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REVIEW ARTICLE

Epidemiological profile of human papillomavirus infections and cervical cancer prevention among sexually active women in Burkina Faso: Literature Review

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ABSTRACT

Cervical cancer is one of the biggest public health challenges in developing countries. According to the Global Cancer Observation in 2022, Burkina Faso recorded 988 new cases, with 775 deaths. Caused mainly by the human papillomavirus (HPV), this cancer is a heavy burden on our populations. The aim of this review was to assess the current state of human papillomavirus infections and cervical cancer prevention among sexually active women in Burkina Faso. Original studies were extracted from PubMed/Medline, Google Scholar, semanticscholar, Hinari and Science Direct using appropriate MeSH terms. Results were extracted and reviewed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyse method (PRISMA). Twenty-four studies from three regions of Burkina Faso were included in the systematic review, with most of the articles from the "Centre" region. Out of a total of 5480 participants for the pooled analyses, the review showed a prevalence of HPV, varying according to population type and region and ranging from 20.6% to 87.2%. In contrast, the overall prevalence of HPV 16 and 18 infections were low compared to the global trend. With a low screening rate, the prevalence of cancerous lesions ranged from 1.5% to 15.42%. The level of knowledge was lower among rural than urban residents. Bivalent and quadrivalent vaccines had low coverage for the genotypes identified. In the fight against cervical cancer in Burkina, concerted efforts are needed to strengthen screening programs, increase HPV vaccination coverage, and raise public awareness. Large-scale national studies are needed to map HPV genotypes in order to make appropriate decisions for cervical cancer control.

Keywords: Epidemiology; Prevention; Cervical cancer; HPV; Burkina Faso.

Abbreviations

HPV: Human Papillomavirus
CC: Cervical Cancer
GLOBOCAN: Global Cancer Observatory
HR-HPV: High Risk Human Papillomavirus
LR-HPV: Low risk Human Papillomavirus
WHO: World Health Organization
PCR: Polymerase chain reaction
VIA/VILI: visual inspection with acetic acid or visual inspection with Lugol iodine
HIV: Human Immunodeficiency Virus
CIN: Cervical intraepithelial neoplasia
KAP: Knowledge, Attitudes and Practices

Introduction

Human Papillomavirus (HPV) is the world's most common sexually transmitted infection[1]. Today there are more than 200 HPV genotypes, with over 120 genotypes identified and sequenced[2]. Depending on their oncogenic potential, they are divided into two groups: high-risk oncogenic HPV (HR-HPV) and low-risk oncogenic HPV (LR-HPV). They are responsible for several infections of the epithelium of the anogenital tract and other mucous membranes, and are also involved in a variety of cancers, including vaginal, penile, vulvar, anal, and oropharyngeal cancers. Low Risk HPV such as HPV 6 and 11 are responsible for condylomatous lesions (warts) of the anogenital tract and laryngeal papillomatosis, most common benign tumor of the larynx[3]. Cervical cancer is an infectious pathology of the cervical mucosa[4]. In approximately 99% of cervical cancer cases, women have been exposed to HPV[5]. Several studies have shown that worldwide, HPV genotypes 16, 18, 31, 33, 35, 45, 52 and 58 are the most common among women with precancerous lesions and cervical cancer[6–8]. Some low-grade precancerous lesions induced by specific HPV genotypes have the potential to develop into cervical cancer if left untreated[9]. It is the fourth most common cancer in women worldwide, after breast, colorectal and lung cancers[10]. It is one of the world's major public health problems. In 2018, the World Health Organization (WHO) estimated that over 311000 women had died of cervical cancer and around 570000 new cases recorded worldwide. Around 85% of these deaths occurred in low- and middle-income countries[11]. Women in sub-Saharan Africa show the highest prevalence[12], which appears to be rising steadily[13].

According to the WHO, cervical cancer will kill more than 443,000 women a year worldwide by 2030, nearly 90% of them in sub-Saharan Africa[13]. According to GLOBOCAN, since 2020, cervical cancer has been the second leading cancer in terms of incidence and mortality in women in Burkina Faso, with 988 new cases and 775 deaths, as of 2022. For a more effective prevention of HPV infections, persistent HPV disease and cervical cancer, HPV vaccination is widely recommended[14,15]. The WHO estimates that HPV vaccination significantly reduces cervical cancer morbidity and mortality. However, epidemiological data on HPV and cervical cancer from sub-Saharan African countries are necessary for the choice of available vaccines, as the distribution of HPV genotypes varies from one country to another[9,14], with more genotype diversity in African countries[16]. The three licensed HPV prophylactic vaccines available are genotype-specific. In fact, the bivalent Gardasil (genotypes 16/18), the quadrivalent Cervarix (genotypes 6/11/16/18) and the nonavalent Gardasil 9 (6/11/16/18/31/33/45/52/58) have been shown to be safe and effective for primary prevention of the targeted genotypes[17].

In Burkina Faso, since April 26, 2022, the quadrivalent human papillomavirus vaccine has been included in the vaccination schedule of the Expanded Program on Immunization to combat cervical cancer. However, are the genotypes identified in the general female population, in populations at high risk of HPV infection, in high-grade precancerous lesions and invasive cervical cancers predominantly covered by the vaccine available in the vaccination program? A systematic review of the epidemiology of human papillomavirus infection and cervical cancer in sexually active women in Burkina Faso therefore seems necessary to make better decisions on the control of HPV infections and cervical cancer, which carries a heavy burden in Burkina Faso. The aim of this review was to examine the epidemiological profile of HPV and the prevention of cervical cancer in sexually active women in Burkina Faso.

Methods

STUDY DESIGN

This study was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyse method (PRISMA)[18]. Research results and the number of articles included and excluded are presented in Figure 1.

INFORMATION SOURCES AND RESEARCH STRATEGIES

We conducted a systematic literature review to identify relevant publications reporting on the epidemiology of human papillomavirus (HPV) infections and cervical cancer, as well as their prevention among sexually active women in Burkina Faso. Original studies in French and/or English were extracted from the PubMed/Medline, Google Scholar, semanticscholar, Hinari and Science Direct databases, using appropriate terms. The records identified have been downloaded in an appropriate format and linked to the zotero software. Boolean operators “AND” and “OR” were used to link mesh terms and to retrieve publications from PubMed/Medline (NCBI) databases. The keywords used were “Epidemiology OR prevention AND human papillomavirus OR cervical cancer” + “country name or country cities”. The crude prevalence of HPV infection was calculated based on the crude data available in the eligible studies.

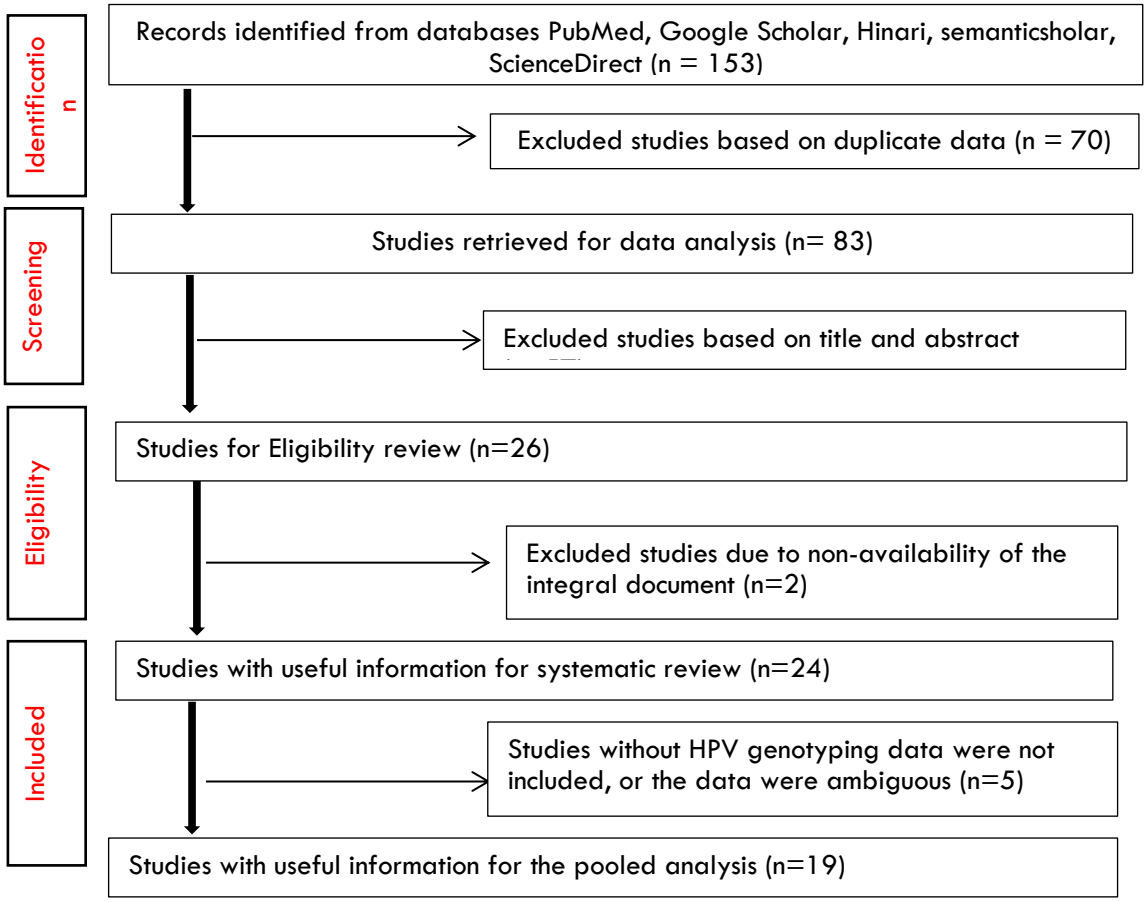


Figure 1. PRISMA diagram showing research strategy for the inclusion of published studies

ELIGIBILITY CRITERIA AND STUDY SELECTION PROCEDURE

After searching through the databases, the studies were then selected on the basis of the following criteria: data are published in a peer-reviewed scientific journal; articles are complete and available; articles relate only to patients residing in Burkina Faso; patients consulted for gynecological problems or participated in a cervical cancer screening campaign; cervical histology results are confirmed for patients with cervical cancer or precancerous lesions; HPV prevalence is calculated with at least five genotypes identified.

The articles selected for analysis will be used to determine the prevalence and genotypic distribution of oncogenic HPV in sexually active women in some of the regions of the country. The HPV molecular diagnostic techniques selected were those based on molecular biology techniques, in particular polymerase chain reaction (PCR) and hybrid capture. HPV genotype classification was also considered. In addition, we systematically excluded journal articles, correspondences to editors, press releases, letters, book chapters, publications in languages other than English/French, and studies whose data were ambiguous or could not be extracted. We considered HIV-negative and HIV-positive populations, sex workers, articles on the epidemiology and prevention of HPV and cervical cancer.

To get a true overview of circulating genotypes in Burkina Faso, HPV genotyping studies carried out on HPV-positive populations were selected. Studies on both Burkinabé and other female populations were included, but only data relating to the Burkinabé population were considered in this study. Articles addressing other sexually transmitted pathologies in addition to HPV in the case of cervical cancer were included in this systematic review. However, articles from the Knowledge, Attitude and Practice surveys on health workers were excluded from this study. For pooled analyses, we considered the total number of HPV-diagnosed samples to be the size of our study population.

DATA EXTRACTION AND ANALYSIS

The data were extracted from various studies carried out in the regions of Burkina Faso for systematic examination. For the articles included in this review, the variables extracted were, study population and study setting, type of study or data collection (cross-sectional, prospective or retrospective) and method of detection. In addition, the overall crude prevalence of HPV infection was determined as the ratio of the total number of women tested positive for at least one HPV to the total number of samples tested, expressed as a percentage. The frequency of HPV genotypes was calculated as the ratio of the genotype of interest to the total number of genotypes identified, taking into account single, multiple and undetermined genotypes. IBM SPSS Statistic 26 and Excel 2016 were used for frequency calculations and graphing.

Results

SELECTION OF STUDIES FOR REVIEW

In our study, a total of 153 articles were extracted from the databases, and for the systematic review, 26 full-text articles were included. According to our inclusion criteria, 24 scientific studies on epidemiological studies of HPV and cervical cancer prevention in sexually active women

conducted in 3 regions of Burkina Faso, including 19 articles on HPV genotyping and 5 articles on cervical cancer screening, knowledge, attitudes, and practices, were selected (Table 1).

Table 1. Overview of original articles selected for the systematic review study

Population	Reference	Region (cities)	Area of interest	Average age (age range)	Size	HPV Prevalence %)
SA	Kabre et *al* [19]	Centre (Ouagadougou)	HPV genotyping	28.2 (18 - 40)	100	23
HIV+/HIV-	Djigma et *al* [20]	Centre (Ouagadougou)	HPV genotyping	33.91 (20 - 53)	421	34.4
SA	Ouedraogo et *al* [21]	Centre (Ouagadougou)	HPV genotyping	31 (15 - 63)	300	43
SA	Salambanga et *al* [22]	Centre (Ouagadougou)	HPV genotyping	34.7 (18-57)	234	52.56
HIV-/HIV+	Djigma et *al* [23]	Centre (Ouagadougou)	HPV genotyping	34.1 (20 - 54)	250	59.6
SA/HIV+	Zohoncon et *al* [24]	Centre (Ouagadougou)	HPV genotyping	33.7 (20-53)	180	73.33
SA	Ouedraogo et *al* [25]	Centre-Est (Tenkodogo)	HPV genotyping	35.5 (20 - 60)	131	34.4
SA	Ouedraogo et *al* [26]	Centre-Est (Garango)	HPV genotyping	39.2	135	43
SA	Ouedraogo et *al* [27]	Centre, Centre-Est, Hauts-Bassins	HPV genotyping	28.02 (15 - 57) 37.37 (20 - 60) 33.14 (16 – 76)	520 266 535	35.42
SA	Sawadogo et *al* [28]	Centre (Ouagadougou)	KAP	29.37 (20-50)	840	-
SA	Compaore et *al* [29]	Centre (Ouagadougou)	CC screening & KAP	37.5 (18 - 72)	351	-
SA	Kagoné et *al* [30]	Hauts-Bassins (Bobo-Dioulasso, Bama)	CC screening & KAP	34.9 (18 - 60)	577	-
SA	Tassembedo et *al* [31]	Centre-Nord (Boussé)	CC screening & KAP	34 IQR (30-50)	418	-
SA	Diendéré et *al* [32]	National	CC screening & KAP	37.5 (25 - 49)	2293	-
SA	Traore et *al* [33]	Hauts-Bassins (Bobo-Dioulasso)	CC screening & HPV genotyping	35.3 (20-56)	181	25.4
SA	Ouattara et *al* [34]	Hauts-Bassins (Bobo-Dioulasso)	CC screening & HPV genotyping	30.7 (19 - 51)	234	20.6
SA/SW	Tovo et *al* [35]	Centre (Ouagadougou)	HPV genotyping	27.12 (17 - 50)	182	54.94
SA/SW	Ilboudo et *al* [36]	Centre (Ouagadougou)	HPV genotyping	27.3 (16 – 50)	200	53
SA/CC	Ouédraogo et *al* [37]	Centre (Ouagadougou)	HPV genotyping	41.5 (22 - 74)	43	48.8
SA/CC	Zohoncon et *al* [38]	Centre (Ouagadougou)	HPV genotyping	46.32 (21-84)	65	72.31
SA CC	Maria et *al* [1]	Centre (Ouagadougou)	HPV genotyping	41.3 (19 -76) 42.3 (24 – 70)	444 39	42.3 87.2
SA/HBV/HCV	Ouédraogo et *al* [39]	Centre (Ouagadougou)	HPV genotyping	37.8 (20 - 65)	100	28
SA/HIV+	Chikandiwa et *al* [40]	Centre (Ouagadougou)	HPV genotyping	36 (IQR, 31–42)	594	27.1
SA/HIV+/SW	Didelot-Rousseau et *al* [41]	Hauts-Bassins (Bobo-Dioulasso)	CC screening & HPV genotyping	28 (16 – 54)	360	66.1
Total	**24 studies**	**3 Regions**	-	-	**9993**	**-**

Legend: SA: sexually active women; HIV+/- : HIV seropositive or seronegative; HCV: Hepatitis C virus; HBV: Hepatitis B virus; SW : sex workers; CC: Cervical Cancer; KAP: knowledge, attitudes and practices.

A total of 9993 participants from the sexually active female population were included for data extraction.

CHARACTERISTICS OF INCLUDED STUDIES

Studies included in this systematic review provided data from the Burkinabe population and met our selection criteria. Table 4 shows that among 5480 sexually active women in the general population, 2232 were infected with at least one of the HR-HPV (16/18/31/33/35/39/45/51/52/56/59/66/68/82) and/or LR-HPV (6/11/40/41/42/43/44/55/54/61/62/82/67/69/71/70/72/73/74/84) genotypes. Of the 24 scientific studies included in the review, 19 had information on the genotypic distribution of HPV and were therefore, eligible for pooled analysis. Multiple infections with at least two specific HPV types were reported in the majority of studies.

EPIDEMIOLOGY OF HUMAN PAPILLOMAVIRUS INFECTION

Prevalence of Human Papillomavirus infection in Burkina Faso

This systematic review reports on the prevalence and distribution of HPV genotypes among sexually active women in Burkina Faso. The analysis of selected studies shows that the prevalence of HPV infections is very high in the general population of women in this low-income country.

HPV prevalence varied according to population type and locality in Burkina Faso. In the sexually active female population with unknown risk of HPV infection, it ranged from 20.6% to 52.56% in the studies included in this review.

Among the studies analyzed, 11 involved HIV-positive women, cases of high-grade precancerous lesions (CIN1/2/3) or cervical cancer, sex workers and HBV/HCV-positive women, thus representing populations at high risk of HPV infection. Indeed, these studies reported that the maximum prevalence of HPV in this at-risk population was 87.2%, 66.1%, 97.59%, 28% respectively in confirmed cases of precancerous lesions or cervical cancer, sex workers, HIV-positive women, and those with hepatitis B and/or C (Table 2).

Table 2. Overview of original articles on Human Papillomavirus infection in sexually active women

Study population	Reference	Region	Prevalence (HPV /Size)	HR-HPV	LR-HPV	Unspecified	Single genotype	Multiple genotypes	Nine most frequent HR-HPV genotypes, in descending order
Population of women with unknown history of HPV infection									
SA	Ouedraogo et *al*[21]	Centre	24.33 % (73/300)	53	20	45	64	9	50'S/18/16/30'S/45
SA	Salambanga et *al*[22]	Centre	52.56 % (123/234)	123	-	0	58	65	59/66/56/45/58/39/51/68/52
SA	Ouedraogo et *al*[25]	Centre-Est	34.4 % (45/131)	45	-	0	25	20	56/66/68/51/18/31/35/52/58
SA	Ouedraogo et *al*[26]	Centre-Est	43 % (58/135)	58	-	0	49	9	56/18/68/66/59/58/35/52/51
SA	Ouedraogo et *al*[27]	Centre Centre-Est Hauts-Bassins	35.42 % (468/1321)	225 103 140	- - -	0 0 0	116 74 108	109 29 32	56/52/66/59/39/51/18/35/68
SA	Traore et *al* [33]	Hauts-Bassins	25.4 % (46/181)	46	-	0	39	7	39/52/18/35/31/68/66/45/51
SA	Ouattara et *al* [34]	Hauts-Bassins	20.6 % (48/234)	48	-	0	39	9	52/66/68/39/51/18/31/35/56
SA	Kabre et *al* [19]	Centre	23 % (23/100)	16	13	2	12	9	18/35/31/52/58/56/45/59/33
SA	Maria *et al* [1]	Centre	42.3% (188/444)	127	108	0	96	92	16/52/18/35/59/66/68/39/53
SA	Djigma et *al*[20]	Centre	24.8% (59/238)	59	12	0	38	21	18/52/58/35/16/31/56
SA	Zohoncon et *al* [24]	Centre	30.2 (19/63)	19	-	0	9	10	52/18/31/35/45/51/39/56/58
Total 1			**34.01 (1150/3381)**	**1062**	**153**	**47**	**727**	**421**	**-**
Population of women at high risk of HPV infection									
HIV+	Djigma et *al* [20]	Centre	59.6 % (149/250)	124	25	119	102	47	18/50'S/30'S/16/45
SA/ HIV+	Djigma et *al* [23]	Centre	63.9 % (117/183)	117	6	0	44	73	18/35/31/52/58/56/45
SA/HIV+	Chikandiwa et *al*[40]	Centre	27.1 % (161/594)	-	161	0	127	34	Only low-risk HPV
SW	Didelot-Rousseau *et al* [41]	Hauts-Bassins	66.1 % (238 /360)	178	53	-	112	126	52/58/35/51/16/31/18/68/39
SW	Tovo et *al* [35]	Centre	54.94 % (100/182)	100	-	0	-	-	68/31/51/52/56/35/66/58/45
SW	Ilboudo et *al*[36]	Centre	53 % (106/200)	106	-	0	49	57	68/31/52/51/56/66/58/35/39
CU	Zohoncon et *al* [38]	Centre	72.30 % (47/65)	47	-	0	31	16	18/31/39/45/16/35/58/52/51
CIN2/3	Ouédraogo et *al*[37]	Centre	48.8 % (21/43)	21	-	0	19	2	39/35/45/33/51/52/56/18/31
HIV+	Zohoncon et *al*[24]	Centre	97.59% (81/83)	**81**	**-**	**0**	**8**	**73**	35/18/31/52/56/58/59/51/33/45/16
CIN	Maria *et al* [1]	Centre	87.2% (34/39)	30	5	0	14	20	52/18/35/59/66/68/39/53
SA/ VHB/ VHC	Ouédraogo et *al*[39]	Centre	28 % (28/100)	18	21	0	13	15	52/18/68/16/31/82/56/66/58
Total 2			**51.55%(1082/2099)**	**822**	**271**	**119**	**519**	**463**	**-**
Total 1 and 2			**40.73%(2232/5480)**	**1884**	**424**	**166**	**1246**	**884**	**18/52/56/35/31/58/66/59/51**

Legend: SA: sexually active women; HIV+/-: seropositive or seronegative HIV; SW: sex workers; CC: cervical cancer; CIN: Cervical intraepithelial neoplasia.

The pooled analysis reported that the overall prevalence of HPV in these different at-risk populations was 69.39%, 59.84%, 45.77%, 28% respectively in confirmed cases of precancerous lesions or cervical cancer, sex workers, HIV-positive women, and HBV/HCV-positive women. This prevalence was 34.01% for the population with unknown high risk of HPV infection (Figure 2).

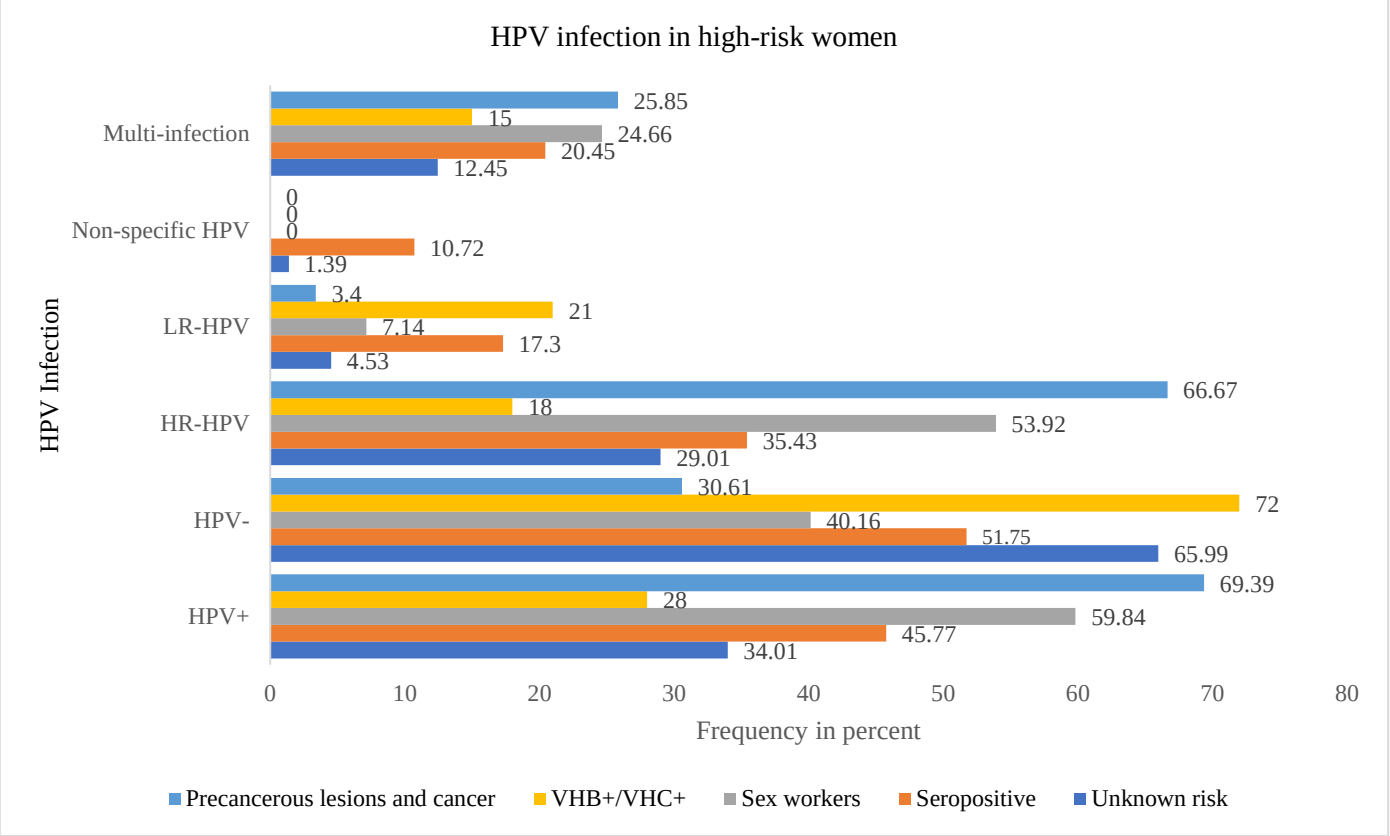


Figure 2. Human Papillomavirus infections in high-risk women

From the pooled analysis of data extracted from eligible studies, only three regions benefited from the HPV epidemiological studies, with the majority conducted in the "Centre" region. Indeed, among the 5480 participants, 3647 were from the "Centre" region, 1201 from the "Hauts-Bassins" region and 532 from the "Centre-Est" region. HPV prevalence reached 40.72% (2232/5480) in the general female population, 51.55% (1082/2099) in the population at high risk of HPV infection, and 34.01% (1150/3381) in the female population with unknown history of HPV risk. In addition, among HPV-infected women, single and multiple infections were 55.82% (1246/2232) and 39.60% (884/2232) respectively, versus 7.44% (166/2232) of unspecified HPV infections.

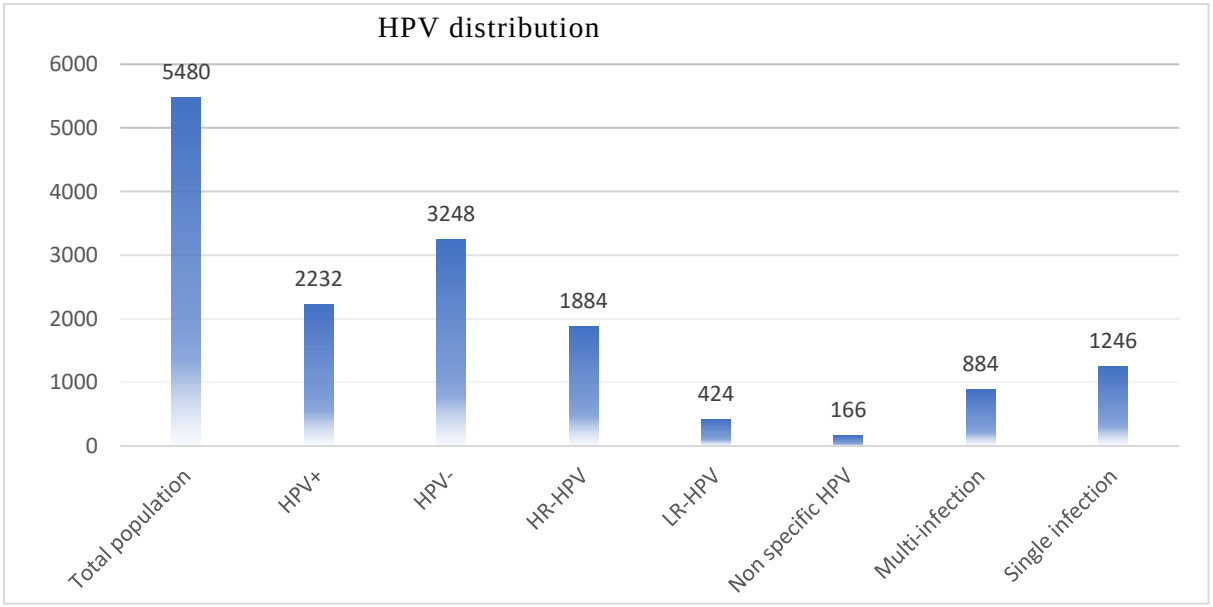


Figure 3. Overall population distribution by Human Papillomavirus status

Figure 4 shows the distribution of the female population according to HPV status by region.

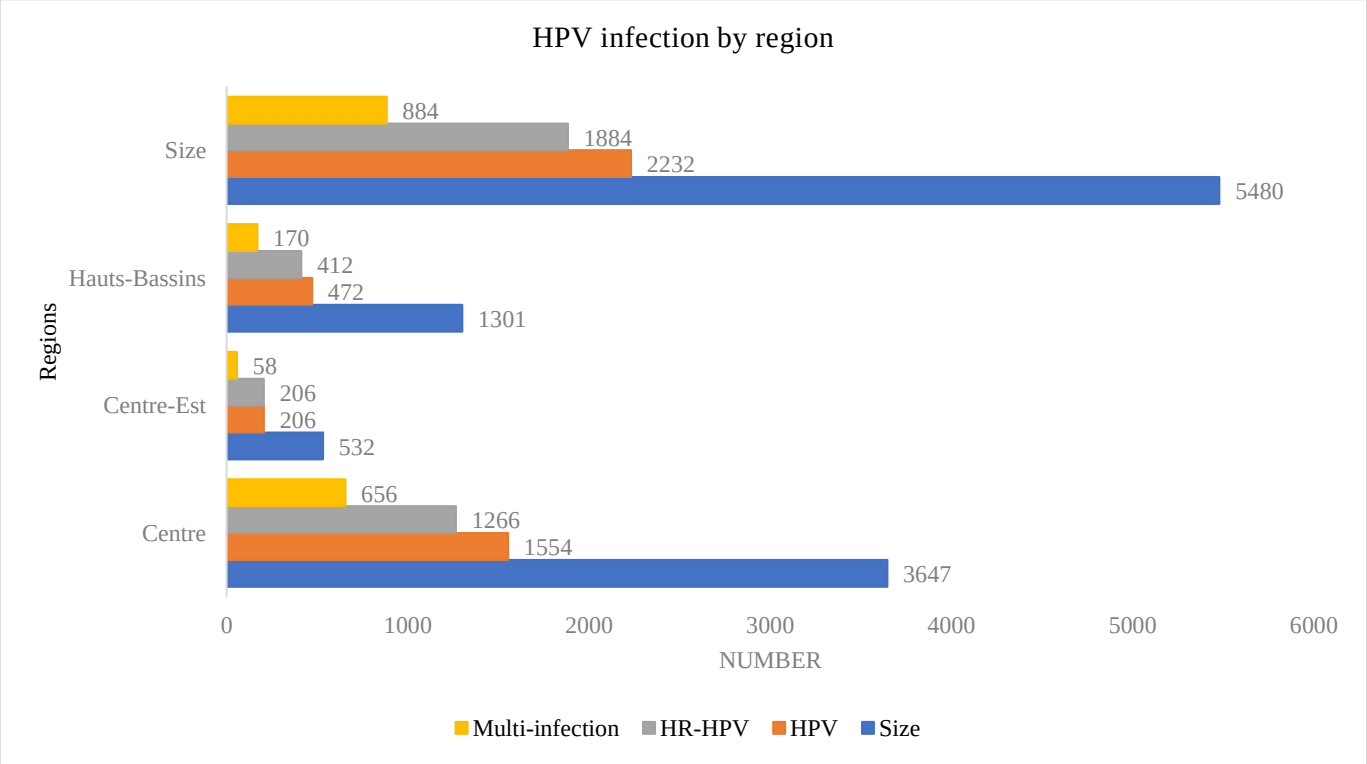


Figure 4. Distribution of women by HPV status and regions

Human Papillomavirus genotype distribution

The studies included in this review showed that the predominance of HPV genotypes in women was a population-based and locality-based variable (Table 2). In fact, several high-risk and low-risk oncogenic HPV genotypes were found in the pooled analysis of 19 studies (Table 3). Among the genotypes, the most frequent HR-HPV were HPV 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68 and the most frequent LR-HPV were HPV 6, 11, 43, 44/55, 54, 69/71, 70 (Table 3). Considering the three most predominant genotypes in the population at high risk of HPV infection, the studies show, in order of respective presence, HPV 18; 31; 52/35/68; 39; 45; 16 (Table 2).

Table 3. Prevalence of HPV genotypes in sexually active women based on collective analysis

HR-HPV	**Number (%)**	**LR-HPV**	**Number (%)**
HPV 16	153 (6.85)	HPV 6	101 (4.52)
HPV 18	**308 (13.80)**	HPV 11	11 (0.49)
HPV 31	**195 (8.74)**	HPV 40	10 (0.45)
HPV 33	74 (3.31)	HPV 42	4 (0.17)
HPV 35	**230 (10.30)**	HPV 43	17 (0.76)
HPV 39	153 (6.85)	HPV 44/55	56 (2.50)
HPV 41	2 (0.09)	HPV 54	29 (1.30)
HPV 45	146 (6.54)	HPV 61	3 (0.13)
HPV 51	**173 (7.75)**	HPV 62/81	14 (0.63)
HPV 52	**298 (13.35)**	HPV 67	11 (0.49)
HPV 53	36 (1.61)	HPV 69/71	25 (1.12)
HPV 56	**280 (12.54)**	HPV 70	26 (1.16)
HPV 58	**182 (8.15)**	HPV 72	4 (0.18)
HPV 59	**175 (7.84)**	HPV 74	37 (1.66)
HPV 66	**182 (8.15)**	HPV 84	1 (0.04)
HPV 68	134 (6.00)	**Total**	**349**
HPV 82	19 (0.85)		
Total	**2740**		

Risk factors associated with Human Papillomavirus infections

Several risk factors favoring HPV infections have been described worldwide. In Burkina Faso, HIV/AIDS, age, multiparity, residence, early age at 1st sex, use of oral contraception, condom use, level of education, number of sexual partners, etc., have been described as risk factors for HPV infection by the eligible studies included in this systematic review (Table 4).

Table 4. Overview of risk factors for HPV infection according to the studies selected

Article	Size	HPV infection risk factors (p-value)
Ouedraogo et *al* [27]	1321	- Level of education (0.002) - Marital status (0.001) - Occupation (< 0.001) - Number of sexual partner (0.003) - Frequency of intercourse (<0.001)
Salambanga et *al* [22]	234	- Age (0.037) - Sexual practices (0.001)
Ouédraogo et *al* [39]	100	- Education level (0.010) - Parity (0.006) - HIV status (0.002)
Maria et *al* [1]	410	- Place of birth (0.005) - Single (0.026) - Age at first sex < 20 years (0.001)
Kabre et *al* [19]	100	- Number of sexual partners (0.04)
Ouedraogo et *al* [26]	135	- Age at first sex (0.003) - Number of sexual partners (< 0.001) - Condom use (0.001)
Ilboudo et *al* [36]		- Level of education (0.019) - Number of sexual partners (< 0.001) - Condom use (< 0.001)

EPIDEMIOLOGY OF CERVICAL CANCER

Prevalence, incidence, mortality and morbidity

For more than a decade, cervical cancer has been a major public health problem in Burkina Faso, despite the efforts made to prevent it. According to GLOBOCAN, since 2008 the crude incidence rate per 100,000 people has fluctuated between 15 and 26, and the crude morbidity rate per 100,000 people between 11 and 21 (Table 5).

Table 5. Summary of GLOBOCAN incidence and morbidity rates over time

Year	Incidence		Morbidity	
	Number of cases	Crude rate/100000	No. of deaths	Crude rate/100000
2008	1230	16.1	838	11.0
2018	2517	25.4	2081	21.0
2020	1132		839	
2022	988	15.9	775	13.0

Influence of Human Papillomavirus infection and Human Papillomavirus genotype distribution on the occurrence of cervical cancer in Burkina Faso

According to the pooled analyses in this study, around 70% of women with precancerous lesions and cervical cancer are infected with at least one HPV genotype, and around 67% are infected with at least one high-risk oncogenic HPV genotype (Figure 5).

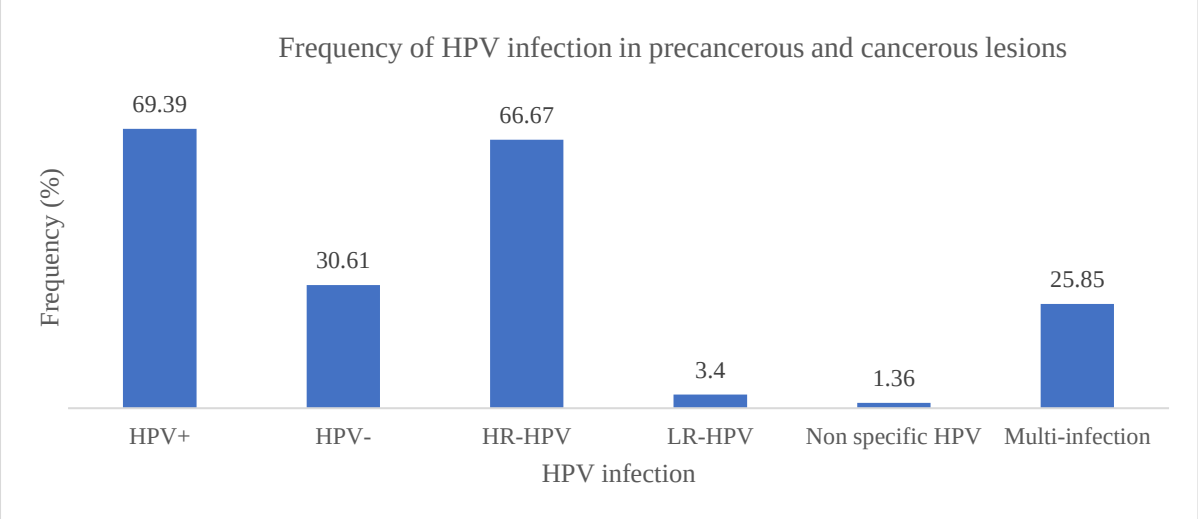


Figure 5. Frequency in percentage of Human Papillomavirus infection in precancerous lesions and cervical cancer

Among the high-risk oncogenic genotypes, HPV18, HPV16, HPV35 and HPV39 are the most frequent, with prevalence rates of 25.49%, 20.59% and 13.72% respectively (Figure 6). The predominant genotypes in these cases of cancer, precancerous lesions and the population at high risk of infection in general, testify to the importance of a nonavalent vaccine that will include HPV-6/11/16/18/31/33/45/52/58.

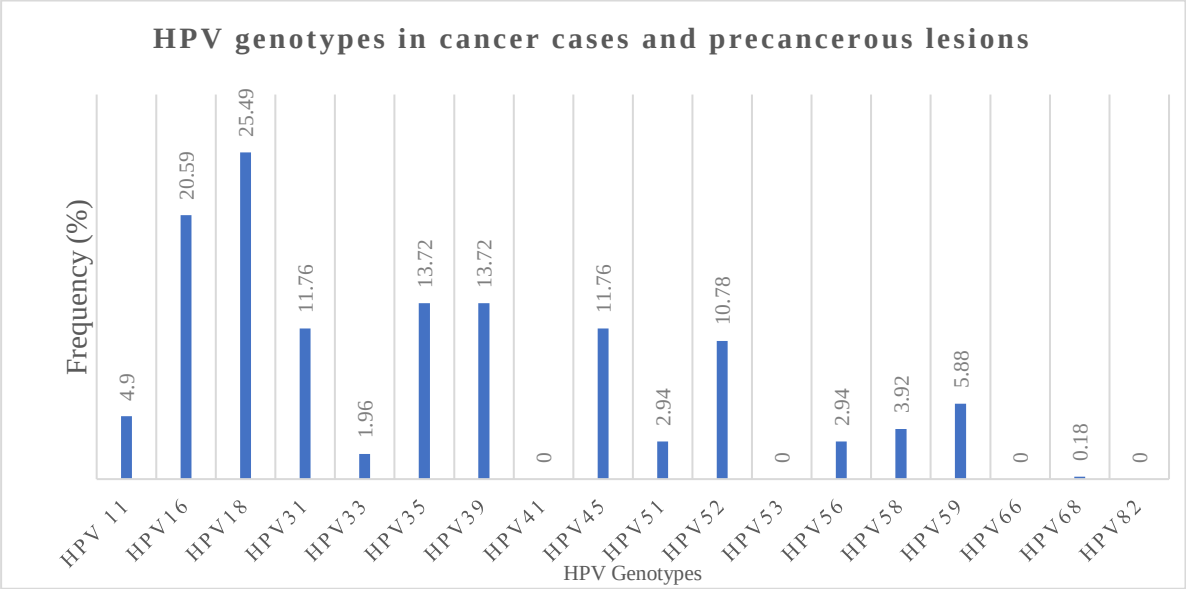


Figure 6. Human Papillomavirus genotypes in cancer cases and precancerous lesions

PREVENTION OF HUMAN PAPILLOMAVIRUS INFECTION AND CERVICAL CANCER

Risk factors associated with cervical cancer

In addition to persistent infection with high-risk oncogenic HPV genotypes, considered to be the main cause of precancerous lesions and cervical cancer, several risk factors were associated. According to the articles included in this review, these were HIV serology, age, knowledge of risk factors and parity (Table 6).

Screening and Knowledge, attitudes and practices on cervical cancer in Burkina Faso

The knowledge, attitudes and practices of sexually active women towards Cervical cancer remain major prevention factors. In fact, the studies selected for this review revealed a low level of cervical cancer knowledge. Most women are still unaware of preventive measures, and less than 10% of women in the various targeted studies were screened.

Screening detects pre-cancerous lesions, which represent the sub-clinical or asymptomatic stage of the disease, and which, if untreated, can progress to cancer. Its aim is to identify individuals with a high probability of contracting or developing the disease. In low-income countries, screening by visual inspection with acetic acid and Lugol's iodine (VIA/VILI) is recommended by the WHO in addition to cervical smear. With this technique, the frequency of detection of precancerous lesions varies from 1.5% to 24% across the studies included. With a low screening rate as previously suggested, several factors such as level of education, age and residence were associated with screening, according to the studies examined. Like HPV infection, several factors are thought to be associated with the development of cervical cancer in women (Table 6).

Table 6. Screening and knowledge, attitudes and practices for cervical cancer in women in Burkina Faso

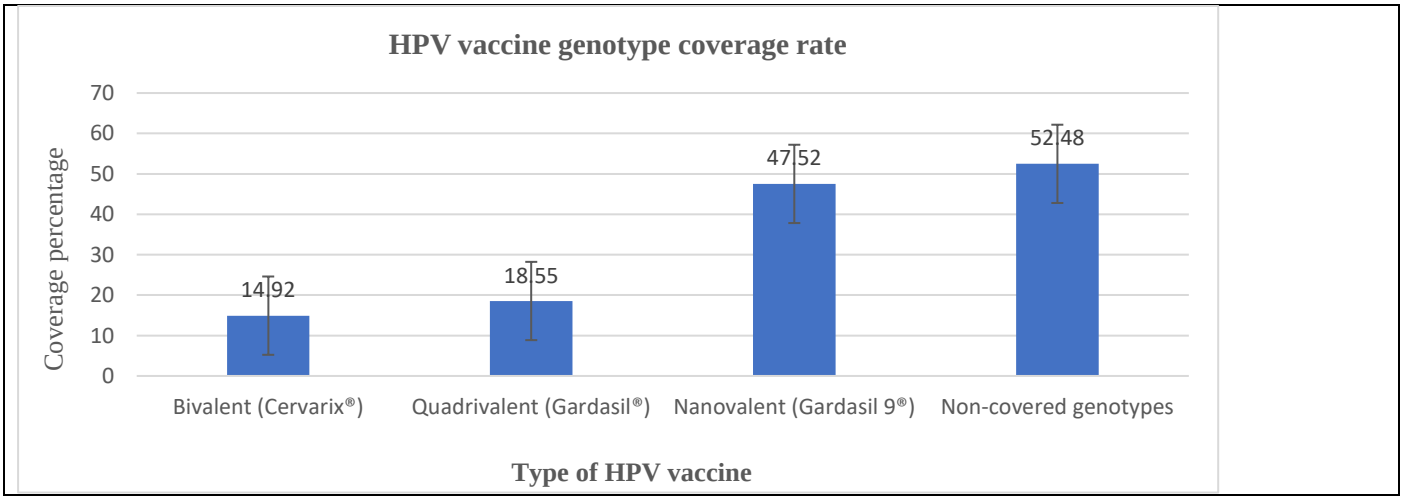
Article	**Size**	**Risk factors associated with precancerous lesions and cervical cancer (p-value)**		
Kagoné et *al* [30]	*577*	- Age (0.0005) - Parity (0.0442)		
Ouédraogo et *al* [37]	43	- HPV status (< 0.001)		
Didelot-Rousseau et *al*[41]	379	- Age (0.001) - HR-HPV types (0.002) - HIV-1 serology (< 0.001)		
Sawadogo et *al* [28]	840	- Think at risk of cervical cancer (0,02) - Family history of cervical cancer (0.002) - History of STI (0.01) - Heard about HPV (0.02)		
Screening and related factors				
Article	***Size***	***Technic***	***Lesion frequency***	***Screening-related factors***
Compaore et *al* [29]	351	-	-	-Education (<0.001) -Age (<0.001) -Residence (0.005) -Employment (0.004) -Motivation by a healthcare professional (0.041)
Kagoné et *al* [30]	*577*	VIA	15.42%	-
Tassembedo et *al* [31]	418	VIA/VILI	5%	-
Ouedraogo et *al* [27]	1321	VIA/VILI	4.39%	-
Didelot-Rousseau et *al* [41]	379	Cervical smear	24,0 %	-
Diendéré et *al* [32]	2293	-	-	- Geographic Regions (0.0001) - Residency (0.035)

Article	Size	Risk factors associated with precancerous lesions and cervical cancer (p-value)		
				- Marital status (0.035) - Education (0.0001) - Occupation (0.0001)
Traore et *al* [33]	181	VIA/VILI	5% (9/179)	-
Ouattara et *al* [34]	234	VIA/VILI	7% (16/234)	-
Ouedraogo et *al* [25]	131	VIA/VILI	1.5% (2/131)	-
knowledge, attitudes and practices on cervical cancer				
Article	***Size***	***knowledge, attitudes and practices (frequencies in %)***		
Kagoné et *al* [30]	577	- Heard about cervical cancer (49%) - Knows at least one preventive measure (35%) - Already screened (8.8%)		
Sawadogo et *al* [28]	840	- Knowledge of CC (64.2%) - Knowledge of HPV (8,5%) - CC Prevention (30.95%) - Contamination mode (19.9%) - Already screened (11.07%)		
Diendéré et *al* [32]	2293	- Already screened (6.2%)		

Legend: STI: Sexually Transmitted Infections; CC: cervical cancer; KAP: knowledge, attitudes and practices

Genotypic coverage of Human Papillomavirus vaccines in Burkina Faso

HPV vaccination remains one of the most effective methods of primary prevention of cervical cancer. The genotypic coverage rate of HPV vaccines is a factor that guides the choice of vaccine among the three licensed vaccines available on the market. Based on a pooled analysis of the studies collected, Figure 7 shows the genotype coverage rate of the three vaccines. The nonavalent vaccine Gardasil 9 covers 47.52% of the genotypes reported in this review. The overall number of genotypes not covered by available vaccines is 52.48%.



HPV vaccine name	HPV genotypes covered	Frequency of coverage in the general population n (%)
Bivalent (Cervarix)	16/18	461 (08.41%)
Quadrivalent (Gardasil)	6/11/16/18	573 (10.45%)
Nonavalent (Gardasil 9)	6/11/16/18/31/33/45/52/58	1468 (26.79%)
HR-HPV genotypes not covered by vaccines	35/39/41/49/51/53/56/59/66/68/82	1621 (29.58%)

Figure 7. Genotype coverage of Human Papillomavirus vaccines in the general population

Discussion

In Burkina Faso, initiatives are underway to combat cervical cancer. However, up-to-date epidemiological data on HPV and cervical cancer are needed to assess the potential impact of these initiatives on cervical cancer prevention, and to identify effective strategies.

Based on 24 studies, this systematic review highlights the epidemiological profile of HPV and the prevention of cervical cancer among sexually active women in Burkina Faso.

This study shows poor coverage of epidemiological data on HPV and cervical cancer. Only studies from three of the 13 regions in Burkina Faso were included in this review. The majority of studies were carried out in the "Centre" region, more precisely in the city of Ouagadougou. Despite this low coverage, we noted a high prevalence of HPV and a varied distribution, both genotypically and geographically in the regions, covered by the study. This prevalence varied from 20.6 to 97.59%, depending on the type of population. It was close to the results of other studies, which reported 8.9% and 81.8% in women from the general West African population[3] and 10.7 to 97.2% in women from sub-Saharan Africa[16]. It was high among women living with HIV, cervical cancer, sex workers and women infected with the hepatitis virus, with respective prevalences of 45.77%, 69.39%, 59.84% and 28%. Like all sexually transmitted infections (STIs), sex workers are exposed to

the HPV infection. With high unemployment, sex work remains a common practice in our countries, and it is not without risks, as it is a key factor in the high rate of STIs in sub-Saharan African countries. Studies on HPV prevention among sex workers in African countries reveal a much higher rate than ours[42–45]. This could be explained by the number of daily clients, the means of protection used by these sex workers, and also by the technique used for HPV genotyping in the various studies.

Immunodepression due to HIV infection is a major public health problem. However, according to UNAIDS, women and girls account for the majority of new HIV infections. Women living with HIV have a higher prevalence of genital high-risk oncogenic HPV (HR-HPV) infection than those in the general population[46]. They are more likely to be infected with several types of HR-HPV and have greater persistence of infection[47]. Nweke *et al* in 2013, Yakub *et al* in 2019 and Zinzendorf *et al* in 2022 reported a prevalence closer to our results[48–50] and Mkunde et al in 2023 recorded a prevalence of 50.9%, similar to our results [51]. In contrast, studies by Nyasenu et al. in 2019 recorded a prevalence of 22.2%[52]. This apparently reduced prevalence could be explained by the effectiveness of antiretroviral treatment and the competition among the viruses mentioned in some studies[53,54].

Cervical cancer and CIN2/3 precancerous lesions are mostly caused by HR-HPV. The prevalence recorded in the present review was close to the 75.3% reported by Kelly et al. in 2017 in Burkina Faso[46]. Human Papillomavirus prevalence among women with unknown risk factors for HPV infection, based on collective analysis of data from the three regions of Burkina Faso, was 34.01%. These results corroborate those of Mkunde et al in 2023 who recorded 38.1%, 34% recorded by Seyoum *et al* in sub-Saharan Africa[16], and the 33.6% by Ouedraogo et al. in West Africa[3]. For women in the general population of Burkina Faso, the pooled analysis shows an overall prevalence of 40.73%. This result is significantly higher than that of Ouédraogo *et al*. who recorded a prevalence of 28.6% in West Africa, and closer to that of Ogembo *et al*. who reported a prevalence of 50.5% in 2015 in a meta-analysis in Africa[55]. This variation in the prevalence of HPV infection could be explained by the difference in sample sizes and also the inclusion of cases of precancerous lesions, cervical cancer and female populations at high risk of HPV infection in some studies.

In this review, the HPV genotypes included were HR-HPV (16/18/31/33/35/39/45/51/52/56/58/59/66/68 /82) and LR-HPV (6/11/43/44,55/54/69,71/70). It showed that the prevalence and distribution of these HPV genotypes in Burkina Faso varied according to region and study population, and 2232 of the 5480 women were infected with at least one of these HPV genotypes. The most frequent high-risk oncogenic genotypes were HPV18/52/56/35/31/58/66/59/51/16/39/45/68 /33/53/82/41 in descending order for the general population. This distribution of HR-HPV genotypes could confirm the observations of Ouedraogo *et al*. in 2023, who reported that the distribution of HR-HPV in West Africa varied from country to country. Seyoum et al. in 2022 reported that HR-HPV genotypes in West African countries were distributed differently from those in Southern and East African countries. Ouedraogo et al. in 2023 explained this difference in distribution by human genetic factors. The second most frequent genotype in this review, HPV52, also attracted the attention of Ouedraogo et al. in 2023, who reported that it was common among the five main genotypes in most of the West African countries included in their study. Unfortunately, it is not included in the licensed quadrivalent cervical cancer vaccine used in Burkina Faso, despite the fact that it has been included in the cases of cervical cancer reported in some African studies[56–58]. Thanks to the support of Technical and Financial partners, the quadrivalent vaccine Gardasil 4 has been integrated into Burkina Faso's Expanded Program on Immunization. This commitment would require particular attention to the coverage rate of the most frequent genotypes in Burkina Faso. Our pooled analysis of studies carried out on HPV-infected women in Burkina Faso revealed that the nine most frequent genotypes were HPV18/52/56/35/31/58/66/59/51. Only HPV18 of the 9 is covered by Gardasil 4, and four genotypes (HPV18/52/31/58) are covered by Gardasil 9.

In this study, the bivalent Cervarix and quadrivalent Gardasil 4 vaccines were poorly covered in infected women. However, 14.92% of genotypes would be protected by Cervarix, 18.55% by quadrivalent Gardasil 4 and 52.48% not covered by the three vaccines. Only Gardasil 9 showed greater genotypic coverage. This low genotypic coverage had been reported in studies in Burkina Faso[1,19,27] and West Africa[3,59] despite the efficacy of these vaccines on the genotypes covered[60]. Despite these vaccines having some cross-protection against other less common HR-HPV types, as reported by some authors[61], our results advocate the introduction of Gardasil 9 vaccine in Burkina as an excellent way to prevent cervical cancer, a silent killer of the female population.

In addition to the primary prevention provided by vaccination in the fight against cervical cancer, other approaches such as secondary prevention and risk factor prevention are key to cervical cancer prevention[62,63]. Most of the time, effective screening programs will detect precancerous lesions[64]. Despite the cost of cervical smear screening, WHO has authorized the detection of lesions by VIA/VILI in developing countries[65]. According to WHO's strategy to eliminate cervical cancer by 2030, screening remains the key factor. In Burkina Faso, VIA/VILI screening is free of charge in health centers. Despite this, WHO estimates that in low-resource countries, only 5% of women are screened for cervical cancer, compared with 40-50% in developed countries[66]. The incidence and mortality of CC in Burkina Faso is still close to the West African average, which remains among the highest in the world[11,67]. Women's level of knowledge, practices and attitudes compromise the Country's efforts in this fight. Indeed, analysis of studies on knowledge, attitudes and practices in this review reveals a low level of knowledge. Less than 60% of women in the various studies are aware of Cervical cancer. This lack of knowledge makes women vulnerable. This finding is in line with previous studies, which have also revealed low

awareness of cervical cancer in African countries[28,64,68–78]. This lack of awareness is at the root of low screening rates in African countries[79,79–81]. According to Chigbu et al. in 2017 in Nigeria, the use of community health educators for door-to-door education on cervical cancer prevention was associated with a significant increase in the uptake of cervical cancer screening and HPV vaccination[82]. According to WHO, community mobilization, health education and counseling are essential elements of an effective cervical cancer control program, as they help to ensure high vaccination coverage, high screening coverage and good treatment compliance. Health education ensures that women, their families and the community at large understand that cervical cancer can be prevented[65].

Given the low level of knowledge about cervical cancer, prevention methods, risk factors and the low screening rate in Burkina Faso, health education about cervical cancer is still needed in sub-Saharan African countries, particularly Burkina Faso. The mapping of oncogenic HPV genotypes and the development of a vaccine covering these genotypes could be a breakthrough in the fight against cervical cancer in Africa.

Study limits

The main objective of this review was to assess the epidemiological profile of HPV and the prevention of cervical cancer in Burkina Faso. It provides important insights into this infection in the female population, but the applicability of its findings is limited. Thus, this study presents limitations such as the diversity of HPV genotyping kits used in the different studies, the number of regions that have been the subject of HPV epidemiological studies with available data (three regions out of the thirteen regions of the country), the non-inclusion of low-risk genotypes in most of our studies included in this systematic review. Studies reporting indeterminate genotypes would also be a limitation for our study.

Conclusion

In Burkina Faso, the fight against cervical cancer remains a major challenge, and HPV infection is a major health problem due to its high prevalence and involvement in the majority of cervical cancer cases. This prevalence varies from one region to another and depends on the type of population. The distribution of oncogenic HPV genotypes responsible for the development of cervical cancer, varies according to the locality and population concerned in Burkina Faso. For more effective prevention of HPV infection and cancer, a large-scale vaccination program with Gardasil 9 would be beneficial. Large-scale national epidemiological studies are needed to determine the risk factors for HPV infections and progression to cervical cancer. In addition, it will be necessary to map HPV genotypes in cases of high-grade precancerous lesions and histologically confirmed cervical cancer, in order to make appropriate decisions for cervical cancer control. Women had insufficient knowledge of risk factors, prevention and screening for cervical cancer, which influenced their attitudes towards adherence to screening. A cervical cancer awareness program should focus on risk factors, prevention methods and the organization of screening campaigns. This information can be used to improve the planning and design of prevention interventions.

Authors' contributions

Conceptualization: PZ and TS. Methodology: PZ, TS, RAO and JS participated in data collection. PZ, TS and RAO reviewed relevant articles; performed cluster analysis; participated in preparation of original project. Writing: PZ.

Revision and editing: PZ, TS, RAO, JS. All authors contributed to data interpretation and discussion and approved the final manuscript.

Pierre Zabré : **PZ** ; Tani Sagna : **TS**, Rogomenoma Alice Ouedraogo : **RAO**, Jacques Simporé : **JS**

Conflict of interest

The authors declare that they have no conflicts of interest.

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