clinic, with the majority visiting for dental pain. Furthermore, the young age group, females, and participants with tertiary education visited the dental clinic more.

## RECOMMENDATION

It is recommended that both healthcare professionals and hypertensive patients be educated on the importance of oral hygiene practices and routine dental check up to minimise the oral health/ periodontal complications associated with hypertension. In addition, hypertensive patients should have dental referral for a comprehensive oral health assessment as part of the overall management.

### Conflict of Interest / Declaration

We certify that this research is original, not presently under consideration for publication elsewhere, and free of conflict of interest.

### Source of fund

The authors funded this study.

**REFERENCES**


Ahmed, H (2016): Periodontology: The value of tooth and cocktail picks. Br. Dent. J.; 220: 280.

Alade GO, Umana-Edeani A (2025): Association of the use of interdental cleaning aids with periodontal disease at the periodontal clinic in a tertiary hospital. Port Harcourt Med. J.; 19(2): 83-93.

Alzahrani HS, Jackson KG, Hobbs DA, Lovegrove JA (2021): The role of dietary nitrate and the oral microbiome on blood pressure and vascular tone. Nutr. Res. Rev.; 34(2): 222-239.

Arowojolu M, Oladapo O, Opeodu O, Nwhator S (2016): An evaluation of the possible relationship between chronic periodontitis and hypertension. J. West Afr. Coll. Surg.; 6: 20–38.

Berchier CE, Slot De, Haps S, Van der Weijden GA (2008): The efficacy of dental floss in addition to a toothbrush on plaque and parameters of gingival inflammation: A systematic review. Int. J. Dent. Hyg.;6: 265-279

Bernabé E, Masood M, Vujicic M (2017): The impact of out-of-pocket payments for dental care on household finances in low and middle income countries. BMC Public Health; 17(1): 109.

Bourgeois D. Bravo M, Llodra JC, et al (2019): Calibrated interdental brushing for the prevention of periodontal pathogens infection in young adults—A randomized controlled clinical trial. Sci. Rep.;9: 15127.

*Bryan N, Tribble G, Angelov N (2017): Oral microbiome and nitric oxide: the missing link in the management of blood pressure. Curr. Hypertens. Rep.; 19: 33.*

Claydon NC (2008): Current concepts in toothbrush and Interdental cleaning. Periodontol. 2000.; 48: 10-22.

Creeth JE, Gallagher A, Sowinski J. et al. (2009): The effect of brushing time and dentifrice on dental plaque removal in vivo. J. Dental Hyg.; 83(3): 111-116.

Dhage VS, Chougule P (2019): Importance of oral hygiene in oro-dental diseases: A Review Study. Int. J. Res. Rev.; 6(12): 69-74.

Del Pinto R, Pietropaoli D, Munoz-Aguilera E, et al., (2020): Periodontitis and hypertension: is the association causal? High Blood Press Cardiovasc Prev.; 27: 281–289.

Desvarieux M, Demmer RT, Jacobs DR Jr, et al. (2010): Periodontal bacteria and hypertension: the oral infections and vascular disease epidemiology study (INVEST). J. Hypertens.; 28(7): 1413-1421.

dos Santos AP, Nadanovsky P, de Oliveira BH (2013): A systematic review and meta-analysis of the effects of fluoride toothpastes on the prevention of dental caries in the primary dentition of preschool children. Community Dent. Oral Epidemiol.; 41(1): 1-12.

Drummond GR, Vinh A, Guzik TJ, Sobey CG (2019): Immune mechanisms of hypertension. *Nat. Rev. Immunol*.;19 :517–532.

Ferreira MC, Dias-Pereira AC, Branco-de-Almeida LS, Martins CC, Paiva SM (2017): Impact of periodontal disease on quality of life: a systematic review. *J. Periodontal Res*.; 52: 651–665.

Fleming EB, Nguyen D, Afful J, Carroll MD, Woods PD (2018): Prevalence of daily flossing among adults by selected risk factors for periodontal disease-United States, 2011-2014. J. Periodontol.; 89: 933-939.

Frencken JE, Sharma P, Stenhouse L, et al. (2017): Global epidemiology of dental caries and severe periodontitis - a comprehensive review. *J. Clin. Periodontol*.; 44(suppl 18): S94–S105.

Gluch, JI (2012): As an adjunct to tooth brushing, interdental brushes (IDBs) are more effective in removing plaque as compared with brushing alone or the combination use of tooth brushing and dental floss. J Evid Based Dent. Pract.; 12: 81–83.

Ibekwe, R (2015): Modifiable Risk factors of Hypertension and Socio-demographic Profile in Oghara, Delta State; Prevalence and Correlates. Ann. Med. Health Sci. Res.; 5(1): 71-77

Imai PH, Hatzimanolakis PC (2011): Interdental brush in type I embrasures: Examiner blinded randomised clinical trial of bleeding and plaque efficacy. Can. J. Dent. Hyg.; 45: 13–20.

Jayedi A, Rahimi K, Bautista LE, et al. (2019): Inflammation markers and risk of developing hypertension: a meta-analysis of cohort studies. *Heart*; 105:686–692.

Kinane D, Stathopoulou P, Papapanou P (2017): Periodontal diseases. Nat. Rev. Dis. Primers.; 3: 17038.

Kumar S, Gopalkrishna P, Syed AK, Sathiyabalan A (2025): The Impact of Toothbrushing on Oral Health, Gingival Recession, and Tooth Wear-A Narrative Review. Healthcare (Basel).; 13(10): 1138.

Landi L, Grassi G, Sforza MN, Ferri C (2021): Hypertension and periodontitis: an upcoming joint report by the Italian Society of Hypertension (SIIA) and the Italian Society of Periodontology and Implantology (SIdP) High Blood Press Cardiovasc Prev.; 28: 1–3.

Mohd Khairuddin AN, Bogale B, Kang J, Gallagher JE (2024): Impact of dental visiting patterns on oral health: A systematic review of longitudinal studies. BDJ Open.; 10(1): 18.

Muñoz Aguilera E, Suvan J, Buti J, et al. (2020): Periodontitis is associated with hypertension: a systematic review and meta-analysis. Cardiovasc Res.; 116(1): 28-39.

Olagundoye OO, Sorunke ME (2025): Pattern of Dental Service Utilization (DSU) and Its Determinants Among Hypertensive Patients in a Nigerian Tertiary Health Centre. Int. J. Med. Health Res.; 4: 2833-2148.

Olajide M, Babalogbon S, Ladeji1 A, et al. (2021): Pattern and Distribution of Patients' Dental Attendance in a Nigerian Tertiary Centre. Saudi J. Oral Dent. Res.; 6(6): 251-260.

Petersen PE (2009): Global policy for improvement of oral health in the 21st century—implications to oral health research of World Health Assembly 2007, World Health Organisation. Community Dent. Oral Epidemiol.; 37: 1-8.

Pietropaoli D, Del Pinto R, Ferri C, et al. (2018): Poor oral health and blood pressure control among US hypertensive adults. Hypertension.; 72: 1365–1373.

*Pignatelli P, Fabietti B, Ricci A, Piattelli A, Curia M (2020): How periodontal disease and presence of nitric oxide reducing oral bacteria can affect blood pressure. Int. J. Mol. Sci.; 21: 7538.*

Piskorz, D (2020): Hypertension and metabolic disorders, a glance from different phenotypes. Am. J. Prev. Cardiol.; 2: 100032.

Ramirez-Ortega AP, Vera-Ponce VJ, Iturregui Paucar CR (2023): Access to Dental Services among Hypertensive Elderly in Peru: Exploring Patterns and Implications. Int. J. Stats. Med. Res.: 12: 155-160

Rossi GP, Bisogni V, Rossitto G, et al., (2020): Practice Recommendations for Diagnosis and Treatment of the Most Common Forms of Secondary Hypertension. High Blood Press Cardiovasc Prev.;27(6): 547-560.

Sood M, Shende R, Saha S, Eruva V (2024): Systematic Review Article: Study of Risk Factors for Hypertension. Eur. J. Cardiovasc. Med.; 14(6): 19 – 22

Sorunke ME, Soroye MO, Oyapero O (2025): Oral hygiene status and practices of hypertensive patients attending a tertiary facility in south-south Nigeria. WJBPHS.; 22(01): 261-273.

Surma S, Romańczyk M, Witalińska-Łabuzek J, et al., (2021): Periodontitis, Blood Pressure, and the Risk and Control of Arterial Hypertension: Epidemiological, Clinical, and Pathophysiological Aspects—Review of the Literature and Clinical Trials Curr Hypertens Rep.; 23(5): 27.

Suzuki S. Yoshino S, Takayanagi A, Ishizuka Y, Satou R (2016): Factors associated with Regular Dental Attendance among White-collar Workers. Dentistry.; 6(374): 1161-1122

Tonetti MS, Greenwell H, Kornman KS (2018): Staging and grading of periodontitis: framework and proposal of a new classification and case definition. *J. Periodontol*.;89(suppl 1): S159–S172.

Warren PR, Jacobs DM, Low ML, Chater BV, King DW (2002): A clinical investigation into the effect of toothbrush wear on efficacy. J. Clin. Dent.; 13(3): 119-124

William B, Mancia G, Spiering W, et al., (2018): Authors/Task Force Members 2018 ESC/ESH Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Cardiology and the European Society of Hypertension. J Hypertens.; 36: 1953–2041.

*World Health Organisation (2025): Hypertension. Fact sheets. Accessed November 11, 2025. Available from:* https://www.who.int/news-room/fact-sheets/detail/hypertension [Google Scholar].

Yost KG, Mallatt ME, Liebman J (2006): Interproximal gingivitis and plaque reduction by four interdental products. J. Clin. Dent.; 17: 79-83.