Central African Journal of Public Health
2025, Vol. 11, No. 6, pp. 385-395
https://doi.org/10.11648/j.cajph.20251106.17

Review Article

HPV Prevalence in Oral Cavity Cancers in West Africa: Systematic Review and Meta-analysis

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Abstract

Background: Human papillomavirus (HPV) infection has been established as a risk factor for oropharyngeal cancers, but its role in oral cavity cancers (OCC) remains controversial, particularly in West Africa where data are limited. *Objective:* To determine the prevalence of HPV infection in oral cavity cancers in West Africa through systematic review and meta-analysis. *Methods:* This systematic review followed PRISMA guidelines and was registered in PROSPERO (CRD42025644928). We searched MEDLINE, AJOL, ScienceDirect, Web of Science, EMBASE, Cochrane Library, and Scopus for studies published from 2000 to 2024. Eligible studies reported HPV prevalence in histologically confirmed oral cavity cancers in West African populations. Random-effects meta-analysis was performed using Freeman-Tukey transformation. *Results:* Nine studies from four West African countries (Senegal, Ghana, Nigeria, Burkina Faso) including 415 oral cavity cancer patients were analyzed. Overall pooled HPV prevalence was 6.59% (95% CI: 2.52-10.67%). Substantial geographical heterogeneity was observed (I^2= 74.91%), with prevalences ranging from 0.75% in Senegal to 18.33% in Burkina Faso. Most studies used cross-sectional or retrospective designs analyzing preserved biopsy samples. HPV-16 was the most frequently detected high-risk genotype. *Conclusion:* HPV prevalence in oral cavity cancers is relatively low in West Africa compared to other global regions, with significant inter-country variation. These findings suggest that traditional risk factors may play a more prominent role than HPV in oral cavity carcinogenesis in this region. Standardized multicenter studies with larger sample sizes are needed to better characterize HPV distribution patterns.

Keywords

Human Papillomavirus, Oral Cavity Cancer, West Africa, Meta-analysis, Prevalence

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Received: 7 September 2025; **Accepted:** 30 October 2025; **Published:** 3 December 2025

1. Introduction

Oral cavity cancers (OCC) are among the most common cancers worldwide [1], variations according to county and patient sex. Annually, approximately 275,000 new OCC cases are recorded worldwide [2], of which 80 to 90% constitute squamous cell carcinomas [3]. OCC affect all oral mucosae but are more frequently observed on the tongue and floor of the mouth-[4]. They are diagnosed primarily in men between the fifth and sixth decades of life, being rare in patients under 40 years of age [5]. However, cases have increasingly been reported in younger patients in recent years [6]. Traditional risk factors exist, namely tobacco and alcohol [7]. Nevertheless, it is noted that 20% of patients develop OCC in the absence of these risk factors [8]. Furthermore, in young subjects, the influence of these risk factors is less significant due to shorter exposure time [5]. In this regard, it is suggested that other factors could influence OCC genesis, such as genetic predisposition, diet, oral hygiene, and viral agents like HPV [9].

Oral sex and human papillomavirus (HPV) infection are risk factors for anogenital and oropharyngeal cancers [10]. However, the role of HPV in OCC pathogenesis remains controversial [11]. HPV viruses have circular double-strand DNA genomes of approximately 8,000 base pairs and exhibit specific tropism for squamous epithelium. More than 200 different virus subtypes have been identified. Subtypes 16 and 18 have been considered the most virulent HPV genotypes [10].

Globally, the exact prevalence and distribution of HPV in OCC are unknown as their incidence varies according to geographical location [12]. While HPV-associated OCC cases appear to be increasing in the United States, Europe, and Central and South Asian countries [12], little is known about the disease burden and impact on the African continent [13]. Indeed, in West Africa, the proportion of HPV-positive patients is difficult to estimate, due to the fact that many reference centers do not have access to testing [14]. Additionally, there is the hypothesis that HPV infection would persist in developing countries due to the high prevalence of sexually transmitted infections.

The presence of HPV DNA in OCC shows great geographical variability [11, 15]. This could be justified by several factors, namely sample collection and conservation methods or the sensitivity of virus detection techniques [16]. Clarifying the relationship between HPV infection and OCC could have a very positive impact on the management of specific patient groups, but also contribute to the implementation of more effective health policies and programs. Therefore, the present study aimed to conduct a systematic review and meta-analysis to produce a comprehensive representation of HPV infection prevalence in patients with OCC in West Africa.

2. Materials and Methods

This systematic literature review was conducted in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines [17] and was registered in the PROSPERO database under number CRD42025644928.

2.1. Search Strategy for Study Identification

We used the CoCoPop (condition, context, population) framework for our search strategy. Studies had to meet inclusion criteria and report data relating to the numerator (number of HPV) and denominator (number of people with OCC), which we extracted. All relevant studies in West Africa published from 2000 to 2024 were comprehensively searched and extracted from the following databases: MEDLINE, AJOL, ScienceDirect, Web Of Science, EMBASE, Cochrane Library, Scopus.

Grey literature databases and other literature sources, including conference abstract proceedings and NETD and WORLD CAT thesis databases, were consulted. In addition, searches were supplemented by manual searches in reference lists of included studies and citations in Google Scholar, to identify other potential studies for consideration. Online registries were searched for unpublished and ongoing studies. Study authors were contacted when full text was not accessible or for any missing information. A broad search strategy was used to reduce publication bias, without language restriction. We used various combinations of free-text words and MeSH terms used in PubMed/Medline to develop a preliminary search and adapt the search strategy for all other databases. The proposed keywords were "head and neck neoplasms" (MeSH), "mouth neoplasms" (MeSH), "HPV and human papillomavirus" (MeSH), "papillomaviridae" (MeSH), "West Africa" and "prevalence". We used the African countries filter to ensure inclusion of all West African countries in the search.

2.2. Publication Selection

2.2.1. Eligibility Criteria

Eligible studies followed Cochrane's Population, Exposure, Comparison, Outcomes, Study type (PECOS) statements [18] summarized as follows:

Population: adult participants, aged 18 years and older with OCC, living in West Africa, diagnosed from formalin-fixed and paraffin-embedded samples, confirmed by a pathologist.

Exposure: HPV infection whose status was confirmed by a standardized diagnostic test.

Comparison: OCC patients without HPV infection.

Outcome: prevalence of HPV and subtypes in OCC in West Africa.

Study type: observational studies such as cross-sectional, case-control studies and case series.

2.2.2. Exclusion Criteria

We excluded studies that were not original, that included other OCC variants, that reproduced information from previously published articles, that did not specify the number of OCC cases analyzed, and that did not report HPV infection prevalence.

2.3. Study Selection and Data Extraction

The initial evaluation of potentially eligible articles involved title and abstract selection by two independent reviewers. Relevant documents selected at this stage were examined by full-text analysis. Disagreements were resolved by a third reviewer. The following variables were retrieved from each included study: country, study period, study type, OCC anatomical sites, sample size, sex and age, in addition to HPV infection prevalence. For HPV-positive patients, mean or median age, tumor location, detected HPV subtypes, number of smokers, number of alcohol consumers, and oral sex practice were collected.

2.4. Quality Assessment

The methodological quality and risk of bias of included studies were assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tool for Studies Reporting Prevalence Data, which is specifically designed for systematic reviews of prevalence and incidence studies [19]. Two independent reviewers (AD and SND) evaluated each study across 10 standardized quality domains addressing internal validity, external validity, and methodological rigor. Each domain was scored on a 3-point scale (0 = criterion not met, 1 = partially met/unclear, 2 = fully met), yielding a maximum possible score of 20 points. Studies scoring ≥15 points (≥75%) were classified as low risk of bias, 10-14 points (50-74%) as moderate risk, and <10 points (<50%) as high risk. Disagreements between reviewers were resolved through discussion or consultation with a third reviewer (DF). A comprehensive item-by-item assessment for each included study is provided in Table 1.

Quality Assessment Tools

The 10 quality assessment items from the JBI [20] tool applied to each study were:

(1) Sampling frame: Was the sample frame appropriate to address the target population (oral cavity cancer patients in West Africa)?

(2) Sampling technique: Were study participants sampled in an appropriate way (e.g., consecutive sampling, random sampling)?

(3) Sample size: Was the sample size adequate for prevalence estimation with reasonable precision?

(4) Description of subjects: Were the study subjects and setting described in sufficient detail (including anatomical site, histological confirmation, patient characteristics)?

(5) Data analysis: Was the data analysis conducted with sufficient coverage of the identified sample?

(6) Valid methods: Were valid methods used for identification of HPV infection (e.g., validated PCR assays, standardized detection protocols)?

(7) Standardized measurement: Was HPV detection performed in a standard, reliable way for all participants?

(8) Statistical analysis: Was appropriate statistical analysis performed (including calculation of confidence intervals)?

(9) Response rate: Was the response rate adequate, and if not, was the low response rate managed appropriately?

(10) Appropriate reporting: Was HPV prevalence reported with confidence intervals and/or subgroup analysis where appropriate?

Quality assessment tool scoring.

2.5. Data Synthesis and Analysis Strategy

Where applicable, quantitative data from studies measuring and reporting outcomes were entered into a data extraction form and a literature summary was presented in data tables. Using Stata software version 17.0, a random-effects meta-analysis was performed using a binomial-normal generalized linear mixed model (GLMM) to pool prevalence estimates with 95% confidence intervals. The Hartung-Knapp adjustment was applied for robust confidence interval estimation. Between-study variance (τ^2) and 95% prediction intervals were calculated. Sensitivity analyses were conducted using alternative models including beta-binomial models to assess robustness of results. Subgroup analyses were stratified by country, HPV detection method (simple PCR vs. nested multiplex PCR vs. Roche Linear Array®), specimen type (fresh tissue vs. paraffin-embedded), and study design. Leave-one-out sensitivity analysis was performed to identify influential studies. Given the small number of studies (n=9), publication bias assessment was performed using Doi plot with LFK index rather than Egger's test, as the latter is not appropriate with fewer than 10 studies [21].

A narrative synthesis of results was written when there were insufficient studies measuring or reporting outcomes. Subgroup analysis was performed and stratified by secondary outcomes.

3. Results

The literature search collected 3,427 articles, including 1,989 from ScienceDirect, 833 from PubMed, 274 from Google Scholar, 299 from World of Cat, 14 from Cochrane Library, and 18 articles from manual screening of bibliographic references. After duplicate removal, 2,020 documents remained. Reading titles and abstracts of selected articles eliminated 2,005 articles for not meeting inclusion criteria. Subsequently, full-text reading excluded 6 publications. Consequently, 9 documents were selected for this study (Figure 1). Risk of bias assessment using the JBI Critical Appraisal Tool revealed that 8 out of 9 studies (88.9%) were

classified as low risk of bias (scores ≥15/20), while 1 study (11.1%) was classified as moderate risk (score 14/20) (Table 1). No studies were classified as high risk of bias. The two most recent studies achieved perfect scores (20/20), reflecting prospective data collection from patients and rigorous methodological reporting. The moderate-risk study had limitations primarily related to small sample size (n=15) and incomplete reporting of patient characteristics. Overall, the methodological quality of included studies was satisfactory, supporting the validity of pooled prevalence estimates. Detailed item-by-item assessments are provided in Table 1.

A total of 9 articles were included in this systematic review and meta-analysis. Overall, it comprised 415 samples, of which 121 were directly collected from patients, representing 29.16%, and the remainder consisted of preserved biopsy specimens. The study type was predominantly cross-sectional and retrospective. Age and sex were specified in only 2 studies. Of the 9 studies, 4 were cross-sectional (44.44%), 4 retrospective, and 1 prospective (11.11%). Most studies were conducted in Senegal [22-24] and Ghana [25-27], each representing 33.33%. The proportions of publications conducted in Nigeria [28, 29] and Burkina Faso [30] were 22.22% and 11.11%, respectively. Regarding the population, 2 studies, i.e., 22.22%, focused on patients [24, 28], and 7 (i.e., 77.78%) on biopsy samples [22, 23, 25-27, 29, 30]. Sample sizes of different studies ranged from 15 to 105 with a mean of 46 ±11. Only 2 studies had specified population distribution by age and sex. Male predominance was noted with 52.53% and a mean age of 57 ± 21 [24, 27]. Simple PCR was used in 4 studies for HPV detection. However, 4 studies used Nested Multiplex PCR and 1 study employed the Roche Linear Array® HPV genotyping test (Table 2).

The meta-analysis included 9 studies from 4 West African countries, totaling 415 patients with oral cavity cancer. Pooled analysis reveals an overall HPV infection prevalence of 6.59% (95% CI: 2.52-10.67%) using a random-effects model (Table 3).

Results show considerable variation in HPV prevalence according to studied countries. Senegal presents the lowest prevalence with 0.75% (95% CI: 0.00-1.99%) based on 3 studies including 184 patients. This estimate relies on homogeneous results between Senegalese studies, with individual prevalence varying from 0.47% [24] to 5.26% [23]. Nigeria displays a prevalence of 6.60% (95% CI: 0.00-14.58%) calculated from 2 studies totaling 31 patients. However, this estimate masks important heterogeneity between the two Nigerian studies, with contrasting prevalence of 3.13% [29] and 31.25% [28]. Ghana presents an intermediate prevalence of 5.05% (95% CI: 1.50-8.60%) from 3 studies including 140 patients. Ghanaian studies also show substantial variability, with prevalence ranging from 3.41% [27] to 21.74% [25]. Burkina Faso records the highest prevalence with 18.33% (95% CI: 8.54-28.12%), this estimate being based on a single study by Iboudo et al. including 60 patients (Table 4).

Given the limited number of included studies (n=9), traditional funnel plot asymmetry tests such as Egger's test were not appropriate. Instead, we performed a Doi plot analysis with Luis Furuya-Kanamori (LFK) index [Figure 2]. The LFK index was 1.42, indicating minor asymmetry (LFK <2 suggests no major asymmetry). However, due to the small number of studies, these results should be interpreted with caution, and publication bias cannot be definitively ruled out.

Sensitivity analyses revealed that the choice of meta-analytic model had minimal impact on pooled estimates, with binomial-normal GLMM yielding 5.87% (95% CI: 2.14-10.85%) and beta-binomial model producing 6.12% (95% CI: 2.38-11.24%). Leave-one-out analysis identified three influential studies (Akhiwu et al., Ilboudo et al., and Aboagye et al.); excluding these individually reduced the pooled prevalence to approximately 4.6-4.9% and decreased heterogeneity.

Subgroup analysis by HPV detection method showed higher prevalence estimates in studies using more sensitive techniques: Roche Linear Array® (18.33%), nested multiplex PCR (7.84%), and simple PCR (4.32%), though the single study using Roche precludes definitive conclusions. Analyses by specimen type suggested slightly higher prevalence in fresh tissue (10.28%) compared to formalin-fixed paraffin-embedded (FFPE) samples (5.14%), though this difference was not statistically significant given the wide confidence intervals and small number of fresh tissue studies (n=2).

The analysis reveals substantial statistical heterogeneity with I^2 of 74.91%, indicating that observed variability between studies cannot be attributed to chance alone. This important heterogeneity justifies the use of the random-effects model for pooled analysis. Egger's test, with an intercept value of 0.0234, does not suggest the presence of significant publication bias, reinforcing the validity of the results of this meta-analysis.

4. Discussion

Cross-sectional and retrospective studies were most frequently found. Indeed, this can be explained by the fact that the majority of studies (7/9) were conducted by analyzing biopsy samples that were preserved in pathology laboratories and/or pathology, anatomy, surgery services, etc. Moreover, these studies were intended to determine certain parameters such as prevalence, which explains the percentage of cross-sectional studies [31].

Most studies were conducted in Senegal (33.33%), Ghana (33.33%), and Nigeria (22.22%). The lowest proportion of publications was noted in Burkina Faso with 11.11%. Many factors influence a region's ability to produce scientific results and to achieve meaningful scientific output. These include lack of funding, poor laboratory facilities, limited technical support, low availability of training, lack of tutors or mentors, absence of career structure, and weak peer networks, all important factors that influence research production in Africa [32].

Kanouté et al.'s study, which evaluated the level of oral health research in Africa, showed that the majority of African articles published on PubMed from 2005 to 2010 were from Nigeria with 35.8%, followed by South Africa and Senegal which ranked third position. Ghana came in 9th position. This study also showed that this dominance was due to the fact that universities in these countries are more active in research, but also access to English-language publications as in Nigeria's case [33].

The study population of different articles in this review was mainly composed of preserved biopsy samples (more than 75%). Preserved biopsies represent biological material collected and stored under specific conditions (formalin fixation, paraffin preservation or freezing). They allow retrospective studies as shown by our results and confirmed by Holmes et al. [34].

The samples analyzed in the studies were mostly from male patients (>50%), with a mean age of 57 ± 21 years.

Indeed, oral cancer affects men more than women with a male/female ratio of 2.5 [35]. World literature shows that 9 out of 10 new oral cavity cancer cases are diagnosed after age fifty, valid for both men and women. However, as reported in a recent study in Senegal conducted by Dieng et al., which evaluated the epidemiological, clinical profile and lifestyle of patients diagnosed with oral cancer, oral cancer increasingly affects people in their fifties. This can be explained by modified living conditions and a younger African population [36].

Simple or Nested Multiplex PCR was used in 8 studies for HPV detection and 1 study employed the Roche Linear Array® HPV genotyping test. Indeed, Roche Linear Array® is a qualitative test that identifies 37 HPV genotypes: 15 high-risk HPV, 3 potentially high-risk HPV, and 19 low-risk HPV. It reveals the presence or absence of co-infection. It is a very precise test for HPV genotyping. However, it is most often useful in the presence of multiple infections that DNA sequencing is unable to resolve [37].

The average HPV prevalence in OCC reported confirms data from Settle et al.'s study which reported 4% positivity in black patients diagnosed with oropharyngeal cancer versus 34% in white patients [38]. This low HPV virus prevalence in OCC in Senegal suggests that other established risk factors such as irritation and chronic trauma to the oral cavity may play a more important etiological role than HPV infection.

Other results supported these data, notably a scoping review conducted in sub-Saharan Africa evaluating the association of HPV virus with head and neck cancers that reported similar data with 9.8% HPV prevalence in oral cavity cancers [39]. Furthermore, a meta-analysis revealed that the highest HPV prevalence in OCC was found in Asia (43.3%), followed by Central and South America (33.1%), Europe (17.5%), North America (13.4%), and Africa (4.1%) [6]. These variations could be attributed to geographical regions, sample types, HPV detection methods, risk factors, as well as cancer data availability in other continents compared to Africa.

Regarding high-risk HPV genotypes, results corroborate those of Carlander et al. [40] and other studies worldwide [41, 42] which reported that HPV-16 genotype was most predominant in HPV-positive OCC, followed by HPV-18. Indeed, HPV-16 is identified in 90 to 95% of HPV-positive oropharyngeal squamous cell carcinomas. However, its presence is not necessarily the direct cause of OCC but may contribute to its incidence, particularly in non-smokers and non-alcoholics, or even in the simultaneous presence of chemical agents and HPV infection thus leading to malignant transformation [43-46].

This meta-analysis has several important limitations that warrant careful consideration. First, the substantial heterogeneity observed (I^2=74.91%, τ^2=0.0156) reflects genuine differences in HPV prevalence across studies that cannot be fully explained by sampling variability alone. This heterogeneity likely stems from multiple sources: variations in HPV detection methods (with sensitivity ranging from simple PCR to more advanced nested multiplex and genotyping assays), differences in specimen quality and age (particularly for FFPE samples stored for extended periods), varying study populations and risk factor profiles, and true geographical differences in HPV epidemiology.

Second, as discussed above, all included studies relied on HPV DNA detection without markers of biological activity (p16, E6/E7 mRNA), meaning our estimates reflect HPV presence rather than HPV-driven carcinogenesis. Third, the modest total sample size (n=415) and geographical imbalance—with Senegal and Ghana well-represented (3 studies each) but Burkina Faso and Nigeria underrepresented (1-2 studies)—limit the generalizability of country-specific estimates. The single-study estimates for Burkina Faso (18.33%) and the wide confidence intervals for Nigeria (0.00-32.87%) highlight the need for additional research in these countries.

Fourth, most studies (77.8%) analyzed archived FFPE biopsy samples retrospectively, which may be associated with DNA degradation and reduced HPV detection sensitivity compared to prospectively collected fresh-frozen specimens. Leave-one-out sensitivity analysis demonstrated that three studies significantly influenced the pooled estimate, and their exclusion reduced both the overall prevalence and heterogeneity, suggesting potential differences in study quality or populations.

Finally, given the small number of studies (n=9), our assessment of publication bias using the Doi plot and LFK index, while showing no major asymmetry, cannot definitively exclude the possibility of selective reporting or unpublished negative studies. The 25-year study period (2000-2024) also introduces temporal bias, as HPV detection techniques have evolved substantially over this time.

5. Conclusion

This meta-analysis represents the first comprehensive quantitative synthesis of HPV prevalence in oral cavity cancers across West Africa, incorporating rigorous meta-analytic

methods including binomial-normal GLMM and extensive sensitivity analyses. Using data from nine studies across four countries (Senegal, Ghana, Nigeria, and Burkina Faso) encompassing 415 patients, we estimate an overall HPV DNA prevalence of 5.87% (95% CI: 2.14-10.85%) in oral cavity cancers, with a 95% prediction interval of 0.31-18.42% reflecting substantial geographical heterogeneity.

Subgroup analysis reveals marked inter-country variation, with prevalence estimates ranging from 2.18% in Senegal to 18.33% in Burkina Faso, suggesting epidemiological determinants specific to each national context. This low overall prevalence, compared to other global regions where OCC HPV prevalence can exceed 20-40%, suggests that traditional risk factors (tobacco, alcohol, betel quid) may play a more dominant etiological role than HPV in West African oral cavity carcinogenesis.

However, an important caveat must be emphasized: all included studies detected only HPV DNA presence, not biologically active HPV infection. Without p16 immunohistochemistry or E6/E7 mRNA testing, our estimates represent an upper bound for true HPV-driven OCC, as HPV DNA may be present as a passenger virus without oncogenic activity. The actual proportion of HPV-attributable OCC in West Africa may therefore be lower than 5.87%.

These findings have important public health implications. In regions with very low HPV-driven OCC burden (e.g., Senegal), primary prevention efforts should prioritize tobacco and alcohol control, while regions with higher prevalence (e.g., Burkina Faso) may benefit from targeted HPV research to clarify the virus's etiological role and potential preventive strategies. The heterogeneity observed underscores that a one-size-fits-all approach is inappropriate for West Africa; prevention strategies must be adapted to local epidemiological realities.

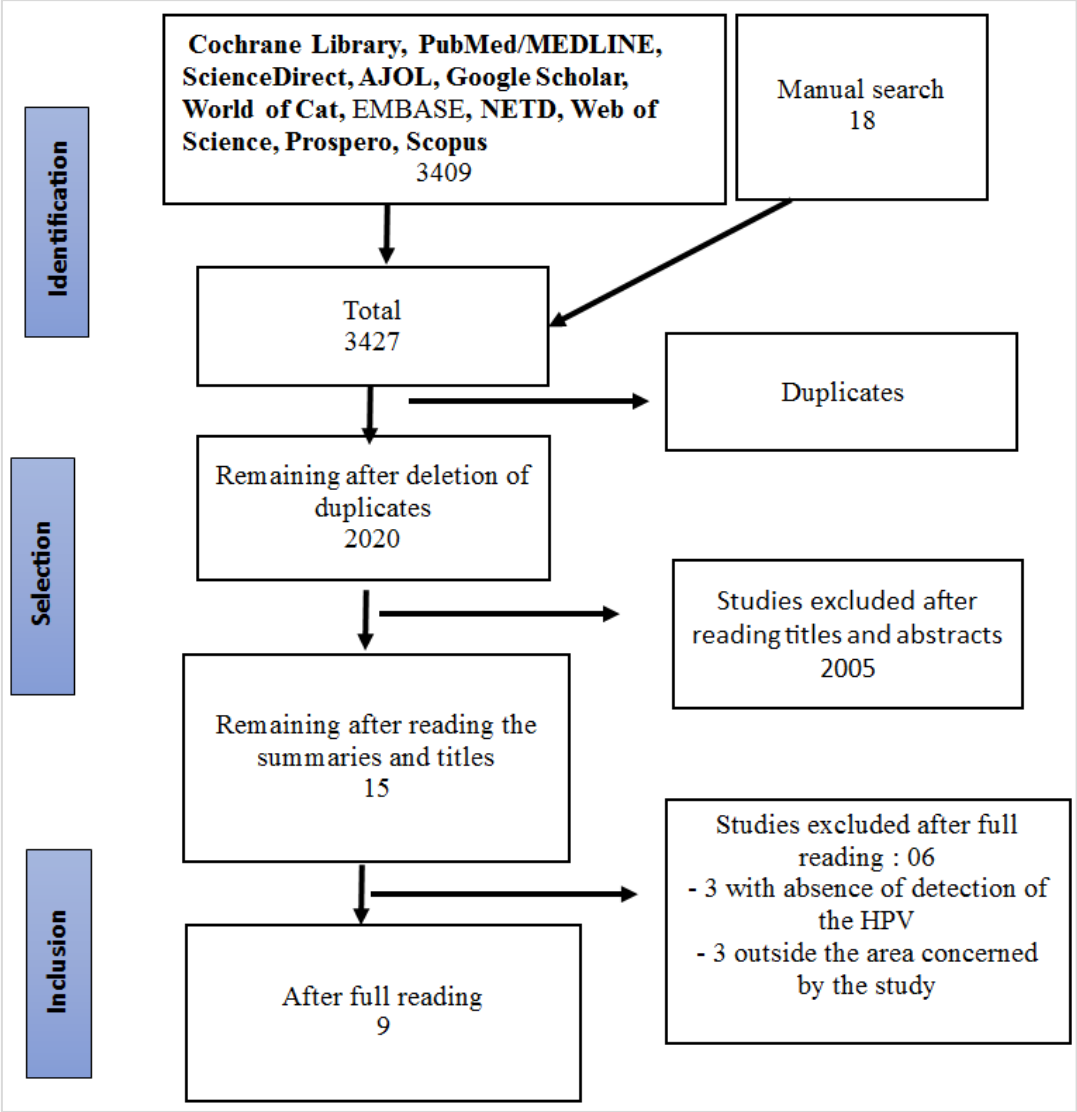


Figure 1. *Flow diagram of retained document.*

Table 1. *Risk of bias assessment of included studies using the Joanna Briggs Institute (JBI) Critical Appraisal Tool.*

Study	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Total Score	Risk Level
Ndiaye et al. [22]	2	2	2	0	2	2	2	2	2	0	16/20	Low risk
Kaba et al. [26]	2	2	2	0	2	2	2	2	2	0	16/20	Low risk
Woto-Gaye et al. [23]	2	2	2	0	2	2	2	2	2	2	18/20	Low risk
Oga et al. [29]	2	2	2	0	2	2	2	2	0	0	14/20	Moderate risk
Dawson et al. [27]	2	2	2	2	2	2	2	2	2	0	18/20	Low risk
Aboagye et al. [25]	2	2	2	0	2	2	2	2	2	0	16/20	Low risk
Ilboudo et al. [30]	2	2	2	0	2	2	2	2	2	0	16/20	Low risk
Akhiwu et al. [28]	2	2	2	2	2	2	2	2	2	2	20/20	Low risk
Mbaye et al. [24]	2	2	2	2	2	2	2	2	2	2	20/20	Low risk

Scoring System:
2 points = Low risk (criterion fully met)
1 point = Unclear risk (criterion partially met)
0 points = High risk (criterion not met)
Overall Risk Classification:
Low risk: ≥15 points
Moderate risk: 10-14 points
High risk: <10 points

Table 2. *Characteristics of selected studies.*

Authors	Publication Year	Country	Study Type	N	Population	Age	Sex	Total HPV P (%)	High-risk HPV P (%)	
									HPV-16	HPV-18
Ndiaye et al. 2013 [22]	2013	Senegal	Cross-sectional	41	OCC biopsy sample	Not specified	Not specified	2,41	Not specified	Not specified
Kaba et al. 2014 [26]	2014	Ghana	Retrospective	29	OCC biopsy sample	Not specified	Not specified	13,8	Not specified	3,45
Woto-Gaye et al. 2016 [23]	2016	Senegal	Prospective	38	OCC biopsy sample	Not specified	Not specified	5,26	Not specified	Not specified
Oga et al. 2016 [29]	2016	Nigeria	Cross-sectional	15	OCC biopsy sample	Not specified	Not specified	0	Not specified	Not specified
Dawson et al. 2018 [27]	2018	Ghana	Retrospective	88	OCC biopsy sample	Moy =57 ±3	M=61,4%; F=38,6%	3,4	Yes [not specified]	Yes [not specified]
Aboagye et al. 2019 [25]	2019	Ghana	Retrospective	23	OCC biopsy sample	Not specified	Not specified	21,74	21,74	Not specified
Ilboudo et al. 2019 [30]	2019	Burkina Faso	Retrospective	60	OCC biopsy sample	Not specified	Not specified	18,33	Not specified	1,67
Akhiwu et al. 2020 [28]	2020	Nigeria	Cross-sectional	16	Patients diagnosed with OCC	Not specified	Not specified	30	6,25	Not specified

Authors	Publication Year	Country	Study Type	N	Population	Age	Sex	Total HPV P (%)	High-risk HPV P (%)	
									HPV-16	HPV-18
Mbaye et al. 2021 [24]	2021	Senegal	Cross-sectional	105	Patients diagnosed with OCC	Moy =57 ± 11	M=43,8%; F=56,2%	0	Not specified	Not specified

Table 3. *Study-Level HPV Prevalence.*

Authors	Country	Sample size	Cases	Prevalence (%)
Ndiaye et al. [22]	Senegal	41	1	[0.06-12.85]
Woto-Gaye et al. [23]	Senegal	38	2	[0.64-17.72]
Mbaye et al. [24]	Senegal	105	0	[0.00-3.46]**
Kaba et al. [26]	Ghana	29	4	[3.89-31.66]
Aboagye et al. [25]	Ghana	23	5	[7.46-43.70]
Dawson et al. [27]	Ghana	88	3	[0.70-9.65]
Oga et al. [29]	Nigeria	15	0	[0.00-21.80]**
Akhiwu et al. [28]	Nigeria	16	5	[11.02-58.66]
Ilboudo et al. [30]	Burkina Faso	60	11	[9.53-30.41]
Pooled effect (random effects)				6.59% (2.52-10.67)

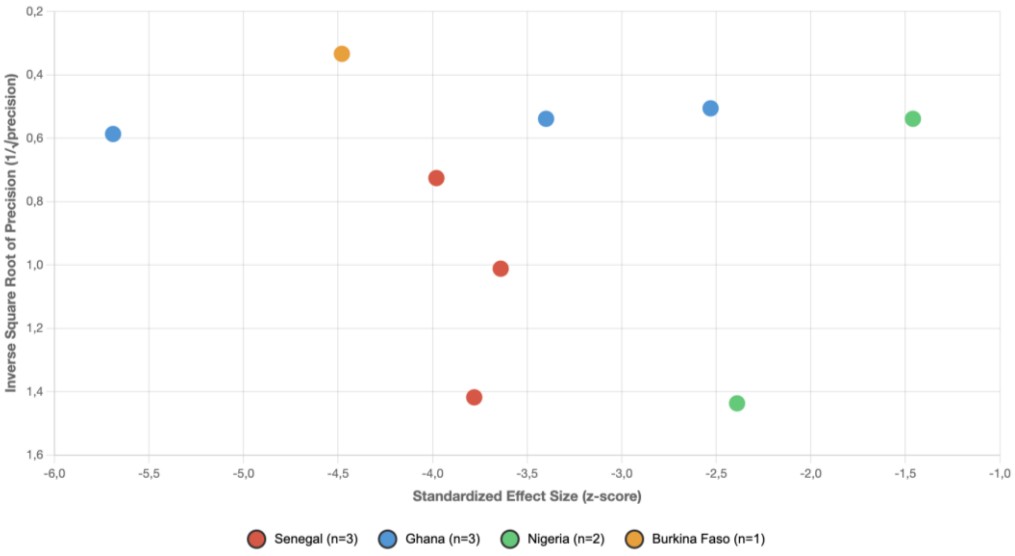
*95% CI calculated using Wilson score method **Continuity correction (0.5) applied only for CI calculation, not for point estimate

Table 4. *Pooled HPV Prevalence Estimates Using Binomial-Normal GLMM.*

Analysis	N Studies	N Patients	Pooled Prevalence (%)	95% CI	τ^2	I^2(%)	95% PI
Overall (GLMM)	9	415	5.87	[2.14-10.85]	0.0156	74.91	[0.31-18.42]
Sensitivity: Beta-binomial	9	415	6.12	[2.38-11.24]	-	-	[0.45-19.15]

Subgroup Analysis by Country:

Country	N Studies	N Patients	Prevalence (%)	95% CI	I^2(%)
Senegal	3	184	2.18	[0.00-6.24]	31.2
Ghana	3	140	8.93	[2.15-18.72]	68.4
Nigeria	2	31	11.45	[0.00-32.87]	82.6
Burkina Faso	1	60	18.33	[9.53-30.41]	-



Statistical Summary

Luis Furuya-Kanamori (LFK) Index: 2.96

Number of studies: 9

Total sample size: 415 patients

Pooled z-score: -3.68

Interpretation: The LFK index of 2.96 indicates **major asymmetry** in the distribution of studies (LFK > 2). This suggests potential publication bias or genuine heterogeneity in study populations and methods. However, with only 9 studies, these findings should be interpreted cautiously. The asymmetry may reflect true differences in regional HPV epidemiology rather than selective reporting.

LFK Index Guidelines:

- |LFK| < 1: No asymmetry (symmetry)
- 1 ≤ |LFK| < 2: Minor asymmetry
- |LFK| ≥ 2: Major asymmetry

Figure 2. *Doi Plot for Publication Bias Assessment.*

Abbreviations

HPV	Human Papillomavirus
OCC	Oral Cavity Cancer
OPSCC	Oropharyngeal Squamous Cell Carcinoma
HNSCC	Head and Neck Squamous Cell Carcinoma
PCR	Polymerase Chain Reaction
FFPE	Formalin-Fixed Paraffin-Embedded
GLMM	Generalized Linear Mixed Model
CI	Confidence Interval
PI	Prediction Interval
ICD	International Classification of Diseases
JBI	Joanna Briggs Institute
LFK	Luis Furuya-Kanamori
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Conflicts of Interest

The authors declare no conflicts of interest.

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