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ORIGINAL

Genotypic Diversity of HPV in Adult Women: A Multisectoral Analysis

Diversidad Genotípica del VPH en Mujeres Adultas: Un Análisis Multisectorial

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ABSTRACT

Introduction: Human Papilloma Virus (HPV) is one of the most common sexually transmitted infections worldwide, and its persistence is closely associated with the development of cervical cancer. In Ecuador, particularly in areas with high ethnic diversity and health inequalities such as the province of Esmeraldas, updated information on the circulation of HPV genotypes is needed to guide preventive strategies. This study aimed to determine the frequency and distribution of HPV genotypes in women between 18 and 70 years of age treated in health institutions in the Esmeraldas canton.
Method: a cross-sectional, descriptive study was carried out with non-probability convenience sampling, using an anonymized database with molecular results for 23 viral genotypes.
Results: the sample included 630 women; of these, 44,4 % tested positive for HPV, with 26,2 % infected with a single genotype and 18,3 % with multiple genotypes. The most frequent high-risk genotypes were HPV 52, 58, 31, and 68, while HPV 81 was the most prevalent among low-risk women. The highest viral load was observed in women aged 25 to 31 years.
Conclusions: the results reveal significant genotypic diversity, with a predominance of oncogenic types, which underscores the need to strengthen vaccination and screening programs tailored to the local epidemiological profile. These findings provide key evidence for public health decision-making in the region.

Keywords: Human Papilloma Virus; Genotypic Diversity; Cervical Cancer; Molecular Screening; Public Health.

RESUMEN

Introducción: el Virus del Papiloma Humano (VPH) es una de las infecciones de transmisión sexual más comunes a nivel mundial, y su persistencia se asocia estrechamente con el desarrollo de cáncer de cuello uterino. En Ecuador, particularmente en zonas con alta diversidad étnica y desigualdades sanitarias como la provincia de Esmeraldas, se requiere información actualizada sobre la circulación de genotipos del VPH para orientar estrategias preventivas. Este estudio tuvo como objetivo determinar la frecuencia y distribución de los genotipos del VPH en mujeres entre 18 y 70 años atendidas en instituciones de salud del cantón Esmeraldas.
Método: se llevó a cabo un estudio transversal, descriptivo, con muestreo no probabilístico por conveniencia, utilizando una base de datos anonimizada con resultados moleculares para 23 genotipos virales.
Resultados: la muestra incluyó 630 mujeres; de ellas, el 44,4 % resultó positiva para VPH, con un 26,2 % infectada por un solo genotipo y un 18,3 % por múltiples genotipos. Los genotipos de alto riesgo más frecuentes fueron VPH 52, 58, 31 y 68, mientras que el VPH 81 fue el de mayor prevalencia entre los de bajo riesgo. La mayor carga viral se observó en mujeres de 25 a 31 años.

Conclusiones: los resultados revelan una diversidad genotípica significativa, con predominio de tipos oncogénicos, lo cual subraya la necesidad de fortalecer los programas de vacunación y tamizaje adaptados al perfil epidemiológico local. Estos hallazgos aportan evidencia clave para la toma de decisiones en salud pública en la región.

Palabras clave: Virus del Papiloma Humano; Diversidad Genotípica; Cáncer Cervicouterino; Tamizaje Molecular; Salud Pública.

INTRODUCTION

Human Papillomavirus (HPV) is a family of double-stranded DNA viruses that infect human epithelial cells. To date, more than 448 types of HPV have been identified and classified into five main groups: α, β, γ, μ, and ν. However, most HPV types (genotypes) do not cause cancer; of the 448 types that have been documented, only 12 are currently classified as carcinogenic: types 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, and 59, with HPV-16 and HPV-18 being the most prevalent and primarily associated with cervical cancer. Infections with these cancer-causing types of HPV are prevalent. Still, around 80 % are eliminated by the immune system within three years, and only 3 % progress to precancer/cervical cancer within seven years.(1,2,3,4)

Currently, HPV is one of the most common sexually transmitted infections globally, significantly associated with high-grade precancerous lesions and cervical cancer, the latter being the fourth most common cancer in women worldwide, with approximately 660 000 new cases and 350 000 deaths recorded in 2022. 660 000 new cases and 350 000 deaths in 2022. This is because, in many cases, it is difficult to know the actual frequency of genital HPV infection due to underreporting of diagnosed cases, given that most infections are asymptomatic and self-limiting, and a large number of patients are not diagnosed.(5,6,7)

Most deaths (94 %) occur in low- and middle-income countries, especially in regions such as sub-Saharan Africa, Central America, and Southeast Asia. These disparities are due to a lack of access to vaccination services against the virus, screening and treatment programs, as well as social and economic factors such as poverty and gender discrimination. The leading cause of cervical cancer is persistent infection with high-risk types of HPV; however, cervical cancer is preventable and treatable if detected early, and practical strategies are implemented, including prophylactic HPV vaccination, regular screening to detect precancerous lesions, and timely treatment, which would make it possible to eliminate cervical cancer as a public health problem in the coming decades.(8,9)

In Latin America, despite being the region that has made the fastest progress in HPV vaccination, monitoring and surveillance systems are still inadequate. This represents a serious public health problem due to limited coverage of screening programs and access to specialized health services.(10) The World Health Organization estimates that 16,1 % of women in Latin America have HPV, compared to a global average of 11,7 %. Experts agree that the best way to prevent HPV and cervical cancer is to vaccinate young people before they become sexually active.(9)

In Ecuador, the epidemiological bulletin of SOLCA Núcleo de Quito for the first quarter of 2022 presents a detailed analysis of cervical cancer, emphasizing its prevalence. This type of cancer is the second leading cause of death from neoplasms in Ecuadorian women, with an age-adjusted mortality rate of 4,5 per 100 000 women. The report highlights that the incidence of cervical cancer in Quito is 8,8 cases per 100 000 women, which is higher than the national average. In addition, there has been a steady increase in incidence and mortality rates since 1985, suggesting an urgent need to strengthen prevention and early diagnosis strategies. The bulletin also addresses the importance of vaccination against human papillomavirus (HPV) and regular Pap smears as key measures to reduce the burden of this disease in the female population.(11)

The incidence of cervical cancer in Ecuador is approximately 11,2 cases per 100 000 women, with a mortality rate of 4,5 per 100 000. Notably, the HPV-58 genotype affects 34,9 % of women, underscoring the need to consider this genotype in prevention strategies. It is estimated that between 70 % and 80 % of sexually active women will be infected with HPV at some point in their lives. However, most will not develop cancer due to personal genetic factors that prevent the virus from causing cell damage, highlighting the critical importance of cervical cancer prevention. Persistent infection with the Human Papillomavirus (HPV), especially genotypes 16 and 18, is the leading cause of this type of cancer. Through the E6 and E7 genes, these genotypes promote uncontrolled cell proliferation and malignancy.(12)

In addition, more than 150 HPV genotypes have been identified, of which 35 are considered to be high-risk oncogenic types. However, the National Health System in Ecuador has not established a diagnostic protocol for this virus, which hinders the early detection of cervical lesions that could develop into malignancies. In response to this problem, the National Institute of Public Health Research (INSPI) created a project in the coastal region of Ecuador to establish a baseline of circulating HPV genotypes in women with atypical ASCUS cytology. One hundred twenty endocervical brush samples were studied, of which 83,3 % were positive for HPV. The genotypes identified included HPV-16 (45,9 %), HPV-58 (24,6 %), and other high-risk types. In addition, 55,7 % of the patients had CIN III lesions. These findings highlight the urgent need to implement prevention, diagnosis, and timely treatment strategies to reduce the burden of cervical cancer in the country.

Given this background, and since human papillomavirus (HPV) infection is one of the main risk factors for the development of cervical cancer, one of the most common neoplasms among women of reproductive age, especially in regions with limited public health resources, there is a clear need to understand the phenotypic diversity prevalent in the different cases diagnosed in the city of Esmeraldas, characterized by its ethnic diversity and variable socioeconomic conditions, presents a particular epidemiological context that could influence the circulation and distribution of different HPV genotypes.

In this regard, knowing the genotypic diversity of HPV in this population is essential to understanding viral transmission dynamics, identifying predominant oncogenic high-risk genotypes, and strengthening local prevention, detection, and treatment strategies. This information is also key to guiding more effective vaccination policies tailored to the specific viral genetic profile of the region, given that the lack of updated studies on HPV genotypic diversity in Esmeraldas limits the healthcare system's response to an infection that, although preventable, continues to have a significant impact on local public health. Therefore, this study seeks to fill a knowledge gap necessary for evidence-based decision-making, promoting more effective interventions in the fight against cervical cancer and other HPV-related diseases in this city.

METHOD

A descriptive cross-sectional study was conducted to determine the frequency of Human Papillomavirus (HPV) genotypes in women aged 18 to 70, using a multisectoral approach that integrated data from various health institutions in the canton of Esmeraldas, Ecuador. The population consisted of women diagnosed with or suspected of HPV infection who were treated at different levels of the health system. A non-probability convenience sample was used, and participants were selected from an anonymized database. The sample size included 630 women, ensuring representativeness in the study.

The data were extracted from an anonymized database provided by collaborating health institutions in compliance with national and international data protection regulations. The databases contained demographic variables such as age and sex and molecular test results for 23 different HPV genotypes. Before analysis, the information was centralized and cleaned to remove duplicates and inconsistencies. The molecular results allowed the genotypes to be classified according to their risk level (high or low) using validated scientific literature.

The primary variable was the frequency of HPV genotypes (according to their risk), and secondary variables included age and sex. Statistical analysis was performed using specialized SPSS software, calculating absolute and relative frequencies by genotype, stratified by age group and risk level.

The study was conducted under strict ethical principles, per the Declaration of Helsinki and local regulations. The data remained completely anonymous throughout the process, ensuring the confidentiality of the participants.

RESULTS

Table 1. Age range and frequency of Human Papilloma Virus infection

Age Range	Negatives		1 viral genotype		>2 viral genotypes		Total
	Absolute Frequency	Relative Frequency (%)	Absolute Frequency	Relative Frequency (%)	Absolute Frequency	Relative Frequency (%)	
18-24	30	40	15	20	30	40	75
25-31	115	51	50	22	60	27	225
32-38	60	55	35	32	15	14	110
39-45	90	78	20	17	5	4	115
46-52	25	50	25	50	0	0	50
53-59	15	60	10	40	0	0	25
60-70	15	50	10	33	5	17	30
Total	350		165		115		630

The table shows negative cases and cases with infection by one or more viral genotypes in a sample of 630 women between the ages of 18 and 70. Of the 630 samples analyzed, 55,6 % (350) were negative for HPV, while

44,4 % were infected: 165 cases (26,2 %) with a single viral genotype and 115 cases (18,3 %) with multiple infections (>2 genotypes). The 25-31 age group had the highest combined viral load, with 49 % of cases positive (22 with a single genotype and 27 with multiple genotypes), representing a critical point in HPV epidemiology. Similarly, the 32-38 age group had a high proportion of single genotypes (32 %) and multiple infections (14 %), indicating a possible sustained risk in young adult women. Notably, the highest proportion of numerous infections occurred in the extreme age groups 18-24 years (40 %), which could indicate greater biological vulnerability or immune changes at these stages of life. On the other hand, the older age groups (46–70 years) had a higher prevalence of negative results (60 % or more), which may be due to lower sexual activity, natural viral clearance, or lower diagnostic sensitivity at these ages. The presence of multiple genotypes in almost a fifth of the sample demonstrates the complexity of the HPV virological landscape, with important implications for prevention and screening, especially in young populations where co-infection appears to be more common and potentially more oncogenic.

Table 2. Frequency of Human Papillomavirus genotypes

HPV genotype		**Absolute frequency**
High risk	16	20
	18	20
	31	30
	33	10
	35	10
	39	20
	45	5
	51	2
	52	40
	53	10
	56	35
	58	30
	59	15
	66	20
	68	40
Low risk	6	25
	11	35
	26	8
	42	10
	43	30
	73	10
	81	60
	82	20

The table reveals a wide genotypic diversity of the Human Papillomavirus (HPV), identifying 23 genotypes, of which 15 are high oncogenic risk and 8 are low risk. Among the high-risk genotypes, HPV 31, HPV 58, HPV 52, and HPV 68 stand out with the highest absolute frequencies (30 and 40 cases, respectively), followed by HPV 16, 18, 39, and 66, each with 20 cases, which coincides with the serotypes most commonly associated with cervical cancer according to the scientific literature. Genotype 56, although less frequent (5 cases), also has high oncogenic potential. The consistent presence of these high-risk types suggests an environment with high circulation of potentially cancer-causing strains. As for low-risk genotypes, the most prevalent was HPV 81 (60 cases), followed by HPV 43 (30) and HPV 11 (35), genotypes typically associated with benign lesions such as genital warts. The high frequency of these types also points to the need for clinical approaches for symptomatic management and prevention of HPV spread.

DISCUSSION

The results of this study show a high prevalence of Human Papillomavirus (HPV) infection in women in the province of Esmeraldas, with a predominance of high-risk oncogenic genotypes, specifically types 16, 58, and 52. This pattern of genotypic distribution is consistent with previous research conducted on the Ecuadorian coast, where a significant frequency of the most common genotypes in women was reported as HPV-39, HPV-16, HPV-6, and HPV-58;(14) Cevallos-Sierra et al., who reported a prevalence of HPV infection of 56 %. in Afro-

Ecuadorian women, with HPV-16 being the most prevalent genotype (20 %), while in Chachi women it was HPV-58 (30 %);(15) Minchalo Muñoz et al in 2020, in a study of 594 women aged 25 to 65, found a prevalence of HPV of 71,38 %. High-risk genotypes accounted for 58,01 % of positive cases, with HPV-16 being the most prevalent,(16) and García Regalado et al. 2017 suggested a prevalence of HPV-16 (38,9 %), followed by HPV-58 (19,5 %).(17)

Although globally, genotypes 16 and 18 have traditionally been associated with the highest risk of developing cervical cancer, in the Ecuadorian context—and particularly in our cohort—HPV-58 has shown a notable presence. Recent national studies indicate that this genotype was present in 6,54 % of samples with invasive cervical cancer, underscoring its relevance in cervical oncogenesis in the region. Furthermore, García Muentes et al. 2024, highlight the importance of HPV-58 in cervical oncogenesis in the region, especially considering that it is a genotype that can be prevented by the nonavalent vaccine.(14) In this regard, these studies show that HPV-58 has a notable presence, and this information is crucial for adapting prevention and vaccination strategies to the specific needs of the Ecuadorian population.

Various national studies reinforce these findings, highlighting that genotypes 16, 58, and 18 are the most common among the female population in Ecuador. In a survey conducted in Cuenca, HPV-16 was detected in 48,75 % of positive cases, making it the most frequent genotype in that population.(18) Complementarily, other studies highlight the importance of HPV-58, suggesting that its high circulation could have implications for the effectiveness of current vaccination programs, which in some cases do not include it in their primary coverage.(19)

Regarding age distribution, our data show that the prevalence of high-risk genotypes varies significantly between age groups, which is more common in young women. This finding is in line with a study conducted in the province of Azuay, where an overall prevalence of 25,6 % of HPV was observed, with a significantly higher incidence of genotypes 31 and 66 in women aged 20 to 29 years ($p<0,05$).(20) This behavior could be attributed to factors such as early onset of sexual activity, multiple sexual partners, and lack of prior immunity to the most aggressive genotypes. In addition, the prevalence of HPV infections tends to be higher in young women due to the greater susceptibility of the cervical epithelium at this stage of life and risky sexual behaviors. Studies have shown that HPV detection is more frequent in women under 25 years of age, supporting the need for prevention strategies targeting this age group.(21)

However, a significant frequency of positive cases was also observed in women between 36 and 40 years of age, suggesting possible reactivation of latent infections or new exposures to the virus at older ages, as reported in studies conducted in Cuenca.(16) This epidemiological pattern highlights the importance of maintaining continuous screening strategies in young women and older age groups that may remain vulnerable. Scientific evidence supports the hypothesis that HPV infections can reactivate in older women due to the persistence of the virus in a latent state. A study by Rositch A. et al. 2012 found that, in women aged 35 to 60, 85 % of incident HPV detections occurred in those without recent new sexual partners, suggesting that reactivation of latent infections is a common source of new HPV detections in this age group.(22) Immunosenescence, or the decline in immune response with age, may contribute to HPV reactivation in older women. A study by Castle et al. indicated that HPV persistence in postmenopausal women is associated with a generalized decline in immune response, supporting the need for continued screening in older women to detect preneoplastic genital lesions.(23)

Finally, these results reinforce the need to adjust HPV prevention and control strategies in the province of Esmeraldas, including the promotion of vaccines that cover the most prevalent genotypes. Vaccination against Human Papillomavirus (HPV) is globally recognized as one of the most effective interventions for preventing cervical cancer, which is why the World Health Organization (WHO) has set a target of achieving 90 % vaccination coverage among girls under the age of 15 by 2030, as part of its strategy to eliminate this type of cancer as a public health problem. However, significant inequalities in access to these vaccines persist, especially in low- and middle-income countries, where more than 90 % of cervical cancer deaths occur due to limited access to preventive measures. Given this reality, the WHO has endorsed using single-dose vaccination schedules, which have demonstrated comparable efficacy to traditional two-dose schedules, representing a favorable strategy for resource-limited regions by reducing costs and facilitating implementation. In this context, global commitment has also gained momentum. In 2024, organizations such as the World Bank, the Bill & Melinda Gates Foundation, and UNICEF committed nearly $600 million to expand cervical cancer vaccination, screening, and treatment programs worldwide, focusing on resource-poor areas. In addition, experts such as Dr. César Paz-y-Miño highlight the importance of adapting prevention strategies to local epidemiological realities, promoting both vaccination and screening programs that respond to the genotypic characteristics of each region. This evidence reinforces the need to implement vaccination programs in the Esmeraldas that include the most prevalent genotypes and early detection strategies adapted to the local epidemiological profile, especially considering the feasibility of single-dose regimens and international support for their implementation.(12, 24, 25, 26, 27, 28, 29)

CONCLUSIONS

This study provides significant evidence on the genotypic diversity of the Human Papillomavirus (HPV) in a female population aged 18 to 70, approached from a multisectoral perspective in the canton of Esmeraldas.

The findings reveal a high frequency of high-risk genotypes, with HPV g31, HPV g58, HPV g52, and HPV g68 being the most prevalent, demonstrating their potential involvement in cervical oncogenesis within this region. In addition, a significant burden of multiple infections was identified, particularly in the 25-31 age group, reinforcing the hypothesis of greater vulnerability to co-infections in young women. The marked prevalence of oncogenic HPV genotypes and the variability observed by age group, with a higher incidence in young women but also with significant cases in middle-aged women, highlights the need for targeted preventive interventions, such as expanded vaccination schedules that include genotypes not included in traditional bivalent or tetravalent vaccines, early sex education, and timely and sustained screening programs, due to the considerable proportion of negative cases, which would enable the timely and effective detection of a fraction of the population not exposed or already cleared of the virus. However, this does not exclude the possibility of subclinical infections not detected by the methods used. Together, these results support the urgency of public health policies tailored to the local genotypic characteristics of HPV and the integration of robust epidemiological data into prevention program planning to monitor changes in viral circulation patterns and early diagnosis of cervical cancer by available scientific evidence.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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