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Association between Tooth Loss and Hypertension: A Systematic Review

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Abstract

Background: An independent relationship between tooth loss and hypertension appears to exist. **Objectives:** The aim of this study was to systematically review the relationship between tooth loss/number of teeth and hypertension. **Materials and Methods:** This review was conducted based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Guidelines. We searched all the relevant studies in international databases of PubMed and Google Scholar search engines from January 2000 to December 2023. **Results:** Fourteen studies (11 cross sectionals, 2 descriptives and 1 Cohort) met the inclusion criteria for this review. Most cross-sectional studies showed that participants with more tooth loss exhibited a greater proportion of hypertension and higher systolic blood pressure than those with less tooth loss. Cohort study showed that the loss of 8 or more teeth was associated with a higher risk of developing hypertension. Descriptive studies reported that missing teeth were marginally significantly associated with hypertension. **Conclusion:** This study has revealed a significantly higher SBP in patients with fewer remaining teeth or more tooth loss. In addition, those with more tooth loss showed a higher risk of hypertension than those with less tooth loss.

Keywords

Tooth Loss, Hypertension, Blood Pressure, Public Health

1. Introduction

Hypertension is a medical condition in which blood pressure is chronically 140/90 mmHg or higher, a value that is taken as a reference and persists over time [1]. It is estimated to affect 1.56 billion people in 2025 and is defined as a persistent high systemic arterial blood pressure [2]. The evolution of blood pressure is shown in **Table 1**.

Table 1. Evolution of blood pressure and stage of blood pressure.

Definitions	Systolic blood pressure (mm/Hg)	Diastolic blood pressure (mm/Hg)	Strokes risk
Optimal blood pressure	< 120	< 80	
Normal blood pressure	120 - 129	80 - 84	
High blood pressure	130 - 139	85 - 89	< 15%
Hypertension stage I (light)	140 - 159	90 - 99	15% - 20%
Hypertension stage II (moderate)	160 - 179	100 - 109	20% 30%
Hypertension stage III (severe)	≥ 180	≥ 110	>30%

The risk factors for blood pressure are dependent, such as age, sex, obesity, excessive alcohol consumption, smoking, diabetes, high dietary salt intake, physical inactivity and stress [3] [4]. In addition, tooth loss is another risk factor that can lead to the development of high blood pressure.

The concept of viewing the mouth separately from the rest of the body must cease because oral health affects people in general by causing considerable pain and suffering and by changing what people eat, their speech, and their quality of life and well-being [5].

Tooth loss is a separation of the tooth from its supporting structure that can be caused by dental caries, periodontal disease, periapical infection, fractured tooth, failure of endodontic treatment, trauma, infection, oral neoplasia and congenital disorders [6] [7]. Tooth loss and remaining teeth are an important indicator of overall oral health [8] [9].

The missing tooth is one of the leading oral conditions causing disability-adjusted life years in almost all global regions and might have a direct implication on patient psychological health, aesthetics, and dietary/nutrition state [10] [11].

In addition to known risk factors such as obesity, physical inactivity, smoking, and low income, several studies have shown an independent association between tooth loss and elevated blood pressure [12], but about tooth loss and hypertension, there are some controversies.

Al Ahmad *et al.*, 2018 in the Malaysian population, noted an association between tooth loss and hypertension in postmenopausal women [13]. On the other

hand, Gordon *et al.* 2018 reported that postmenopausal women who lost one or more teeth had a 20% higher risk of hypertension [14]. Another study by Da *et al.* (2019) found an association between tooth loss and hypertension in older Chinese people [15]. A study in the South African population showed that complete edentulousness is a risk indicator for hypertension [16].

However, the literature evokes different conclusions about this association. The association between impaired mastication, including tooth loss and obesity, was suggested in a systematic review [17].

The purpose of this study was to synthesize and analyze the various studies that had been conducted to provide an overview of the scientific advances in the possible association between tooth loss and hypertension.

2. Materials and Methods

This systematic review was reported according to Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.

2.1. Search Strategy and Data Sources

Literature search was conducted for English evidence in PubMed and Google Scholar from January 2000 to December 2023. The following keywords were used: Tooth loss, hypertension, and blood pressure. After the electronic search, a manual search was also conducted through the reference lists from original research and review articles.

The inclusion criteria were defined as follows: 1) written in English, 2) published from January 2000 to December 2023, 3) investigating the association between tooth loss and hypertension, 4) conducted on adult human subjects (age $\geq$ 18 years), and 5) using quantitative methods of data collection. The exclusion criteria were defined as follows: 1) reviews studies or meta-analyses, 2) involving animals, and 3) published in another language than English.

2.2. Data Extraction

Data were extracted from each eligible study by three independent authors (Lubadi E, Mantshumba A, Kumpanya P) using a specifically developed data extraction sheet. Disagreements were resolved by consensus. The following data were extracted from each eligible study: first author, publication year, type of study, number of subjects, mean age, number of tooth loss, mean blood pressure, and key results.

The collected data were recorded on a computer using Microsoft Office Excel 2016 and then stored in a database using SPSS version 20.0 for analysis.

3. Results

Of 14 studies (11 cross-sectional studies [13] [15] [16] [18]-[25], two descriptive studies [12] [26] and one cohort study [27] were included in this systematic review, as shown in the flow chart (**Figure 1**).

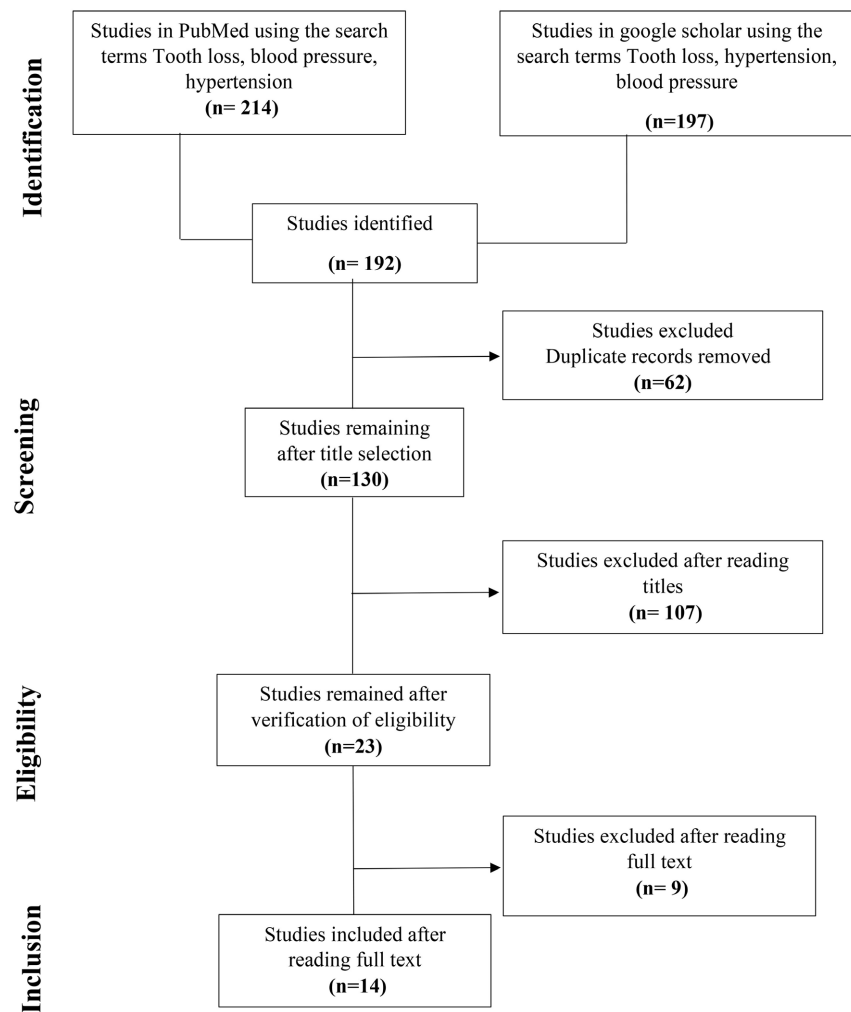


Figure 1. Flow chart of literature search.

The characteristics of the studies are presented in **Table 2**. Fourteen studies [12] [13] [15] [16] [18] [27] categorized blood pressure into hypertensive and normal according to global criteria. All studies used values of systolic blood pressure (SBP) and diastolic blood pressure (DBP). In terms of the number of teeth, four studies evaluated the number of missing teeth [16] [18] [21] [27]. Regarding the age range of participants in **Table 3**, six studies included participants aged ≤ 50 years [12] [16] [18] [21] [23] [24] [26].

Two studies used menopausal women [13] [19]. The distribution of countries where the included studies were conducted is as follows in **Table 2**: Asia 8 [13] [15] [19]–[21] [23] [26] [27]; America 2 [18] [22]; Africa 1 [16]; and Europe 3 [12] [24] [25].

According to the association between the number of remaining/missing teeth and hypertension. The prevalence of hypertension was compared between/among groups with different numbers of remaining teeth in eleven cross-sectional studies [13] [15] [16] [18]–[25] (**Table 2**). One of the eleven studies showed an inverse association between the number of remaining teeth and hypertension [12]. On the

other hand, a different study failed to find an association between the number of remaining teeth and hypertension [22] [25].

Table 2. Characteristics of selected items.

N°	Authors & years	Country/ sample size	Type of study	Gender	Average age (years)	Number of teeth lost		Mean BP SBP/DBP (mmHg)	Key results
						< 10	≥ 10		
Cross sectional									
1	Ayo-yusuf <i>et al.</i> 2008 [16]	South Africa/9098	Cross sectional	M: 3628 F: 5470	45	7013	2085	130/78	Total tooth loss is a risk indicator for established hypertension
2	Peres <i>et al.</i> 2012 [18]	Brazil 1720	Cross sectional	M: 761 F: 959	38.1	382	1338	132.9/85	Total tooth loss is associated with increased SBP among adults
3	Taguchi <i>et al.</i> 2014 [19]	Japan/98	Cross sectional	F: 98	54.8	73	25	129.1/78.9	Tooth loss increased risk of hypertension in postmenopausal
4	Singh <i>et al.</i> 2015 [20]	India 1480	Cross sectional	M: 718 F: 762	58	878	602	153.3/95.2	Tooth loss was associated with a higher probability of hypertension among dental middle age and older adults
5	Hye-Sun Shin 2017 [21]	South Korea 13561	Cross sectional	M: 5757 F: 7804	42.5	2114	11,447	146.7/83	Number of teeth may be associated with hypertension after adjusting for age, gender, education, smoking...
6	Maia <i>et al.</i> 2018 [22]	Brazil 212	Cross sectional	M: 53 F: 159	57.5	38	174	130/78.87	The annual dental visit and the self-concept of dental treatment need were associated with tooth loss
7	Al Ahmad <i>et al.</i> 2018 [13]	Malaysia/60	Cross sectional	F: 60	59.5	26	34	136.4/79.2	Tooth loss is associated with the increase risk of hypertension in postmenopausal
8	Da <i>et al.</i> 2019 [15]	China 3677	Cross sectional	M: 1644 F: 2033	70.23	1455	2222	150/75.9	Tooth loss may be associated with severe hypertension among older chinese adults
9	Hosadurga <i>et al.</i> 2020 [23]	Malaysia 269	Cross sectional	M: 119 F: 150	39.5	206	63	125.3/78.9	SBP was higher among the participants with increasing tooth loss
10	Mendes <i>et al.</i> 2021 [24]	Portugal 10576	Cross sectional	M: 4264 F: 6312	44.9	8111	2465	135.3/83	BP and tooth loss are related, and age is the key indicator in this association
11	Delbruto <i>et al.</i> 2021 [25]	Portugal 1543	Cross sectional	M: 682 F: 861	59.4	426	1117	156.6/77	Age captures most of the effect of the association between pulsatile components of BP and severe tooth loss.
Descriptive									
12	Volzke <i>et al.</i> 2006 [12]	Germany 4185	Descriptive	M: 2035 F: 2150	49.5	1698	2487	136.01/83.6	There is an inverse association of the number of teeth SBP and hypertension in men
13	Dar Odeh <i>et al.</i> 2019 [26]	Saudi Arabia 1768	Descriptive	F: 1768	31.2	1156	612	142/87.3	In a linear regression model, missing teeth was marginally significantly associated with hypertension
Cohort									
14	Woo <i>et al.</i> 2021 [27]	South Korea 19680	Cohort	M: 11,568 F: 8112	51.8	19,475	205	112.1/71	Lost of 8 or more teeth was associated with higher risk of developing hypertension

Legend: SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; BP: Blood Pressure.

Table 3. Articles according to gender and average age.

Authors	Average age (years)	Gender	
		Male	Female
Volzke <i>et al.</i> [12]	49.5	2035	2150
Ayo-yusuf <i>et al.</i> [16]	45	3628	5470
Peres <i>et al.</i> [18]	38.1	761	959
Taguchi <i>et al.</i> [19]	54.8	/	98
Singh <i>et al.</i> [20]	58	718	762
Hye-Sun Shin [21]	42.5	5757	7804
Maia <i>et al.</i> [22]	57.5	53	159
Al Amad <i>et al.</i> [13]	59.5	/	60
Da <i>et al.</i> [15]	70.23	1644	2033
Dar Odeh <i>et al.</i> [26]	31.2	/	1768
Hosadurga <i>et al.</i> [23]	39.5	119	150
Woo <i>et al.</i> [27]	51.8	11,568	8112
Mendes <i>et al.</i> [24]	44.9	4264	6312
Delbruto <i>et al.</i> [25]	59.4	682	861
Average/Total	50.13	31,229	36,698

4. Discussion

This systematic review was conducted to analyze the association between tooth loss and hypertension based on scientific evidence from clinical studies during the last two decades.

The prevalence of hypertension was compared between/among groups with different numbers of remaining teeth in eight cross-sectional studies [16] [18] [19] [21]-[23] [26] [27] (Table 2). On the other hand, two studies failed to find an association between the number of remaining teeth and hypertension [22] [25]. Ten studies analyzed the association between number of missing teeth and hypertension [12] [13] [15] [16] [18]-[21] [26] [27] (Table 2). One of the fourteen studies displayed a positively significant association [27]. Two studies showed that menopausal women with hypertension had a higher number of remaining teeth than those without hypertension [13] [19]. About the association between the number of remaining/missing teeth and SBP/DBP. Fourteen studies analyzed this association [12] [13] [15] [16] [18]-[27] (Table 2). One study demonstrated that the number of remaining teeth was inversely associated with SBP and DBP [12]. In the same study, men with fewer teeth had significantly higher SBP than those with higher teeth, which was significantly higher [12], but this association was not observed in women [13]. The gender showed a female predominance of 54.02% [12] [13] [16] [19]-[25]. This finding could be justified by the greater aesthetic interest that women have in dental restoration. However, men also perceive the loss of teeth as a real castration of their power assets; aesthetic prejudice is less

deeply rooted in the psyche of men [9]. What's more, the cyclical hormonal changes that characterize women's lives are a favorable factor for the development of periodontal disease, which accounts for 75% of tooth loss [28]. For women, the association between tooth loss and hypertension was marginally or not observed in studies including younger participants (19 - 39 years) [29]. However, in the Völzke's study including individuals aged 20 - 79 years, the significant association was found among men unlike among women [30].

Two studies reported that populations with a greater number of missing teeth exhibited significantly higher SBP or DBP than those with a smaller number of missing teeth [20] [27].

Regarding the number of tooth loss, the group with less than 10 teeth lost was predominant (63.37%). However, studies that reported a greater number of participants who lost more than 10 teeth revealed a high average BP [15] [20]. In one study, participants with missing teeth > 10 were more times likely to have SBP > 140 mmHg than the participants with missing teeth ≤ 10 among adults [27]. According to the type of studies, we found a predominance of cross-sectional studies with 78.58% [15] [31].

One study demonstrated that the number of remaining teeth was inversely associated with systolic blood pressure and diastolic blood pressure after adjusting for covariates [18]. In another study, men with higher teeth loss had significantly higher systolic blood pressure than those with fewer teeth loss, but this association was not observed in women [30]. Another study showed that the participants with a higher number of remaining teeth exhibited a significantly higher systolic blood pressure than the population with a lower number of remaining teeth, but this association was not observed with diastolic blood pressure [25].

Hosadurga *et al.*, 2020 showed that, the mean systolic blood pressure was higher among the participants who were edentulous than partially edentulous, and it reported also that participants with a greater number of missing teeth exhibited significantly higher systolic blood pressure or diastolic blood pressure than those with a smaller number of missing teeth [23].

One cohort study compared the incidence of hypertension in regard to different numbers of teeth. A significantly higher incidence of hypertension was observed in the population with a lower number of teeth [27]. This study demonstrated that the loss of 10 or more teeth was associated with a higher risk of developing hypertension. Thus, the higher number of lost teeth may be associated with the risk of hypertension.

Therefore, the association between tooth loss and hypertension may be explained by nutritional intake. In addition, tooth loss and inflammation of periodontal pockets due to removed teeth may lead to chronic systemic inflammation and increase the risk of hypertension [32].

Al-Ahmad *et al.*, 2018 showed that group with hypertension had higher mean of number of missing teeth than normal blood pressure group, and it showed that

menopausal women with hypertension had a higher number of remaining teeth than those without hypertension [13].

According to Singh *et al.*, 2015, tooth loss was associated with higher systolic blood pressure and peripheral arterial disease among men [20].

Total tooth loss was significantly associated with hypertension. The mechanisms have been proposed to explain the association between tooth loss and hypertension. Due to masticatory insufficiency, tooth loss may alter the eating habits of subjects and so cause less intake of vitamins, fiber and more cholesterol, consequently increasing the risk of hypertension [15].

There are some limitations in this study. Firstly, all studies included in this review were observational studies except one cohort study. Interventional studies are necessary to analyze this relationship. Secondly, some studies could not be included in this study because of a lack of data for real number of participants by tooth loss and hypertension.

The strength of this study is the inclusion of studies with a large number of participants.

5. Conclusions

This study has revealed a significantly higher systolic blood pressure in participants with fewer remaining teeth or more tooth loss and this association is bidirectional.

Future studies are needed to investigate the mechanisms underlying the association between hypertension and tooth loss further.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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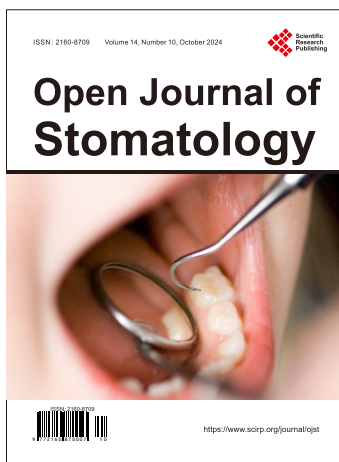
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