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Hypertension and other etiological risk factors associated with the sublingual varices: A systematic review and meta-analysis

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ABSTRACT

Objective: This review assesses the association between hypertension and other etiological risk factors associated with sublingual varices.

Introduction: Hypertension, smoking, type 2 diabetes, cardiovascular disease, and denture-wearing are risk indicators for sublingual varices. A better understanding of the potential risk factors associated with sublingual varices can assist dental clinicians in identifying underlying systemic conditions that require timely and appropriate management.

Methods: The search strategy aimed to retrieve both published and unpublished literature. The databases searched included PubMed, Scopus, Google Scholar, EBSCO-APA PsycInfo, Web of Science, CINAHL, ProQuest, and Shodhganga. All retrieved citations underwent screening to assess compatibility with the inclusion criteria. The methodological validity of the included studies was critically appraised using the JBI critical appraisal tool. Quantitative data were aggregated and analyzed through a meta-analysis. For dichotomous data, the effect size was presented as odds ratios.

Results: Among the nine studies included in this review, eight were cross-sectional, and one was a case-control study. The total number of participants in all nine studies was 3,854, with individual survey participant numbers ranging from 151 to 1008. The methodological quality of all included studies was good. Risk factors such as history of smoking [OR 2.59 (95 % CI 1.39, 4.81), $p = 0.003$], hypertension [OR 4.99 (95 % CI 1.86, 13.39), $p = 0.001$], cardiovascular diseases [OR 6.01 (95 % CI 4.15, 8.70), $p < 0.001$] and denture wearing [OR 2.64 (95 % CI 1.53, 4.53), $p < 0.001$] were significantly associated with sublingual varices.

Conclusion: Hypertension, cardiovascular disease, history of smoking and denture wearing. are the risk factors associated with sublingual varices.

Systematic review registration number: PROSPERO CRD42023396643.

1. Introduction

Oral varicosities (OV) are a frequent ailment that is more prevalent in older people.[1] Varicosities can occasionally be visible in the cheeks and lips, as well as on the floor of the mouth, particularly close to the Ostia of the sublingual glands.[2] The ventral aspect and borders of the tongue are the most commonly affected areas in the oral cavity, and they typically involve the lingual ranine veins.[3]

Sublingual Varices (SLV), which are benign venous lesions commonly located beneath the lateral borders of the tongue, are often referred to as varicosities. This condition is often characterized by multiple raised blue-purple lesions and is more commonly detected during routine dental check-ups. Pathogenesis of SLV is associated with the changes in the connective tissue or thinning of the venous wall due to the age-related degeneration of elastic fibres.[4]

The occurrence of sublingual varices, with a prevalence of around 30 %, can vary depending on the age of the population being studied.[4–6] Previous studies have investigated the correlation between sublingual varices and other conditions, including varicose veins and liver cirrhosis.[7] Most recent research has revealed links between SLV and smoking,[1,8,9] high blood pressure,[1,5,8–10] type 2 diabetes, Cardiovascular Disease (CVD),[4,6] and denture-wearing.[6] Additionally, there is a potential link between SLV, portal hypertension, and varicose veins in the legs.

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High blood pressure increases the risk of the variceal development, OV has been mentioned in relation with the cardiopathies nor cardiomyopathies,[3] specifically associated with mitral heart disease and congestive heart failure. Cardiovascular conditions like hypertension and heart disease are typical circulatory system diseases requiring many medical resources.[11] Hence, detecting SLV during a clinical examination may reveal information about medical issues that the patient is unaware of.[12] Detecting hypertension in dental settings can prompt recommendations for further medical evaluation. Despite existing studies that have explored the association between various risk factors and sublingual varices, the results have often been controversial or inconclusive. A systematic literature review on risk factors for sublingual varices is crucial for providing clinicians with essential information and evidence to identify the disease along with its associated risk factors. As of the search conducted in February 2023 in the Systematic Reviews and Implementation Reports of JBI (Joanna Briggs Institute), PubMed, and PROSPERO databases, no recent or forthcoming systematic reviews on the same topic were found. Therefore, the primary objective of this review was to conduct a systematic analysis focussing on examining the association between hypertension and other etiological risk factors linked to sublingual varices.

1.1. Review question

What are the risk factors associated with the sublingual varices?

2. Inclusion criteria

2.1. Participants

Both male and female participants aged 18 and above, with or without sublingual varices.

2.2. Exposure of interest

Any studies that explore/estimate the association between any risk factor (hypertension and other etiological risk factors such as obesity, BMI, smoking, snuff user, hyperlipidaemia, cardiovascular disease etc.) with the sublingual varices.

2.3. Outcomes

SLV- Clinically, small, dilated veins that can be observed under the lateral borders of the tongue.

Classification of SLV.

Grade 0: Absent or only a few visible dilated veins.

Grade 1: Dilated veins in a moderate or severe form.

2.4. Types of studies

Observational studies evaluating risk/risk factors for sublingual varices was considered for the present review. This review will not include any publications without primary data.

3. Methods

JBI methodology for systematic reviews designed for etiological studies was used to conduct the present review.[13] For the systematic review report, the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines[14] were followed and registered in the Prospective International Register of Systematic Reviews (PROSPERO) under the registration number CRD42023396643.

3.1. Search strategy

The search strategy aimed to retrieve both published and unpublished literature. Initially, the PubMed database was searched to identify relevant articles and key terms. Subsequently, a comprehensive search strategy, encompassing all identified keywords and associated index terms tailored to each additional bibliographic database, was executed. Furthermore, the reference lists of all retrieved articles were meticulously screened for any additional relevant references.This review exclusively considers studies published in English and those with full-text availability. To maximize sensitivity, no specific year-of-publication range was set. The search was conducted in August 2023 and encompassed the following databases: PubMed, Scopus, EBSCO-APA PsycInfo, Web of Science, and CINAHL. The search for unpublished studies included Google Scholar, ProQuest and the Theses database Shodhganga. The search strategy for each database is detailed in Supplementary File. 1.

3.2. Study selection

All identified articles after the completion of the literature search were imported into Covidence (https://app.covidence.org/reviews/active). After the removal of duplicate citations, two independent reviewers (A.J and V.K.S) screened the title and abstract to remove irrelevant articles by assessing the compliance with the inclusion criteria mentioned previously. The full text of the selected citations was again assessed for the compatibility with the inclusion criteria by two independent reviewers (A.J and V.K.S). Disagreements were settled by a third reviewer (C.J).

3.3. Assessment of methodological quality

Studies retrieved were independently evaluated by two reviewers (A.J and V.K.S). Methodological validity of the study was assessed using JBI critical appraisal tool[15] for observational studies. Any disagreements in assessing methodological quality were settled by a third reviewer (C.J). Critical appraisal findings were presented descriptively.

3.4. Data extraction

Customized data extraction tool was used for the data extraction by two reviewers (A.J and V.K.S) from the included studies. The data extraction included details about author, year in which study being conducted, location of the study (Country), name of the journal, study design, study populations, age group, total sample size, risk factors/exposures, outcomes, and authors' conclusions. Any conflicts in the data extraction process were resolved by third reviewer (C.J).

3.5. Data synthesis

Quantitative data, where possible, pooled in random effects meta-analysis model using JBI SUMARI. Random effects models were considered as there is clinical (study population), methodological and statistical heterogeneity. The effect size was estimated at the 95 % confidence intervals. For dichotomous data, the effect size was presented as either odds ratios. Included studies were assessed for the statistical heterogeneity χ^2, τ^2, and I^2 tests.

3.6. Assessing certainty in the findings

GRADE (Grading of Recommendations, Assessment, Development and Evaluation) approach[16] was used to assess the certainty of evidence. GRADEpro GDT was used to create the Summary of Findings (SoF). The risk of SLV will be the outcome reported in the SoF (Fig. 1. Summary of Findings).

Risk factors compared to Sublingual Varices for [health problem and/or population]

Patient or population: [health problem and/or population]
Setting:
Intervention: Risk factors
Comparison: Sublingual Varices

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Sublingual Varices	Risk difference with Risk factors
Hypertension	2299 (5 non-randomised studies)	⨁⨁◯◯ Low[a,b,c]	**OR 4.99** (1.86 to 13.39)	19 per 100	**35 more per 100** (11 more to 57 more)
Cardio Vascular Disease	873 (3 non-randomised studies)	⨁⨁⨁⨁ High[d]	**OR 6.01** (4.15 to 8.70)	19 per 100	**40 more per 100** (31 more to 48 more)
Denture	858 (2 non-randomised studies)	⨁⨁◯◯ Low[a,c]	**OR 2.64** (1.53 to 4.53)	37 per 100	**24 more per 100** (10 more to 36 more)
Gender	2769 (5 non-randomised studies)	⨁⨁◯◯ Low[a]	**OR 1.08** (0.91 to 1.28)	32 per 100	**2 more per 100** (2 fewer to 6 more)
Smoking	2988 (6 non-randomised studies)	⨁⨁◯◯ Low[a,b]	**OR 2.59** (1.39 to 4.81)	41 per 100	**23 more per 100** (8 more to 36 more)
Smoking duration	171 (2 non-randomised studies)	⨁⨁◯◯ Low[a,c]	**OR 3.22** (0.49 to 21.06)	33 per 100	**28 more per 100** (14 fewer to 58 more)

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **OR:** odds ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

Explanations

a. Statistical heterogeneity
b. Variation in the definition of Outcome
c. Wide confidence interval
d. Events rates are low

Fig. 1. Summary of findings.

4. Results

4.1. Study inclusion

A total of 95 titles were initially obtained through searches across various databases and additional sources. Following the removal of duplicates, 65 studies underwent screening based on title and abstract to determine eligibility. Among the remaining articles, 15 were selected for full-text retrieval, and each underwent a thorough assessment for eligibility. Six articles were subsequently excluded as they did not meet the inclusion criteria (Supplementary File. 2. provides a list of the excluded studies along with the reasons for their exclusion). Ultimately, nine full-text studies were critically appraised and included in this review. The results of the search and the study selection process are presented in a PRISMA flow diagram (Fig. 2 Search results and study selection and inclusion process).

4.2. Methodological quality

Methodological quality was assessed for nine studies using JBI critical appraisal tool for cross sectional studies[4–6,9,10,15,17,18] and case-control study.[19] All the included studies were of good quality. Except for one study conducted by Jafari et al.,[17] all studies identified confounding factors. A summary of the methodological quality of all publications is provided in Tables 1 and 2.

4.3. Description of studies

Out of the nine studies included in this review, eight were cross-sectional[4–6,9,10,15,17,18] while one was a case-control study.[19] The characteristics of the included studies are summarized in Table 3. The studies included in this review were published between 2010 and 2022, and they were all in English. The included studies were conducted in six countries namely Italy,[10] Turkey,[5] Saudi Arabia,[6] Iran,[9,17,19] Sweden[4,15]

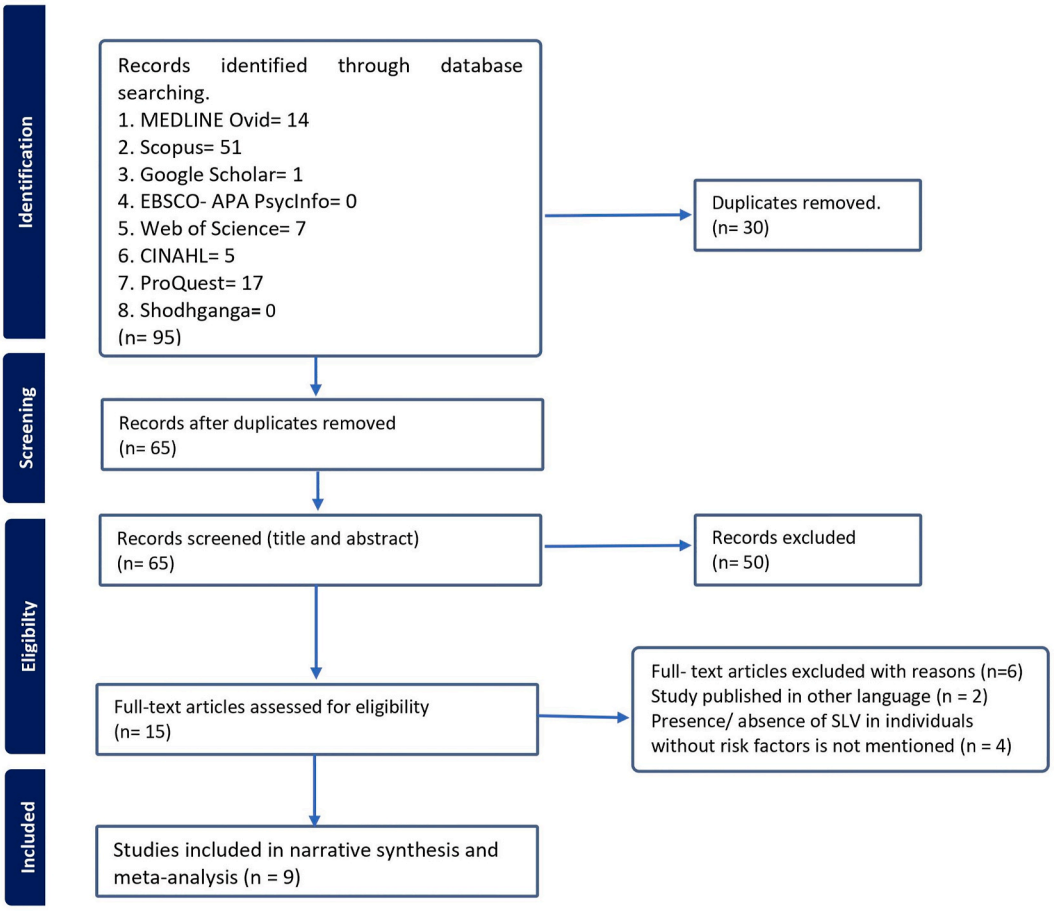


Fig. 2. Search results and study selection and inclusion process.

Table 1
Critical appraisal of the included cross-sectional studies.

Author, Year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Quality Assessment
Hedstrom 2015[4]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Baharvand 2022[9]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Akkaya 2019[5]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Al-Shayyab 2015[6]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Accardo 2021[10]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Hedstrom 2010[15]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Jafari 2022[17]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Good
Shivakumar 2020[18]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Total	100	100	100	100	100	87.5	100	100	

JBI critical appraisal checklist for cross-sectional studies.
Q1. Were the criteria for inclusion in the sample clearly defined?.
Q2. Were the study subjects and the setting described in detail?.
Q3. Was the exposure measured in a valid and reliable way?.
Q4. Were objective, standard criteria used for measurement of the condition?.
Q5. Were confounding factors identified?.
Q6. Were strategies to deal with confounding factors stated?.
Q7. Were the outcomes measured in a valid and reliable way?.
Q8. Was appropriate statistical analysis used?.
Y, Yes: U, Unclear; N, No.

and India.[18] The total number of participants across all nine studies was 3,854, with individual study participant numbers ranging from 151 to 1008. All study groups were drawn from the general population,[4–6,9,10,15,17,18] except for one study which focused on the elderly.[19]

All the studies identified a range of risk factors (exposures) associated with sublingual varices. These risk factors gender,[5,6,10,17,18] age,[6,17,18] smoking,[5,6,10,17–19] smoking duration,[6,18] hypertension,[4,9,10,17,18] cardiovascular disease,[6,15,18] diabetes mellitus,[10] obesity,[10] antihypertensive therapy,[10] denture wearing,[6,17] removable partial denture,[17] favourite food,[6] leg varicosity,[17] length of stay[17] and literacy.[17]

Table 2
Critical appraisal of the included case control studies.

Author, Year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Quality Assessment
Barzideh 2021[19]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
Total	100	100	100	100	100	100	100	100	100	100	

JBI critical appraisal checklist for case-control studies.
Q1. Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?.
Q2. Were cases and controls matched appropriately?.
Q3. Were the same criteria used for identification of cases and controls?.
Q4. Was exposure measured in a standard, valid and reliable way?.
Q5. Was exposure measured in the same way for cases and controls?.
Q6. Were confounding factors identified?.
Q7. Were strategies to deal with confounding factors stated?.
Q8. Were outcomes assessed in a standard, valid and reliable way for cases and controls?.
Q9. Was the exposure period of interest long enough to be meaningful?.
Q10. Was appropriate statistical analysis used?.

4.3.1. Gender as a risk factor for SLV

Five studies[5,6,10,17,18] with total sample of 2769 individuals that evaluated the effect of gender on sublingual varices. The odds ratio was 1.08 (95%CI 0.91, 1.28; $p = 0.366$, $I^2 = 83$ %; see Fig. 3. Association of Gender and Sublingual Varices) and not statistically significant.

4.3.2. History of smoking as a risk factor for SLV

Six studies[5,6,10,17–19] involving a total of 2988 individuals, assessed the effect of smoking on sublingual varices. The odds ratio was 2.59 (95 % CI 1.39, 4.81; $p = 0.003$, $I^2 = 88$ %; see Fig. 4a. Association of Smoking and Sublingual Varices), and it was statistically significant. This indicates that patients with a history of smoking had 2.59 times the odds of developing sublingual varices compared to patients without a smoking history.

4.3.3. Duration of smoking as a risk factor for SLV

Two studies[6,18] involving a total of 171 individuals, evaluated the effect of smoking duration on the incidence of sublingual varices. The odds ratio was 3.22 (95 % CI 0.49, 21.06; $p = 0.222$, $I^2 = 84$ %; see Fig. 4b. Association of smoking duration and Sublingual Varices), and it was not statistically significant. This indicates that there was no significant association between smoking duration and the risk of sublingual varices.

4.3.4. History of blood pressure as a risk factor for SLV

Five studies[4,9,10,17,18] involving a total of 2299 individuals, evaluated the effect of blood pressure on sublingual varices. This analysis revealed that hypertensive individuals had 4.9 times the odds of developing sublingual varices compared to normotensive individuals. The odds ratio was 4.99 (95 % CI 1.86, 13.39; $p = 0.001$, $I^2 = 93$ %; see Fig. 5a. Association of Hypertension and Sublingual Varices), and it was statistically significant.

4.3.5. History of cardiovascular disease as a risk factor for SLV

Three studies[6,15,18] involving 873 individuals assessed the effect of cardiovascular disease on sublingual varices. The odds ratio of 6.01 (95 % CI 4.15, 8.70; $p < 0.001$, $I^2 = 0$ %; see Fig. 5b. Association of Cardiovascular Diseases and Sublingual Varices) and was statistically significant, meaning that individuals with cardiovascular disease had 6.01 times the odds of developing sublingual varices as compared to individuals without cardiovascular disease.

4.3.6. History of denture wearing as risk factor for SLV

The analysis was based on two studies[6,17] involving a total of 858 individuals to evaluate the effect of denture wearing on the incidence of sublingual varices. The odds ratio was 2.64 (95 % CI 1.53, 4.53, $p < 0.001$, $I^2 = 53$ %; see Fig. 6. Association of Denture wearing and Sublingual Varices), and it was statistically significant. This means that denture wearers had 2.6 times the odds of developing sublingual varices compared to non-denture wearers.

For all the data synthesis, random effect models were considered for statistical analysis, as there is heterogeneity.[20]

4.3.7. Narrative synthesis of the risk factor for SLV

Age is significantly associated with the SLV in all three included studies,[6,17,18] even though cutoffs for age varied across the studies. Antihypertensive therapy,[10] diabetes Mellitus,[10] obesity,[10] favourite food,[6] length of stay (Nursing home)[17] and literacy[17] found no significant association with the presence of SLV. Leg varicosities found significant association with the presence of SLV ($P < 0.01$).[17] However, these results should be interpreted with caution as only one study was used for some associations, and studies with high variability were included.

4.4. Discussion

This systematic review aimed to identify and describe the risk factors associated with sublingual varices. The review drew upon a comprehensive analysis of nine epidemiological studies. Despite variations in study designs, there were sufficient similarities among the included studies that facilitated meta-analysis. This review successfully identified a range of both modifiable and nonmodifiable risk factors associated with sublingual varices.

4.4.1. Gender as a risk factor for SLV

The pooled analysis did not reveal a significant difference in the risk of sublingual varices between males and females. Nevertheless, the observed high heterogeneity among the included studies suggests that other factors may be influencing the development of sublingual varices. Despite females being less susceptible to certain risk factors associated with SLV, such as cardiovascular disease and smoking, the lack of a significant association between gender and SLV raises the possibility of hormonal influences among females in the development of sublingual varices.[6]

4.4.2. History of smoking as a risk factor for SLV

Our review concludes that smoking is significantly associated with an increased risk of sublingual varices. The pooled analysis demonstrates that patients with a history of smoking are more likely to develop sublingual varices compared to those without a smoking history. Smoking is a predisposing factor for CVD, particularly hypertension, and its effect depends on peripheral resistance through constricting blood vessels on the arterial side. However, it is important to acknowledge the limitations of this analysis. The source of heterogeneity in the study arises from variations in the definition of smoking across studies. Specifically, four studies defined smoking simply as present or absent without providing clarity on factors such as the number of cigarettes smoked per day or the history of former smoking.[6,10,17,18] The

Table 3
Characteristics of the included studies.

Sl. No	Author, Year	Location of the study	Name of the Journal	Study design	Total sample size (N)	Study population	Age group	Risk factors	Sublingual Varices
1	Accardo, 2021[10]	Italy	BMC Oral Health	Cross-sectional study	1008	General population	45–85 years of age	Gender Blood pressure Hypertensive SBP≥140 mmHg and/or DBP≥90 mmHg Non -hypertensive- SBP <140 mmHg and DBP <90 mmHg Smoking Diabetes Mellitus Obesity Antihypertensive therapy	Grade 0 = none or few visible Grade 1 = medium/severe
2	Akkaya, 2019[5]	Turkey	Folia Morphologica	Cross-sectional study	691	General population	18–88 years of age	Gender Smoking 0 = No smoking 1 = Current/former smokers	Grade 0 = none or few visible Grade 1 = medium/severe
3	Al-Shayyab, 2015[6]	Saudi Arabia	Saudi Medical Journal	Cross-sectional study	391	General population	13–74 years of age	Age ≤40 and > 40 Gender Smoking Smoking duration ≤15 years and >15 years Favourite food Vegetables and others Denture wearing Medical history (CVD) Hypertension Angina pectoris Myocardial infarction Stroke Atrial fibrillation Cardiac valve dysfunction, and others	Grade 0 = none or few visible Grade 1 = medium/severe
4	Baharvand 2022[9]	Iran	General Dentistry	Cross-sectional study	151	General population	30–75 years of age	Blood Pressure Hypertensive SBP≥120 mmHg and/or DBP≥80 mmHg Non-hypertensive SBP< 120 mmHg and/or DBP<80 mmHg	Grade 0 = none or few visible Grade 1 = medium/severe
5	Barzideh 2021[19]	Iran	Oman Medical Journal	Case control study	222	Elderly	> 65 years	Smoking Smokers, if they Smoked at least One cigarette per day for more than six months	Grade 0 = none or few visible Grade 1 = medium/severe
6	Hedstrom 2015[4]	Sweden	BMC Oral Health	Cross-sectional study	431	General population	>40 years	Blood Pressure Hypertensive SBP≥140 mmHg and/or DBP≥90 mmHg Non -hypertensive- SBP <140 mmHg and DBP <90 mmHg	Grade 0 = none or few visible Grade 1 = medium/severe
7	Hedström 2010[15]	Sweden	British Journal of Oral and Maxillofacial Surgery	Cross-sectional study	281	General population	40 and 92 years	Medical history Hypertension, Angina pectoris, Myocardial Infarction, and stroke atrial fibrillation and cardiac valve dysfunction	Grade 0 = none or few visible Grade 1 = medium/severe

(*continued on next page*)

Table 3 (*continued*)

Sl. No	Author, Year	Location of the study	Name of the Journal	Study design	Total sample size (N)	Study population	Age group	Risk factors	Sublingual Varices
8	Jafari 2022[17]	Iran	Iranian Journal of Otorhinolaryngology	Cross-sectional study	478	General population	Mean age 74.5 years	Gender Age ≥74.5 years and <74.5 years Smoking Length of stay Mean 2 years Blood pressure Hypertensive SBP≥120 mmHg and/or DBP≥80 mmHg Non-hypertensive SBP< 120 mmHg and/or DBP<80 mmHg Complete denture Removable partial denture Leg varicosity Literacy	Grade 0 = none or few visible Grade 1 = medium/severe
9	Shivakumar 2020[18]	India	Journal of International Oral Health	Cross-sectional study	201	General population	Mean age 52.3 ± 11.5 years	Age ≤50 years and ≥50 years Gender Smoking Smoking duration ≤15years and ≥15years Blood Pressure Hypertensive SBP≥140 mmHg and/or DBP≥90 mmHg Non -hypertensive SBP <140 mmHg and DBP <90 mmHg Medical history Atrial fibrillation myocardial infarction stroke, ischemic heart disease	Grade 0 = none or few visible Grade 1 = medium/severe

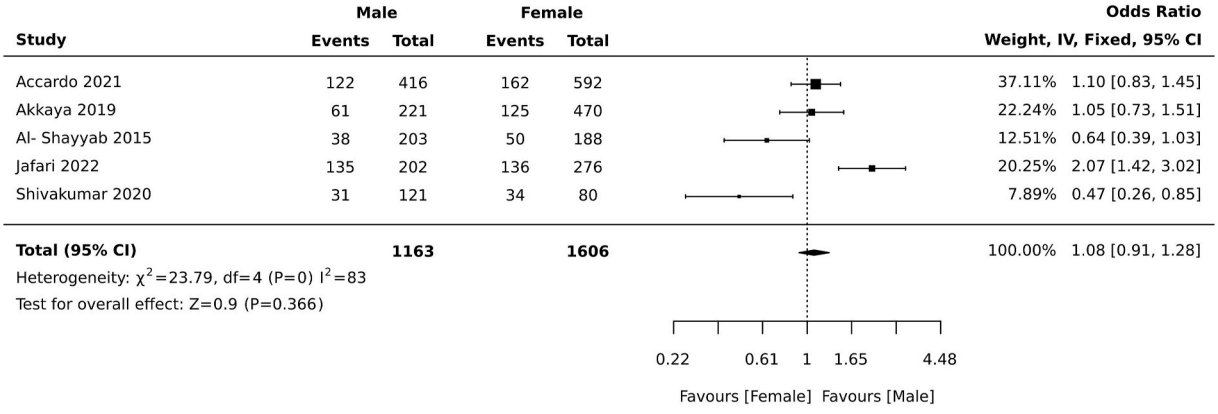
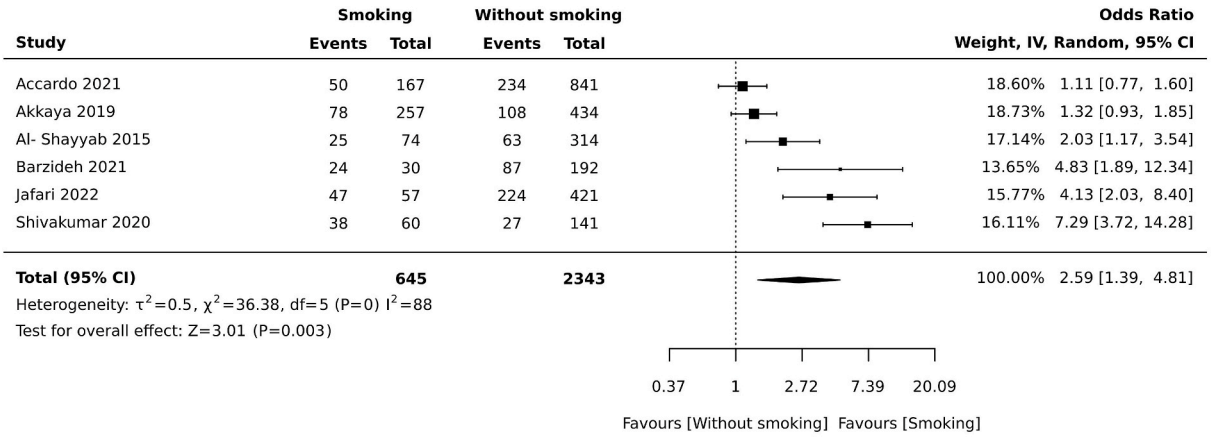


Fig. 3. Association of gender and sublingual varices.

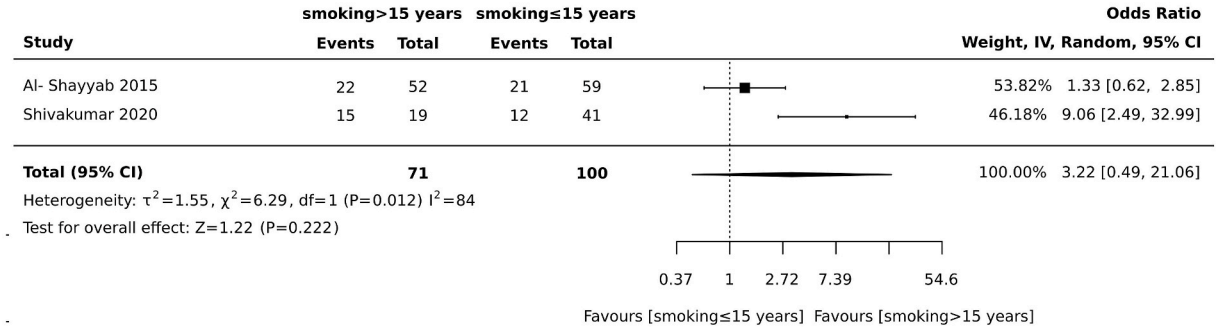
heterogeneity in the review may be attributed to variations in the definition of smoking across studies. Akkaya et al. defined smokers based on a history of current or former smoking.[5] In contrary, Barzideh et al.[19] defined smokers as individuals who had smoked at least one cigarette per day for more than six months. This divergence in the definition of smoking could impact the overall findings. Another source of heterogeneity arises from differences in study design. One study[19] utilized a case-control design, while all others were based on cross-sectional studies.[5,6,10,17,18]

4.4.3. *Duration of smoking as a risk factor for SLV*

The non-significant odds ratio implies that there is no conclusive evidence to support a significant association between smoking duration and the incidence of sublingual varices in the analyzed studies. This maybe because of the smoking has a preventive effect on the development of varicose veins due to vasoconstrictive effect of nicotine. The



a. Smoking and Sublingual Varices



b. Smoking duration and Sublingual Varices

Fig. 4. Association of smoking and sublingual varices.

wide confidence interval reflects the uncertainty around the estimate and indicates a lack of precision in the effect size.

4.4.4. History of blood pressure as a risk factor for SLV

In the current review, blood pressure was found to be a risk factor for SLV. The association between clinical changes in sublingual varices and hypertension might be due to circulatory anastomosis in the venous system of the tongue or a hemodynamic effect in which arterial pressure affects the veins through arteriovenous shunts.[4] Increased arteriovenous blood flow could transfer arterial pressures which is much higher than venous pressure to the venous circulation, with vein dilatation and consequent morphologic changes in their walls. However, a high level of heterogeneity was present. This may be due to the (a) variation in the definition of hypertensive patients; three studies defined hypertensive as SBP≥140 mmHg and/DBP≥90 mmHg and Non -hypertensive SBP <140 mmHg and DBP <90 mmHg[4,10,18] and two studies defined hypertensive as SBP≥120 mmHg and/or DBP≥80 mmHg Non-hypertensive SBP< 120 mmHg and/or DBP<80 mmHg. (b) Variation in the age group among the included studies, 45–85 years,[10] >40 years,[4] 41–63 years,[18] 30–75 years,[9] mean age 74.5[17].

4.4.5. History of cardiovascular disease as a risk factor for SLV

In the current review, cardiovascular disease was found to be a risk factor of SLV. There was no evidence of variability among the effect sizes across the included studies. This indicates a high level of consistency among the study results, with no significant heterogeneity. The lack of variability strengthens the confidence in the overall findings and suggests that the observed association is consistent across the studies.

4.4.6. History of denture wearing as a risk factor for SLV

Our study found that denture-wearing is associated with the SLV and there is a moderate level of heterogeneity across the included studies. Jafari et al.[17] included removable or complete denture wearers, while Al-Shayyab and Baqain[6] did not explicitly mention whether participants wore partial or complete dentures. Neither study considered the duration of denture wearing. Poor oral hygiene and inflammation created by using a prosthesis will be the causes of these denture-induced lesions. Poorly fitting dentures may contribute to mechanical irritation or trauma to the sublingual area, leading to the development of the SLV.

4.4.7. Limitations of this review

The meta-analysis relied only on studies published in English and included studies were with smaller sample sizes. This limitation may impact the statistical power to detect a significant association. Furthermore, it's important to note that the analysis is observational in nature, and as such, causality (temporal relationship) cannot be established.

4.4.8. Recommendations of research

The wide confidence intervals and non-significant p-values indicate the necessity for larger studies or additional research to arrive at more definitive conclusions regarding risk factors such as smoking duration and denture wearing.

4.4.9. Recommendations for practice

The clinical implication of this study is the potential utility of sublingual varices as an indicator of the risk for hypertension and cardiovascular diseases. The examination of the lateral borders of the tongue during yearly dental visits is a quick and non-invasive procedure. It

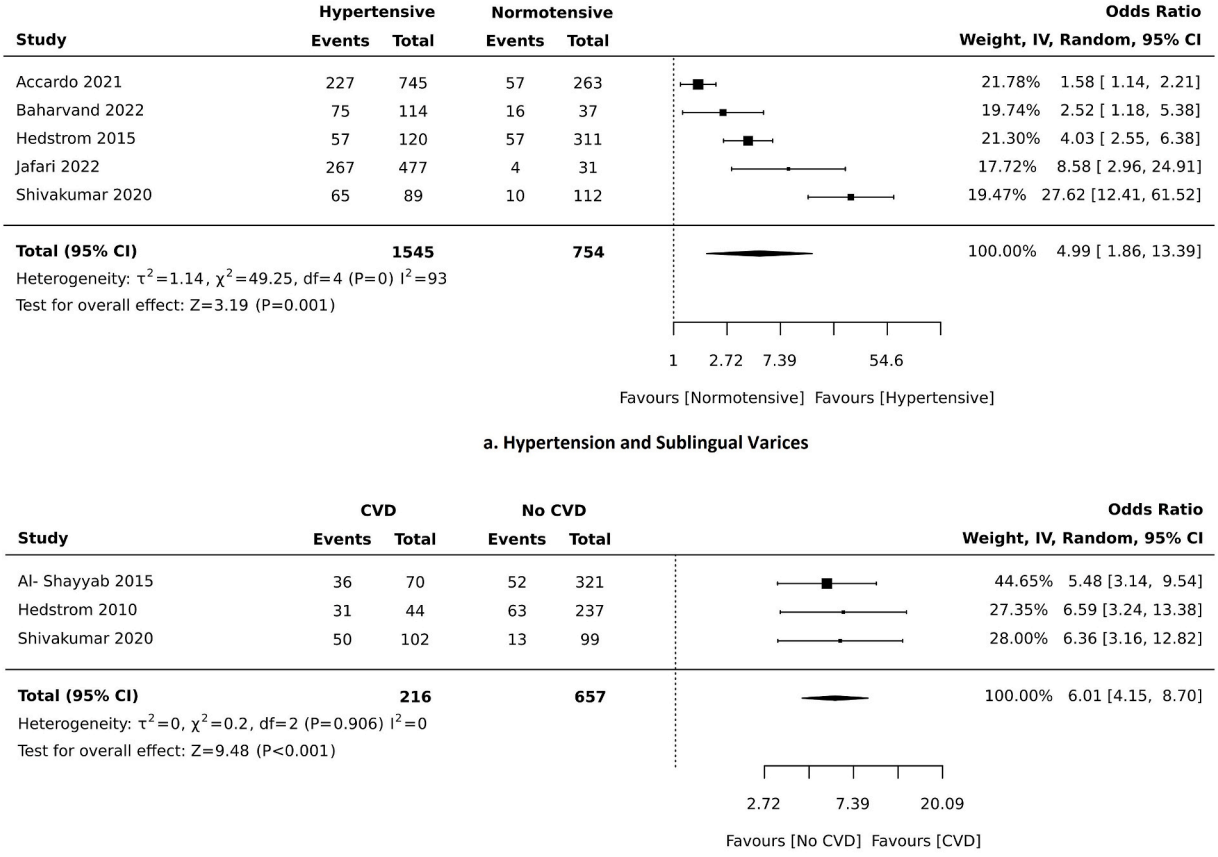


Fig. 5. Association of cardiovascular diseases and sublingual varices.

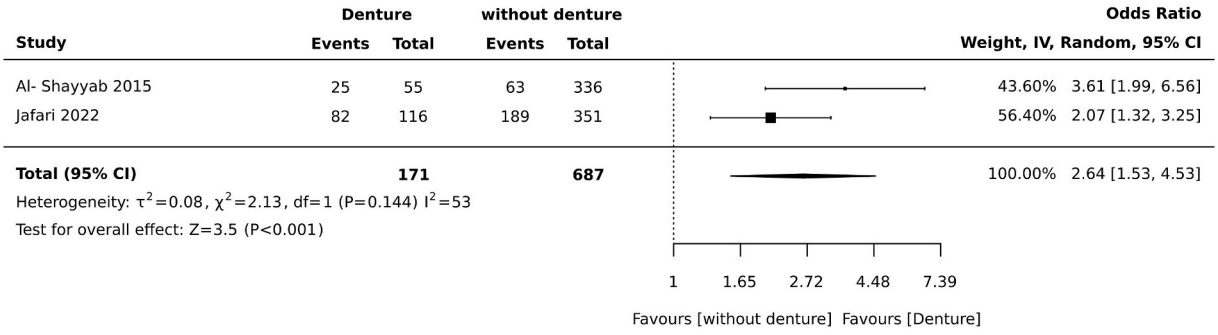


Fig. 6. Association of Denture wearing and Sublingual Varices.

poses no harm to the patient and could serve as a valuable method for dental public health professionals to participate in preventive healthcare actively. With minimal effort on the part of the dental surgeon and minimal discomfort to the patients, it is possible to diagnose hypertension[4] and cardiovascular diseases with high positive predictive value.

5. Conclusion

The review found a significant association between sublingual varices and risk factors such as hypertension, cardiovascular disease, history of smoking and denture wearing. However, these results must be interpreted with caution due to the limited number of included studies.

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Compliance with ethical standards

Conflict of Interest: The authors declare that they have no conflict of interest.

Research involving human participants and/or animals: Not Applicable.

Informed Consent: Not Applicable.

Patients/guardians consent

Not Applicable as this is a systematic review.

Ethical clearance

Not Applicable as this is a systematic review.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jobcr.2024.09.014.

References

1. Lazos J, Rodríguez Marco E, Brunotto M, Panico R, Piemonte E. Oral varicose veins: clinical features and its association with medical conditions. *Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology*. 2020 May;32(3):216–221.
2. Ettinger RL, Manderson RD. A clinical study of sublingual varices. *Oral Surg Oral Med Oral Pathol*. 1974 Oct;38(4):540–545.
3. Lazos J, Piemonte E, Panico R. Oral varix: a review. *Gerodontology*. 2015 Jun;32(2):82–89.
4. Hedström L, Albrektsson M, Bergh H. Is there a connection between sublingual varices and hypertension? *BMC Oral Health*. 2015 Jul 11;15:78.
5. Akkaya N, Olmez D, Ozkan G. Evaluation of the factors associated with sublingual varices: a descriptive clinical study. *FOLIA MORPHOLOGICA*. 2019;78(2):325–330.
6. Al-Shayyab MH, Baqain ZH. Sublingual varices in relation to smoking, cardiovascular diseases, denture wearing, and consuming vitamin rich foods. *Saudi Med J*. 2015 Mar;36(3):310–315.
7. Duarte NT, de Oliveira Godoy A, da Rocha Tenório J, et al. Prevalence of sublingual varices in patients with cirrhosis and the correlation with nitrogen compounds. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*. 2020 Jan;129(1):39–44.
8. Bergh H, Kastberg C, Albrektson M, Hedström L. Persistence and stability of sublingual varices over time and their connection to underlying factors: an 8 year follow up study. *BMC Oral Health*. 2022 Aug 11;22(1):346.
9. Baharvand M, Mortazavi H, Eshaghian M, Mirzaei H. Sublingual varicosity as a possible indicator of hypertension. *Gen Dent*. 2022;70(2):46–49.
10. Accardo A, Pascazio L, Costantinides F, Gorza F, Silveri G. Influence of hypertension and other risk factors on the onset of sublingual varices. *BMC Oral Health*. 2021 May 4;21(1):235.
11. Ahti TM, Mäkivaara LA, Luukkaala T, Hakama M, Laurikka JO. Lifestyle factors and varicose veins: does cross-sectional design result in underestimate of the risk? *Phlebology*. 2010 Aug;25(4):201–206.
12. Viswanath V, Nair S, Chavan N, Torsekar R. Caviar tongue. *Indian J Dermatol, Venereol Leprol*. 2011;77(1):78–79.
13. Chapter 7: Systematic reviews of etiology and risk - JBI Manual for Evidence Synthesis - JBI Global Wiki [Internet]. [cited 2023 Feb 17]. Available from:: https://jbi-global-wiki.refined.site/space/MANUAL/4687372/Chapter+7%3A+Systematic+reviews+of+etiology+and+risk.
14. Peres KG, Cascaes AM, Nascimento GG, Victora CG. Effect of breastfeeding on malocclusions: a systematic review and meta-analysis. *Acta Paediatr*. 2015 Dec;104(467):54–61.
15. Hedström L, Bergh H. Sublingual varices in relation to smoking and cardiovascular diseases. *Br J Oral Maxillofac Surg*. 2010 Mar;48(2):136–138.
16. Iorio A, Spencer FA, Falavigna M, et al. Use of GRADE for assessment of evidence about prognosis: rating confidence in estimates of event rates in broad categories of patients. *BMJ*. 2015 Mar 16;350(mar16 7):h870. h870.
17. Jafari A, Alaee A, Rezai M, Masoudi M. Evaluation of sublingual varices prevalence and its respective factors in two Iranian nursing homes in 2019. *Iranian Journal of Otorhinolaryngology*. 2022 Jul;34(4). https://doi.org/10.22038/ijorl.2022.63364.3170 [Internet][cited 2023 Apr 2].
18. Shivakumar K, Raje V, Kadashetti V. Assessing the correlation between sublingual varices and hypertension among the adults of Satara district, Maharashtra: an observational study. *J Int Oral Health*. 2020 Jul;12(4):349–354.
19. Barzideh N, Alaee A, Azizi A. The relationship between smoking and sublingual varices in the elderly. *Oman Med J*. 2021 Jul 15;36(4):e288. e288.
20. Tufanaru C, Munn Z, Stephenson M, Aromataris E. Fixed or random effects meta-analysis? Common methodological issues in systematic reviews of effectiveness. *Int J Evid Base Healthc*. 2015 Sep;13(3):196–207.