**Prevalence of sexually transmitted infection (STI) history among sexually active youth during Papillomavirus infection in the Republic of Congo**

**Abstract**

Papillomavirus infection is the most widespread Sexually Transmitted Infection (STI) in young girls. The literature reports that in 80% of cases, this STI is eliminated naturally by the body: this is known as viral clearance. However, in the remaining 20% of cases, the infection persists and can lead to cervical cancer 10 or even 30 years after primary infection. This persistence is due to a number of risk factors, including other sexually-transmitted infections (STIs) such as chlamydia, mycoses and so on. So, in the absence of data on HPV, STIs and young people, and with a view to developing a sound policy to combat human papillomavirus infection, we conducted a prospective, analytical study of sexually active young girls living in the Republic of Congo, in general secondary schools in the cities of Pointe-Noire and Brazzaville. Of the 260 girls surveyed, only 198 aged between 15 and 25 had given their approval for the study. The average age of our study was reported to be 19 years. We observed that 64.14% of our study population had early sexual intercourse, with only 33.3% using contraceptive methods. The prevalence of previous STIs was estimated at 64.6%, with mycoses predominating (73.4%), followed by chlamydia (15.6%). There was an association between contraceptive use and STIs (p=0.003). Girls with single or cohabiting parents were 3 to 4 times more likely to contract an STI than those with married parents. Molecular analysis reported a 45.45% prevalence of HPV carriage. We noted that girls whose parents were cohabiting were 3 times more likely to carry HPV than those whose parents were married. There was no association between STI history and HPV carriage. These results underline the importance of practicing IEC with sexually active young girls in order to prevent the risk of exposure to STIs and minimize the contraction of STIs in general and HPV in particular.

**Keywords:** prevalence, STI history, sexually active young people, HPV infection, Republic of Congo

1. **Introduction**

HPV is a small, non-enveloped, double-stranded circular DNA virus belonging to the Papillomaviridae family. More than 200 types have been identified, classified according to their tropism and pathogenicity [1,2]. HPV infection is common, since 80% of women and men are exposed to it during their lifetime. Most of the time, infection is symptom-free and transient. Indeed, in 80% of cases, the immune system eliminates the virus in less than two years, a process known as viral clearance [3,4]. However, in around 20% of cases of high-risk HPV infection, pre-cancerous lesions may develop, which may disappear naturally or progress to cancer after several years. Of the 14 high-risk HPV genotypes (HPV 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66 and 68), the two most common (HPV 16 and 18) are responsible for 71% of cervical cancers worldwide [5-7]. These different types of oncogenic HPV are responsible for over 582,000 new cases of cervical cancer (UCC), causing around 266,000 deaths worldwide every year [8]. In countries with limited resources, cervical cancer is a real public health problem due to a number of risk factors: (i) early sexual debut, (ii) lack of screening policy, (iii) high frequency of sexually transmitted infections, (iv) multiple sexual partners and (v) lack of vaccination policy against oncogenic HPV in young people. It is in these conditions that HPV infection occurs rapidly after first intercourse (3 to 4 years).

In Africa, the prevalence of HPV is high among young people, with carriage between the ages of 20 and 25 [9-11]. In the Republic of Congo, numerous studies show that genotypes 16 and 33 are the most frequently reported, while genotype 18 comes third. However, young people are often exposed to STIs, partly because of the blatant lack of awareness-raising policies, and partly because of the lack of sexual health education programs in educational establishments.

Knowing the impact of STIs in the persistence of HPV infection, we wanted to conduct a study to correlate sexually transmitted infections (STIs), which are caused by bacteria, viruses and parasites, with exposure to HPV infection, in order to prevent exposure to STIs by studying risk factors such as early sexual intercourse, the use of contraceptive methods and many other aspects that may be linked to the sexual health of young girls and their exposure to sexually transmitted infections such as chlamydia, herpes, condyloma and mycosis in a population made up of adolescent girls in secondary school in the Republic of Congo, more specifically in the cities of Brazzaville and Pointe-Noire.

1. **Materials and methods**
   1. **Procedure and study population**

This was a cross-sectional, prospective, analytical study carried out on a population of Congolese girls and women aged between 15 and 24. This population consisted of young high school girls. It was conducted in the Republic of Congo, more specifically in the departments of Brazzaville and Pointe-Noire over a period from December 07, 2019 to September 20, 2021.

* 1. **Data collection**

Participants were interviewed by healthcare professionals consisting of nurses and psychologists, with in-depth knowledge of STIs, cervical cancer, its screening and human papillomaviruses (HPV). Interviews were conducted in French and the country's national languages (Lingala or Kituba). At high school level, teachers were made aware of the need for these health professionals to visit. Girls interested in taking part in the study discussed the objectives with the health professionals. The objectives were well explained to the participants.

The questionnaire was divided into three sections:

1. Socio-demographic characteristics and sexual behavior of the girls;

2. Level of knowledge about HPV;

3. STI-based clinical history of young women.

Information on age, level of education, age of first sexual intercourse, condom use, number of sexual partners and use of contraceptive methods was also collected.

* 1. **Types of sample for molecular analysis**

We collected vaginal samples. A naked-eye inspection of the ano-genital region was performed on the participant in the gynaecological position, using a single-use speculum to appreciate the various aspects of the cervix. Samples were taken by cytobrushing the endocervical canal, turning the cytobrush 3 times to collect the endocervical cells. Samples were stored in a jar containing BD SurePath™ transport solution (Benex Limited, Dun Laoghaire, Ireland) and frozen at 20°C in the refrigerator pending analysis.

* 1. **Molecular analysis**

After returning the samples to room temperature and resuspending them with a vortex, a volume of 1000µl of the suspension was dispensed into ready-to-use cartridges (lot no. 15402 from the manufacturer Céphéid) for each sample. The cartridges were then placed in the GeneXpert 4-module automaton for 60 minutes, in accordance with the manufacturer's instructions, to detect genotypes 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66 and 68.

* 1. **Statistical analysis**

Statistical analysis was carried out using Excel spreadsheets and Stata13 software. Logistic regression analysis was performed to identify the effect of demographic characteristics on the level of knowledge about HPV. The concordance between tests was determined by summing the positives and negatives of the two tests divided by the total number of participants, and multiplying by 100. We assessed the risk (order ratio: OR) with the association of each explanatory variable together with virus carriage and STI history, using a logistic regression model to account for independently associated risk factors.

Associations were considered statistically significant for p < 0.05.

* 1. **Ethical considerations**

This study was conducted in accordance with the ethical guidelines for human research in the Republic of Congo and following the 1964 Declaration of Helsinki and its subsequent amendments. Accordingly, the study received the approval of the Health Sciences Research Ethics Committee of the Republic of Congo (n°033-40MESRSIT/DGRST/CERSSA/-23) and administrative agreements at the level of the Ministry of Primary, Secondary and Literacy Education (n°216/MEPSA-CAB of August 14, 2020). For girls under 18, an ethical clearance has been obtained from parents through the Congo Pupils' and Students' Parents' Association. Confidentiality and anonymity of the information provided were guaranteed. Only the medical staff were authorized to have access to information that could identify the participant. All participants gave their consent by means of a signed consent form.

1. **Results**

A total of 260 young women were approached during the study. Only 198 had given their consent to participate in this study. Thus, 198 participants constituted the sample for the present study.

* 1. **Socio-demographic characteristics**

Table I below presents the socio-demographic characteristics of the study participants, divided between the cities of Brazzaville and Pointe-Noire. The majority of participants were aged between 18 and 24. The majority of participants' parents were married (53.03%). Cohabitation was also fairly common (30.81%), while parents were less likely to be single (16.16%). The majority of families had between 2 and 5 children (63.2%). The range of the number of children in the siblings most represented is that of [3 to 6[ with a percentage of 59.09%. This simply means that the majority of girls surveyed lived in families with 3, 4 or 5 children. This first part was the subject of an article [6].

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Features** | **Population (N=198)**  **enquêtée**  **N=360** | **Proportions (%)** | |
| **N** | **%** | **95% IC** |
| Age, extreme (min, max) in years | | 15 ; 24 |  |  |
| Age, Mean (standard deviation) | | 19 (+/-1,87) |  |  |
| **Median age (q1 ; q3)** | | 19(18 ; 20) |  |  |
| **Age groups (classes)** | |  |  |  |
|  | Under 18s | 35 | 17,68 | 12,63 - 23,72 |
|  | 18 years and over | 163 | 82,32 | 76,28 - 87,37 |
| **Parents’marital status** | |  |  |  |
|  | Single | 32 | 16,16 | 11,32 - 22,04% |
|  | Cohabitation | 61 | 30,81 | 24,46 - 37,74 |
|  | Married | 105 | 53,03 | 45,83 - 60,14 |
| **Number of siblings** | |  |  |  |
|  | [1 à 3[ | 66 | 33,33 | 26,81 - 40,36 |
|  | [3 à 6[ | 117 | 59,09 | 51,90 - 66,01 |
|  | [6 à 10] | 15 | 7,58 | 4,30 - 12,19 |

**Table I.** Socio-demographic characterisrics of the study population

* 1. **Attitudes, practices and HPV carriage in the study population**

Table II shows a breakdown of the various characteristics of our study population. The prevalence of STIs was 64.65% (128 cases), with a 95% CI ranging from 57.55% to 71.29%. Among STIs, we observed a predominance of mycoses (73.44% or 94/128) and condylomas were the least represented with a prevalence of 1.56% (2/128). The prevalence of HPV carriage was reported at 45.5% (90/198). Only 33.3% of our study population used contraception.

|  |  |  |  |
| --- | --- | --- | --- |
| **Features** | | **Workforce** | **Proportions in % (95% CI)** |
| **STI** | | **N=198** |  |
|  | Positive | 128 | 64,65(57,55 – 71,29) |
|  | Negative | 70 | 35,35(28,71 – 42,45) |
| **HPV** | | **N=198** |  |
|  | Positive | 90 | 45,45(38,38 – 52,67) |
|  | Negative | 108 | 54,55(47,33 – 61,62) |
| **STI category** | | **N=128** |  |
|  | Chlamydiae | 20 | 15,63(9,81 – 23,9) |
|  | Condylomes | 2 | 1,56(0,19 – 5,53) |
|  | Herpès | 12 | 9,38(4,94 – 15,80) |
|  | Mycoses | 94 | 73,44(64,91 – 80,85) |
| **Age of first sexual intercourse** | | **N=198** |  |
|  | < 18 ans | 127 | 64,14(57,04 – 70,82) |
|  | ≥18 ans | 71 | 35,86(29,18 – 42,96) |
| **Use of contraceptives** | | **N=198** |  |
|  | Yes | 66 | 33,33(26,81 – 40,36) |
|  | No | 132 | 66,67(59,64 – 73,19) |

**Table II.** Attitudes, practices and molecular of the study population

* 1. **Correlation between age group, marital status and STI history**

We found that the marital status of the girls' parents was heterogeneously distributed in both STI modalities with high significance (p= 0.0002). This variable could have an influence on the occurrence of STIs in our study population. On the other hand, there was no significant association between girls' age and history of STIs. This means that age was not a risk factor in the occurrence of sexually transmitted infections (Table III).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | | **STI** | | | | |  | |  | |
|  | | **Positive** | | | **Negative** | |  | | | **P** |
|  | | **n** | **%** | | **N** | **%** | **N** | **%** | |  |
| **Age group in year** | |  | |  |  | |  |  | |  |
|  | Under 18s | 23 | 17,97 | | 12 | 17,14 | 35 | 17,68 | | **0,88** |
|  | 18 years and over | 105 | 82,03 | | 58 | 82,86 | 163 | 82,32 | |
| **Parents’ marital status** | |  | |  |  | |  |  | |  |
|  | Single | 24 | 18,75 | | 8 | 11,43 | 32 | 16,16 | | **0,0002** |
|  | Cohabitation | 50 | 39,06 | | 11 | 15,71 | 61 | 30,81 | |
|  | Married | 54 | 42,19 | | 51 | 72,86 | 105 | 53,03 | |

**Table III.** Comparative description of the socio-demographic characyeristics of young girls on the occurrence of STIs

* 1. **Risk factors associated with STI history**

Comparing girls from married parents with those whose parents were either cohabiting or single in Table IV, we found that girls whose sires were single or cohabiting had 3 to 4 times the risk of contracting an STI compared with those whose parents were married. These two results had a significant association (p=0.018 and p=0.0001).

**Table IV.** Risk factors associated with a history of STI

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Total, N** | **STI** | | | |  | |
|  | **N=198** | **Positive** | | **Negative** | |  |  |
| **Parents’ marital status** | |  | **n** | **%** | **n** | **%** | **ORC (95% IC)** | **p** |
| Célibataires | Single | 32 | 24 | 75,00 | 8 | 25,00 | **2,83(1,17 ; 6,88)** | **0,018** |
| Concubinages | Cohabitation | 61 | 50 | 81,97 | 11 | 18,03 | **4,29(2,01 – 9,15)** | **0,0001** |
| Mariés | Married | 105 | 54 | 51,43 | 51 | 48,57 | **1** |  |

1= reference. ORc = Gross Odd ration

* 1. **Correlation between STIs, HPV, age at first intercourse and contraceptive use**

Table V shows a significant difference between girls who used contraceptive methods and those who did not, when correlating STIs and contraceptive use (p=0.003). However, there was no association between HPV carriage, age at first intercourse and STIs.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | | **STI** | | | | |  | |  | |
|  | | **Positive** | | | **Negative** | |  | | | **P** |
|  | | **n** | **%** | | **n** | **%** | **N** | **%** | |  |
| **HPV** | |  | |  |  | |  |  | |  |
|  | Positive | 62 | 48,44 | | 28 | 40,00 | 90 | 45,45 | | **0,25** |
|  | Négative | 66 | 51,56 | | 42 | 60,00 | 108 | 54,55 | |
| **Age of first sexual intercourse** | |  | |  |  | |  |  | |  |
|  | <18 years | 80 | 62,50 | | 47 | 67,14 | 127 | 64,14 | | **0,51** |
|  | ≥18 years | 48 | 37,50 | | 23 | 32,86 | 71 | 35,86 | |
| **Use of contraception** | |  | |  |  | |  |  | |  |
|  | Yes | 52 | 40,63 | | 14 | 20,00 | 66 | 33,33 | | **0,003** |
|  | No | 76 | 59,38 | | 56 | 80,00 | 132 | 66,67 | |

**Table V.** Prevalence of STIs according to HPV carriage, age at firts sexual intercourse and contraceptive use

* 1. **STI prevalence by contraceptive use**

Looking at Table VI, we found that the population in our study who used contraception had 3 times more risk of contracting an STI than those who did not. This difference was significant at p=0.003.

**Table VI.** Prevalence of STIs according to contraceptive use

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Total, N** | **STIs** | | | |  | | |
|  | **N=198** | **Positive** | | **Negative** | |  |  |
| Use of contraception | |  | **n** | **%** | **n** | **%** | **ORC (95% IC)** | **P** |
|  | Yes | 66 | 52 | 78,79 | 14 | 21,21 | **2,74(1,38 ; 5,42)** | **0,003** |
|  | Nove | 132 | 76 | 57,58 | 56 | 42,42 | **1** |  |

* 1. **HPV-HR carriage as a function of age at first intercourse and contraceptive use**

Table VII shows that there was no significant association between HPV carriage and age at first intercourse and contraceptive use.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | | **HPV** | | | | |  | |  | |
|  | | **Positive** | | | **Negative** | |  | | | **P** |
|  | | **n** | **%** | | **n** | **%** | **N** | **%** | |  |
| **Âge of first sexual intercourse** | |  | |  |  | |  |  | |  |
|  | 18 and over | 33 | 36,67 | | 38 | 35,19 | 71 | 35,86 | | **0,82** |
|  | Under 18s | 57 | 63,33 | | 70 | 64,81 | 127 | 64,14 | |
| **Utilisation de la contraception** | |  | |  |  | |  |  | |  |
|  | Yes | 31 | 34,44 | | 35 | 32,41 | 66 | 33,33 | | **0,76** |
|  | No | 59 | 65,56 | | 73 | 67,59 | 132 | 66,67 | |
|  |  |  |  | |  |  |  |  | |  |

**Table VII.** HPV carriage according to age at firts intercourse and contraceptive use

* 1. **Risk factors independently associated with HPV carriage**

In our study, we found a significant association between girls with cohabiting parents and HPV carriage (p=0.001). These girls were 3 times more likely to carry HPV than those whose parents were married. On the other hand, when comparing girls whose parents were single with those whose parents were married, there was no association with HPV carriage, as shown in Table VIII.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Total, N** | **HPV** | | | |  | |
|  | **N=198** | **Positive** | | **Negative** | |  |  |
| **Parents’ marital status** | |  | **N** | **%** | **n** | **%** | **ORC (95% IC)** | **P** |
| Célibataires | Single | 32 | 14 | 43,75 | 18 | 56,25 | **1,37(0,61 ; 3,06)** | **0,44** |
| Concubinages | Cohabitation | 61 | 38 | 62,30 | 23 | 37,70 | **2,91(1,51 ; 5,59)** | **0,001** |
| Mariés | Married | 105 | 38 | 36,19 | 67 | 63,81 | **1** |  |

**Table VIII.** Risk factors independently associated with HPV carriage

1. **Discussion**

Papillomavirus infection, the main cause of cervical cancer, remains the most common sexually transmitted infection among young women [6,12]. In the Republic of Congo, the few data available on HPV and STIs are not very varied, while the persistence of this infection is sometimes due to the presence of other STIs that disrupt the clearance of this HPV infection. The literature reports that young girls and adolescents are more exposed to STIs between the ages of 15 and 30, and that HPV is predominant in this age group [13,14]. Knowing the pathogenic power of HPV and its consequences in the occurrence of UCC, a consequence sometimes due to exposure to STIs as a cofactor of persistence, we were willing to carry out this study to establish the links of co-infection between HPV and STIs, including chlamydia, herpes, condyloma and mycosis. The present study was conducted in a population of sexually active young female high school students in the cities of Brazzaville and Pointe-Noire, Republic of Congo, over a period from December 07, 2019 to September 20, 2021. The objective was to determine the prevalence of STI history and susceptibility during HPV infection in a population of sexually active young females.

Of 260 young people surveyed, 198 aged between 15 and 24 agreed to take part in our study. The average age in our study was 19. This average age is higher than that obtained by Ambounda et al in Gabon in a population of young adolescent girls [15]. On the other hand, in studies carried out in Kenya and Mali, the average age reported was much higher than ours [16,17]. These differences may be due to the sample sizes of these studies. However, in a study of Cameroonian women, Embolo et al obtained an average age similar to ours for the population aged between 15 and 25 years [18].

64.14% of our study population had had early sexual intercourse. This confirms the fact that young girls before they reach maturity are often exposed to early sexual intercourse, as reported in the literature[19,20]. The precociousness of sexual intercourse was also revealed by Adedini et al. in a study of young girls in Nigeria. This study reported a prevalence of between 53.3% and 55.2% [21]. The average age at first intercourse was 16.76±1.65 years, as in the studies by Mukeya et al in Mali and Duval et al in Réunion. The same is true of the work by Adohinzin et al in Burkina Faso, where the mean age at first intercourse was 17.6 years. These results confirm the precocity of sexual intercourse among young girls, compared with the study by Zohoncon et al, in Burkina Faso, who reported an average age of first intercourse of 20 years [16,22-24].

We also noted that only 33.3% of girls in our study used contraceptives (66/198). However, some studies carried out in South Africa and Brazil report lower rates than ours (11% and 21.9%) [25,26]. Another study, in Nigeria to be precise, obtained a higher rate than ours (72.4) [21]. These differences can be explained by the quality and implementation of awareness-raising and outreach programs on sexuality education for young girls or adolescents, as part of a policy to combat unwanted pregnancies and among young girls of childbearing age.

In the study population, 128 participants (64.65%) had a history of STIs, with a predominance of mycoses (73.4%), followed by chlamydia (15.6%), herpes (9.38%) and condylomata (1.56%). Our results differ from those reported by Djouedjon, Chinyere and Carneiro (44.72%, 46.3% and 36.2% for the first three STIs) in a population of women of childbearing age. This difference may be due to sample size, average age, the study population of these studies and the early onset of sexual intercourse in our study [27-29]. The study by Wastiaux et al reported a prevalence of 21.7%, with chlamydia predominating (77%). This confirms what the literature reports about sex life and the predominance of STIs in young people [30-32]. These observed differences are also the result of a lack of knowledge and communication about STIs in developing countries, which leaves the way open for misinformation, especially among minors and sexually active young people, because in these countries with limited resources, sex remains a taboo subject [27,33,34].

The results of our study showed a significant association between the use of contraceptive methods and STIs (p=0.003). This significant difference is explained by the fact that young people, once they can avoid unwanted pregnancies, can now indulge in unprotected sex and multiply their sexual partners.

There was a significant difference between STI history and parental marital status in our study population. When looking for independently associated factors, we found that girls whose parents were single or cohabiting were 3 to 4 times more likely to contract a sexually transmitted infection. This can be explained by the simple fact that in households where parents are not in a marital relationship, childcare remains a serious problem.

Molecular analysis of our study samples using GèneXpert technology reported a prevalence of 45.45%. In reviewing the literature, we noted that, whether old or recent, the various studies show that the prevalence of HPV, whatever the methodology used, varies from one country to another, and within the same country, from one population to another, and within the same age group, from one category of person to another. The study by Tchounga et al in Côte d'Ivoire, for example, showed a carriage rate of 2.8% among adolescent girls. The difference with our study may lie in the country's cervical cancer control policy, which emphasizes the relevance and importance of HPV vaccination in the adolescent age group. Also in Africa, one study reported a prevalence of 48.2% among girls aged between 15 and 24[35]. Among women aged 25 and over, several studies conducted in Central Africa show that prevalence varies between 12 and 64.4% [36,37]. In West Africa, prevalence ranged from 16.5% to 33.2% [11,38,39]. In East Africa, a study conducted in a cohort of young women in Tanzania found a higher prevalence (74%) than in our study [40]. Thus, comparing our results with those of other studies, although the prevalence of HPV in young girls varies according to the region of the world, all studies agree that this infection is more important in the juvenile age group, which is more exposed to early sexual intercourse with multiple partners. This often exposes them to high levels of STIs. These results corroborate those of previous studies, which have shown that sex life and early sexual relations are legion in the two cities of Brazzaville and Pointe-Noire [29,36]. The differences observed in terms of prevalence can also be explained in relation to the average age of the studies, the sample size of the population used by the various authors and the type of population recruited, i.e. the cohort behaviours. These studies also show that the high prevalence of HPV may in part reflect the at-risk population served by the study sites used for the studies. Other studies have shown that an increase in the number of sexual partners, early sexual intercourse, the use of intravaginal insertions and the number of previous pregnancies or the young age of girls are some of the behavioral risk factors in young women, although the risk of infection differs from person to person [41,42].

**Conclusion**

Sexually-active young people are particularly vulnerable to sexually-transmitted infections, especially HPV, which is often contracted at first intercourse. Lack of information, low uptake of screening, irregular condom use and contraceptive methods all contribute to the silent spread of these infections. It is therefore essential to strengthen sex education, encourage HPV vaccination and promote easy, confidential access to prevention and screening services. Prevention means protecting young people's present and future sexual health.

**Consent to publication**

Consent to publication was obtained from all persons included in the study.

Availability of data and materials

All data underlying the results described in this article were fully presented in the manuscript.

**Abbreviations**

IC95%: 95% confidence interval, aOR: Adjusted odds ratio, cOR: Crude odds ratio, HPV: Human papillomavirus, CCU: Cervical cancer, MEPSA-CAB: Ministry of Primary, Secondary Education and Literacy-Cabinet, PN: Pointe-Noire, BZV: Brazzaville, USA: United of States America.

**Références**

1. Wakabayashi R, Nakahama Y, Nguyen V, Espinoza JL. The Host-Microbe Interplay in Human Papillomavirus-Induced Carcinogenesis. Microorganisms. 2019;7: 199. doi:10.3390/microorganisms7070199

2. McBride AA. Human papillomaviruses: diversity, infection and host interactions. Nat Rev Microbiol. 2022;20: 95–108. doi:10.1038/s41579-021-00617-5

3. Infections à papillomavirus. [cited 29 Mar 2023]. Available: https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-a-prevention-vaccinale/infections-a-papillomavirus

4. Wolf J, Kist LF, Pereira SB, Quessada MA, Petek H, Pille A, et al. Human papillomavirus infection: Epidemiology, biology, host interactions, cancer development, prevention, and therapeutics. Rev Med Virol. 2024;34: e2537. doi:10.1002/rmv.2537

5. Boumba LMA, Qmichou Z, Mouallif M, Attaleb M, Mzibri ME, Hilali L, et al. Human papillomavirus genotypes distribution by cervical cytologic status among women attending the General Hospital of Loandjili, Pointe-Noire, Southwest Congo (Brazzaville). J Med Virol. 2015;87: 1769–1776. doi:10.1002/jmv.24221

6. Bissala B, Essangui E, Kojom LP, Nganga P, Lemba P, Ntsiba A, et al. Knowledge, Sexual Behaviors on Human Papillomavirus Infections and Associated Factors: Survey Among Female Adolescents and Adults in the Republic of Congo. Cancer Res J. 2023;11: 59–69. doi:10.11648/j.crj.20231102.14

7. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018;68: 394–424. doi:10.3322/caac.21492

8. Zur Hausen H. Papillomaviruses and cancer: from basic studies to clinical application. Nat Rev Cancer. 2002;2: 342–350. doi:10.1038/nrc798

9. Oyouni AAA. Human papillomavirus in cancer: Infection, disease transmission, and progress in vaccines. J Infect Public Health. 2023;16: 626–631. doi:10.1016/j.jiph.2023.02.014

10. Djonouma I. Papillomavirus typing in cervical cancer screening among HIV-positive women in Bamako. Thesis, University of Sciences, Techniques and Technologies of Bamako. 2023. Available: <https://www.bibliosante.ml/handle/123456789/5881>

11. Tounkara FK, Téguété I, Guédou FA, Goma-Matsétsé E, Koné A, Béhanzin L, et al. Human papillomavirus genotype distribution and factors associated among female sex workers in West Africa. PLOS ONE. 2020;15: e0242711. doi:10.1371/journal.pone.0242711

12. Nganga PC, Boumba LMA, Tsimba CPL, Tchibinda FGL, Nkounkou RBB, Ataboho EE, et al. Prevalence and Genotyping of Human Papillomavirus among Women in the Departments of Niari and Bouenza, Republic of the Congo. J Biosci Med. 2022;10: 64–77. doi:10.4236/jbm.2022.101007

13. Monsonego J, Zerat L, Syrjänen K, Zerat JC, Smith JS, Halfon P. Prévalence des génotypes d’HPV chez les femmes en France : implications pour le dépistage et la vaccination. Gynécologie Obstétrique Fertil. 2013;41: 305–313. doi:10.1016/j.gyobfe.2013.03.003

14. Meda ZC, Ramde Z, Hien H, Ilboudo B, Ouattara CA, Traore I., et al. Evaluation of the effectiveness of the Human papillomavirus (HPV) test in the screening of precancerous lesions of the cervix in Burkina Faso: case of the Souro Sanou University Hospital (CHUSS) of Bobo-Dioulasso. Rev. DEpidémiologie Santé Publique. 2023;71: 101540. doi:10.1016/j.respe.2023.101540

15. Ambounda NL, Woromogo SH, Moussa FEY, Kouanang AJ, Tekem VNS. Sexuality and behaviour of adolescents in relationship to sexually transmitted diseases in Libreville: a cross-sectional study. Int J Reprod Contracept Obstet Gynecol. 2020;9: 2782–2787. doi:10.18203/2320-1770.ijrcog20202708

16. Mukeya Mvumbi G, Dembélé Keïta B, Camara N, Théra I, Guédou FA, Traoré S, et al. Prevalence and factors associated with hepatitis B and C among female sex workers in Bamako, Mali. Pan Afr Med J. 2024;49. doi:10.11604/pamj.2024.49.118.39119

17. Masha SC, Wahome E, Vaneechoutte M, Cools P, Crucitti T, Sanders EJ. High prevalence of curable sexually transmitted infections among pregnant women in a rural county hospital in Kilifi, Kenya. PLOS ONE. 2017;12: e0175166. doi:10.1371/journal.pone.0175166

18. Embolo Enyegue EL, Ngono Abondo FE, Awalou H, Mogo CB, Koanga Mogtomo ML. Sexually transmitted infections (STIs)/HIV associated to human papillomavirus (HPV) in precancerous lesions among Cameroonian women. | EBSCOhost. 1 Sep 2024 [cited 31 Mar 2025] p. 530. doi:10.52142/omujecm.41.3.15

19. Monsonego J, Zerat L, Syrjänen K, Zerat JC, Smith JS, Halfon P. Prevalence of HPV genotypes in women in France: implications for screening and vaccination. Gynecology Obstetrics Fertil. 2013;41: 305–313. doi:10.1016/j.gyobfe.2013.03.003

20. Fleury H. Virologie Humaine. Masson. Paris; 2009.

21. Adedini SA, Mobolaji JW, Alabi M, Fatusi AO. Changes in contraceptive and sexual behaviours among unmarried young people in Nigeria: Evidence from nationally representative surveys. PLOS ONE. 2021;16: e0246309. doi:10.1371/journal.pone.0246309

22. Adohinzin CC, Meda N, Gaston AM, Ouédraogo GA, Sombie I, Berthe A, et al. Risk-taking among young people in Bobo Dioulasso: an analysis of factors associated with precocity and multiple sexual partners. Pan Afr Med J. 2016;25. doi:10.11604/pamj.2016.25.132.9767

23. Duval C. Prevalence of Chlamydia trachomatis infections among women attending screening centers in the West and South of Réunion.

24. Zohoncon TM, Bisseye C, Djigma FW, Yonli AT, Compaore TR, Sagna T, et al. Prevalence of HPV High-Risk Genotypes in Three Cohorts of Women in Ouagadougou (Burkina Faso). Mediterr J Hematol Infect Dis. 2013;5: e2013059. doi:10.4084/MJHID.2013.059

25. Odimegwu CO, Ugwu NH. A multilevel mixed effect analysis of neighbourhood and individual level determinants of risky sexual behaviour among young people in South Africa. Reprod Health. 2022;19: 119. doi:10.1186/s12978-022-01407-9

26. Borges ALV, Duarte LS, Lay AAR, Fujimori E. Individual and context correlates of the oral pill and condom use among Brazilian female adolescents. BMC Womens Health. 2021;21: 307. doi:10.1186/s12905-021-01447-6

27. Dakenyo RD, Kenfack B, Vogue N, Tsakoue EF, Ebode ME, Cumber SN. Knowledge, attitudes and practices of women of reproductive age in the Mifi Health District on cervical cancer prevention, Cameroon. Pan Afr Med J. 2018;31. Available: <https://www.ajol.info/index.php/pamj/article/view/208085>

28. Ezeanya CC, Agbakoba ,Nneka Regina, Enweani ,Ifeoma Bessie, and Oguejiofor C. Predominance of cervicitis agents with minimal testing rate within the student population in Benin city, Nigeria. J Obstet Gynaecol. 2019;39: 840–844. doi:10.1080/01443615.2019.1584888

29. Carneiro FP, Darós AC, Darós ACM, de Castro TMML, de Vasconcelos Carneiro M, Fidelis CR, et al. Cervical Cytology of Samples with Ureaplasma urealyticum, Ureaplasma parvum, Chlamydia trachomatis, Trichomonas vaginalis, Mycoplasma hominis, and Neisseria gonorrhoeae Detected by Multiplex PCR. BioMed Res Int. 2020;2020: 7045217. doi:10.1155/2020/7045217

30. Grondin C, Duron S, Robin F, Verret C, Imbert P. [Adolescents’ knowledge and behavior on sexuality, infectious transmitted diseases, and human papillomavirus vaccination: results of a survey in a French high school]. Arch Pediatr. 2013;20: 845–852. doi:10.1016/j.arcped.2013.05.012

31. Ho GYF, Bierman R, Beardsley L, Chang CJ, Burk RD. Natural History of Cervicovaginal Papillomavirus Infection in Young Women. N Engl J Med. 1998;338: 423–428. doi:10.1056/NEJM199802123380703

32. Thomas JO, Herrero R, Omigbodun AA, Ojemakinde K, Ajayi IO, Fawole A, et al. Prevalence of papillomavirus infection in women in Ibadan, Nigeria: a population-based study. Br J Cancer. 2004;90: 638–645. doi:10.1038/sj.bjc.6601515

33. Lubeya MK, Mwanahamuntu M, Chibwesha CJ, Mukosha M, Monde MW, Kawonga M. Implementation Strategies Used to Increase Human Papillomavirus Vaccination Uptake by Adolescent Girls in Sub-Saharan Africa: A Scoping Review. Vaccines. 2023;11: 1246. doi:10.3390/vaccines11071246

34. Chaturvedi AK, Katki HA, Hildesheim A, Rodríguez AC, Quint W, Schiffman M, et al. Human Papillomavirus Infection with Multiple Types: Pattern of Coinfection and Risk of Cervical Disease. J Infect Dis. 2011;203: 910–920. doi:10.1093/infdis/jiq139

35. Ogembo RK, Gona PN, Seymour AJ, Park HS-M, Bain PA, Maranda L, et al. Prevalence of Human Papillomavirus Genotypes among African Women with Normal Cervical Cytology and Neoplasia: A Systematic Review and Meta-Analysis. PLOS ONE. 2015;10: e0122488. doi:10.1371/journal.pone.0122488

36. Boumba ALM, Malanda Mboungou Moudiongui D, Ngatali SFC, Takale RP, Moukassa D, Peko JF. Oncogenic human papillomavirus in breast cancer: molecular prevalence in a group of Congolese patients. Access Microbiol. 2021;3: 000216. doi:10.1099/acmi.0.000216

37. Bouassa R-SM, Nodjikouambaye ZA, Sadjoli D, Adawaye C, Péré H, Veyer D, et al. High prevalence of cervical high-risk human papillomavirus infection mostly covered by Gardasil-9 prophylactic vaccine in adult women living in N’Djamena, Chad. PLOS ONE. 2019;14: e0217486. doi:10.1371/journal.pone.0217486

38. Adams AR, Nortey PA, Dortey BA, Asmah RH, Wiredu EK. Cervical Human Papillomavirus Prevalence, Genotypes, and Associated Risk Factors among Female Sex Workers in Greater Accra, Ghana. J Oncol. 2019;2019: e8062176. doi:10.1155/2019/8062176

39. Ouédraogo CMR, Rahimy RML, Zohoncon TM, Djigma FW, Yonli AT, Ouermi D, et al. Epidemiology and characterization of high-risk human papillomavirus genotypes in a population of sexually active adolescents in Ouagadougou. J Gynecology Obstetrics Biol Reprod. 2015;44:715–722. doi:10.1016/j.jgyn.2014.12.021

40. Watson-Jones D, Baisley K, Brown J, Kavishe B, Andreasen A, Changalucha J, et al. High prevalence and incidence of human papillomavirus in a cohort of healthy young African female subjects. Sex Transm Infect. 2013;89: 358–365. doi:10.1136/sextrans-2012-050685

41. Didelot-Rousseau M-N, Nagot N, Costes-Martineau V, Vallès X, Ouedraogo A, Konate I, et al. Human papillomavirus genotype distribution and cervical squamous intraepithelial lesions among high-risk women with and without HIV-1 infection in Burkina Faso. Br J Cancer. 2006;95: 355–362. doi:10.1038/sj.bjc.6603252

42. Suominen NT, Luukkaala TH, Laprise C, Haataja MA, Grénman SE, Syrjänen SM, et al. Human Papillomavirus Concordance Between Parents and Their Newborn Offspring: Results From the Finnish Family Human Papillomavirus Study. J Infect Dis. 2024;229: 448–456. doi:10.1093/infdis/jiad330