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Characterization of human papillomavirus genotypes infections in patients with cervical lesions and cervical cancer in Urumqi, Xinjiang from 2016 to 2023

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Abstract

Background The persistence of high-risk human papillomavirus (HPV) infection is well-established as a key etiological factor in the progression to cervical intraepithelial neoplasia (CIN) and cervical cancer (CC). This study aims to investigate the clinical and epidemiological characteristics associated with HR-HPV infections diagnosed in conjunction with cervical intraepithelial lesions in Urumqi, Xinjiang.

Methods Between 2016 and 2023, we collected clinical data from 4,389 patients with cervical lesions who underwent colposcopic histopathological examination at the People's Hospital of Xinjiang Uygur Autonomous Region. Cervical samples were obtained for HPV DNA genotyping and cytological analysis. Patients presenting with cervical abnormalities or abnormal cytology results subsequently underwent cervical biopsy.

Results The prevalence of HPV infection among 4,389 patients with cervical lesions were found to be 98.95% (4,345/4,389). Specifically, the prevalence of HPV types 16 and 18 were 78.87% (1,314/1,666). The five most common genotypes identified were HPV types 16, 52, 58, 31, and 33, with infection rates of 34.57%, 19.54%, 12.45%, 8.98%, and 7.66%, respectively. Among the patients with cervical lesions, cervical inflammation was observed in 522 individuals (11.90%), while the distribution of cervical intraepithelial neoplasia (CIN) was as follows: CIN I in 644 patients (14.67%), CIN II in 1,067 patients (24.31%), CIN III in 1,041 patients (23.72%), and CC in 1,115 patients (25.40%). The distribution of patients in the CC group was most prevalent among those aged ≥ 60 years (47.99%, 322/671). A high prevalence was also observed in the 30~39 year age group within the CIN III group (29.47%, 275/933). Han and Uygur patients accounted for 85.90% of cervical lesion cases (3,770/4,389). Hui patients were predominantly identified within the CIN II group (34.12%), whereas Uighur patients were most frequently observed in CC group (36.60%) ($P < 0.005$).

Conclusions Patients with cervical lesions had high HPV prevalence in Urumqi, Xinjiang. The five most prevalent HPV types identified in this population are HPV 16, 52, 58, 31, and 33. Epidemiological studies focusing on high-risk HPV types hold significant clinical implications, particularly in informing and guiding HPV vaccination strategies.

Keywords Human papillomavirus, Cervical lesions, Cervical cancer, Vaccine, Xinjiang

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Background

Cervical cancer (CC) ranks as the fourth most prevalent gynecological malignancy, representing a significant global health concern that predominantly affects women [1, 2]. Global epidemiological surveillance data indicate that CC was responsible for approximately 604,127 newly reported cases and 341,831 mortality cases worldwide in 2020 [3]. Recent epidemiological data from China demonstrate a significant disease burden, with gynecological cancer diagnoses surpassing 258,000 cases in 2022, among which CC comprised 111,800 cases, accounting for 43.2% of all gynecological malignancies [4]. CC predominantly affects younger women, with peak incidence occurring between the ages of 35 and 44 years and a median age at diagnosis of 50 years [5]. Additionally, there are notable variations in the incidence and mortality rates of CC on a global scale.

Human papillomavirus (HPV), a small double-stranded DNA virus, encompasses over 200 identified genotypes [6, 7]. HPV can be broadly classified into high-risk genotypes, which are strongly associated with CC, and low-risk genotypes [8]. Notably, a majority exceeding 80% of females will experience at least once during their lifetime [9]. However, approximately 90% of these infections are expected to resolve spontaneously within a two-year timeframe [10]. Particularly significant is the fact that continuous infection with high-risk HPV is regarded as the main etiological element in the progression of cervical intraepithelial neoplasia (CIN) and CC. Combining primary prevention with HPV vaccination and secondary prevention with effective HPV testing and screening for cervical pre-cancer has proven to be highly effective [11]. Nonetheless, the distribution of HPV genotypes varies significantly across different regions and countries [12–14]. Therefore, it is important to understand HPV genotype distribution and prevalence in order to guide vaccination efforts and develop effective prevention and treatment strategies.

Urumqi, the capital of the Xinjiang Uyghur Autonomous Region in northwest China, is characterized by its vast territory and diverse ethnic population. Historically, the region has faced a high incidence of CC, exacerbated by limited medical resources [15]. The existing epidemiological literature on the distribution of HPV in Xinjiang is sparse. This study utilizes data derived from colposcopic pathology examinations conducted on patients at the People's Hospital of Xinjiang Uygur Autonomous Region from 2016 to 2023. The analysis focuses on the predominance and distribution of HPV genotypes and the demographic characteristics of patients with different cervical lesions, including age, ethnicity, and year of diagnosis. The objective is to establish a foundational framework for the timely prevention, detection, and management of CC, as well as to inform the promotion and implementation of targeted vaccination strategies for women in XinjingProvince.

Materials and methods

Clinical data

The clinical information of 4,389 patients who underwent colposcopy and histopathological examination in People's Hospital of Xinjiang Uygur Autonomous Region from January 2016 to December 2023. CC screening was performed using HPV-DNA testing and the ThinPrep cytologic test (TCT). In cases of abnormal test results, colposcopy and cervical biopsy were performed to diagnose cervical lesions.

Inclusion criteria: ① Patients have complete clinical data; ② Patients have undergone comprehensive colposcopy and pathological biopsy to assess the extent of lesions. Exclusion criteria: ① Individuals experiencing acute vaginal inflammation, or who have applied vaginal medications or participated in sexual intercourse within 72 h; ② Patients with a history of treatment for cervical precancerous lesions, as well as those who have undergone hysterectomy due to such conditions; ③ Pregnant or lactating women; ④ Patients with incomplete clinical data.

Methods

HPV sampling and testing methods

The gynecologist utilized a cotton swab to remove excess mucus from the cervix and subsequently employed an HPV detection brush, performing five clockwise rotations to facilitate the adherence of mucosal cells and secretions. The tips of the cervical brush were then placed separately into vials containing transport medium and stored at 2～8 °C until HPV DNA extraction and genotyping could be conducted. The genotyping was carried out using a PCR assay developed by QIAGEN Enterprises Management Co., Ltd. (Shanghai, China), capable of detecting 15 HR-HPV genotypes (16, 18, 31, 33, 35, 39, 45, 51, 52, 53, 56, 58, 59, 66, and 68). The manufacturer's instructions were followed for all detection procedures.

Thinprep Cytologic Test (TCT)

Specimen collection procedures are consistent with those utilized for HPV sampling. The interpretation of results is conducted following evaluation and diagnosis by a pathologist. According to the 2014 Bethesda System for Reporting Cervical Cytology (TBS), TCT results are classified into several categories: negative for intraepithelial lesion or malignancy (NILM), atypical squamous of undermined significance (ASC-US), atypical squamous cell-cannot exclude HSIL (ASC-H), atypical glandular cells (AGC), low-grade squamous intraepithelial lesion (LSIL), high-grade squamous intraepithelial lesion (HSIL), squamous cell carcinoma (SCC) and adenocarcinoma.

Colposcopy and pathological diagnosis

Patients undergoing CC screening who have any of the following indications should be referred for colposcopy: (1) positive for HPV 16 or 18; (2) positive for other HPV types in combination with TCT result of ASC-US or higher; (3) negative for HPV but with TCT result of LSIL or higher. Colposcopy and tissue biopsy should be conducted by gynecologists who possess both the requisite training and experience in these procedures. All targeted biopsies from suspicious lesions should be submitted to the pathology department for histological assessment. The results should be categorized based on the presence of inflammation (indicating no squamous epithelial lesions), CIN grade (1~3), and cervical cancer.

Statistical analysis

A database was established and visualized using Microsoft Excel (version 2021), with subsequent data analysis conducted using SPSS software (version 27.0). The prevalence of HPV genotypes has been assessed annually. Count data are presented as the number of cases (n) and percentages (%). Comparisons of rates among multiple groups are performed using the Chi-square test, with a significance threshold set at $P < 0.05$ to indicate statistically significant differences.

Results

Prevalence of HPV genotypes in the cervical lesion samples

A retrospective analysis of colposcopy data was conducted involving 4,581 patients with cervical lesions from 2016 to 2023 (Fig. 1). The age of participants ranged from 18 to 88 years, with a mean age of 47.29 years. Due to incomplete data for certain individuals, the final study cohort comprised 4,389 patients. Among these, 4,345 were identified as positive for high-risk HPV infections, yielding a prevalence rate of 98.95% (4,345/4,389). The distribution of specific HPV genotypes revealed the following top five infection rates: HPV-16 at 34.57% (1,502/4,345), HPV-52 at 19.54% (849/4,345), HPV-58 at

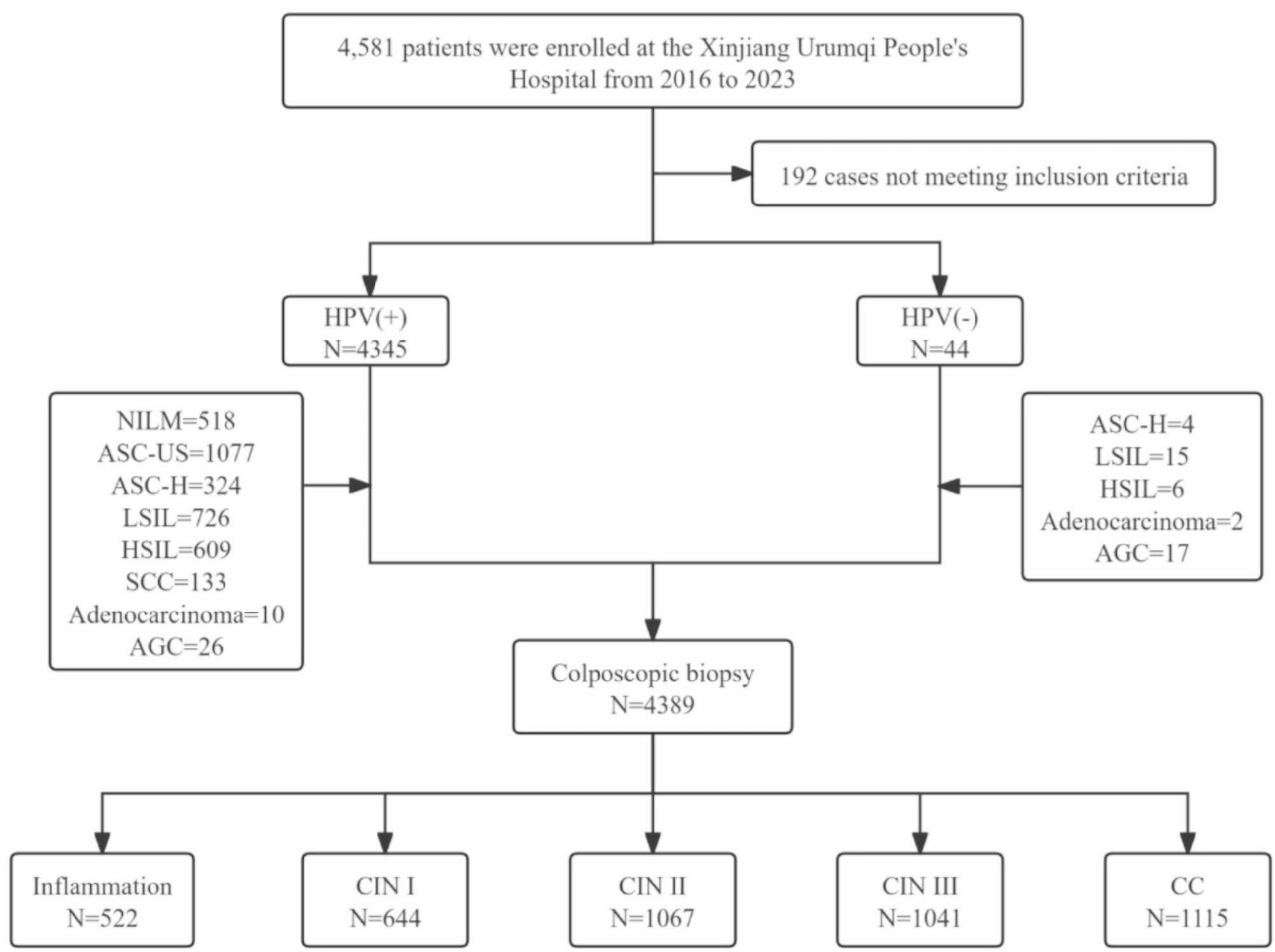

Fig. 1 Flowchart of the study population

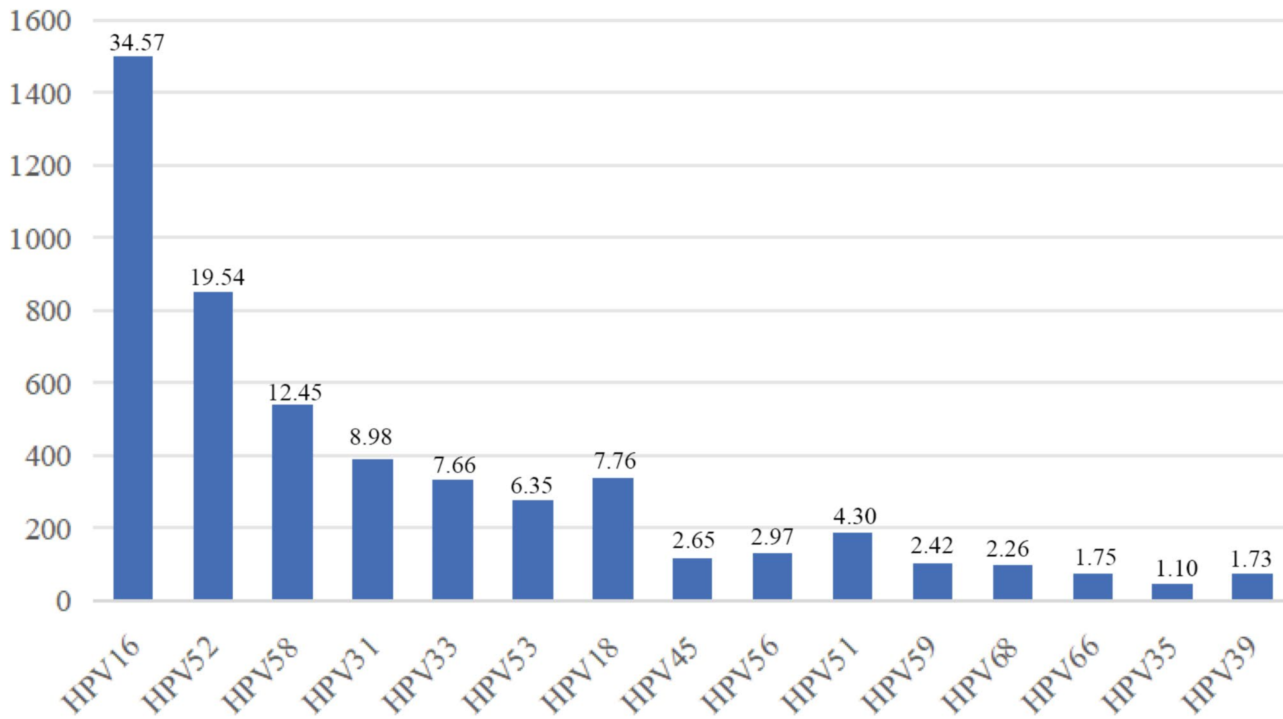

Fig. 2 The distribution of HPV genotypes

Table 1 Distribution of HPV genotypes according to histological abnormalities [n(%)]

HPV subtype	*N*	Inflammation (*n* = 522)	CIN I (*n* = 644)	CIN II (*n* = 1067)	CIN III (*n* = 1041)	CC (*n* = 1115)
HPV16	1502	119(22.80)	191(29.66)	313(29.33)	386(37.08)	493(44.22)
HPV52	849	97(18.58)	130(20.19)	207(19.40)	216(20.75)	199(17.85)
HPV58	541	82(15.71)	83(12.89)	167(15.65)	113(10.85)	96(8.61)
HPV31	390	47(9.00)	55(8.54)	101(9.47)	94(9.03)	93(8.34)
HPV33	333	44(8.43)	51(7.92)	92(8.62)	72(6.92)	74(6.64)
HPV53	276	46(8.81)	41(6.37)	83(7.78)	74(7.11)	32(2.87)
HPV18	337	36(6.90)	49(7.61)	80(7.50)	91(8.74)	81(7.26)
HPV45	115	16(3.07)	22(3.42)	22(2.06)	26(2.50)	29(2.60)
HPV56	129	22(4.21)	21(3.26)	32(3.00)	28(2.69)	26(2.33)
HPV51	187	26(4.98)	43(6.68)	42(3.94)	30(2.88)	46(4.13)
HPV59	105	12(2.30)	19(2.95)	30(2.81)	25(2.40)	19(1.70)
HPV68	98	8(1.53)	12(1.86)	31(2.91)	23(2.21)	24(2.15)
HPV66	76	15(2.87)	15(2.33)	15(1.41)	12(1.15)	19(1.70)
HPV35	48	6(1.15)	2(0.31)	17(1.59)	15(1.44)	8(0.72)
HPV39	75	13(2.49)	12(1.86)	23(2.16)	10(0.96)	17(1.52)
HPV(-)	44	12(2.30)	4(0.62)	1(0.09)	3(0.29)	24(2.15)

12.45% (541/4,345), HPV-31 at 8.98% (390/4,345), and HPV-33 at 7.66% (333/4,345). Notably, HPV-18 was identified as the seventh most prevalent high-risk HPV genotype (Fig. 2).

Among the 4,389 cervical lesion samples analyzed, there were 522 cases of inflammation, 644 cases of CIN I, 1,067 cases of CIN II, 1,041 cases of CIN III, and 1,115 cases of CC. The prevalence and HPV genotype distribution of cervical abnormalities are summarized in Table 1. In the inflammation group, the predominant HPV types identified were HPV16, 52, 58, 31, and 53. In the CIN I and CIN II groups, the most prevalent types were HPV16, 52, 58, 31, and 33. For the CIN III and CC groups, the predominant HPV types included HPV16, 52, 58, 31, and 18 (Fig. 3). Overall, HPV16, HPV52, and HPV58 emerged as the most prevalent subtypes associated with cervical lesions.

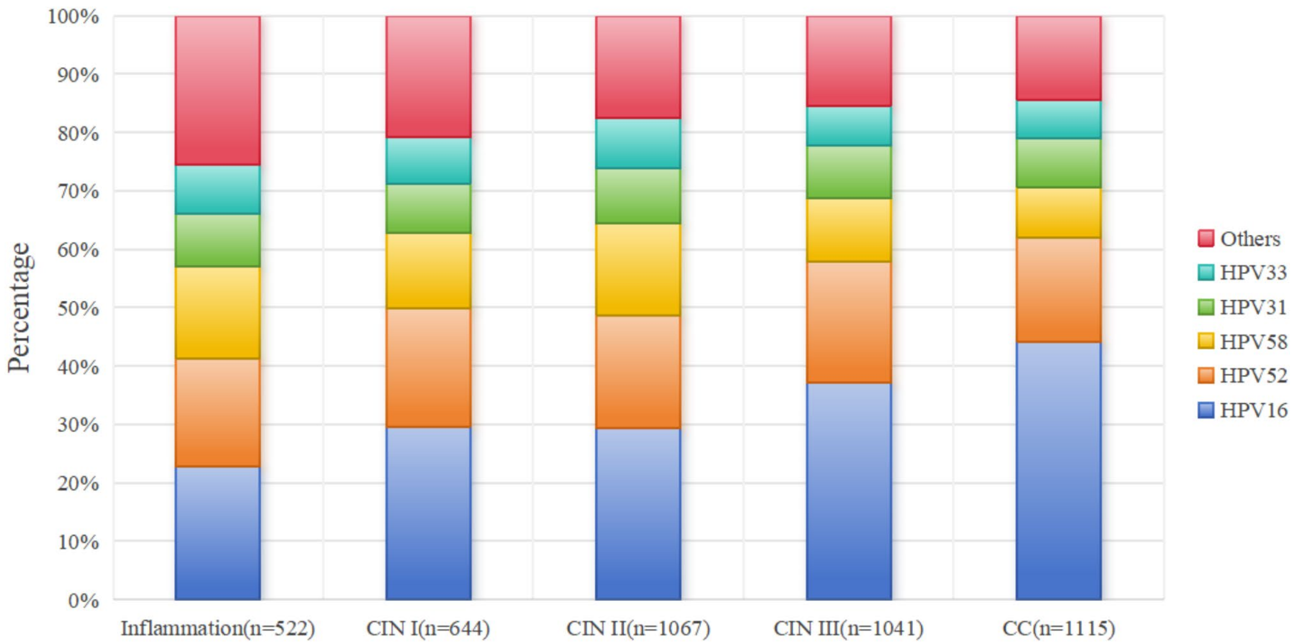

Fig. 3 Distribution of the top five HPV infection in different levels of cervical lesions among women in Urumqi

Table 2 Comparison of the prevalence of HPV16/18 infection relative to other HR-HPV types among 4345 patients [n(%)]

HPV type	*N*	Inflammation	CIN I	CIN II	CIN III	CC
HPV16/18 (+)	1666	139(8.34)	213(12.79)	345(20.71)	434(26.05)	535(32.11)
HR-HPV (+)	2679	371(13.85)	427(15.94)	721(26.91)	604(22.55)	556(20.75)
x^2	107.641					
P	<0.001					

HPV 16/18 and HR-HPV type distribution in cervical lesions

Among HPV16/18 positive patients, the proportion of CIN II to CC cases were notably higher (78.87%, 1,314/1,666), while the inflammation group had the lowest representation (8.34%, 139/1,666). In contrast, in patients with HR-HPV infections, the distribution were more evenly spread, with CIN II cases (26.91%, 721/2,679) comprising the largest proportion and inflammation cases (13.85%, 371/2,679) being the least represented ($P<0.001$) (Table 2).

Analysis of HPV infection rates across various age groups over different years

Patients were categorized into five age groups: <30 years, 30~39 years, 40~49 years, 50~59 years, and ≥60 years. The HPV positivity rates among individuals in the <30, 30~39, 40~49, and ≥60 age groups exhibited statistically significant differences across the years ($P<0.05$). Notably, HPV infection rates in the <30 and 30~39 age groups demonstrated a consistent upward trend over the years, with the highest positivity rates recorded in 2023 compared to previous years. In contrast, HPV positivity rate in the 40~49 age group displayed a downward trend, peaking in 2018 and declining to its lowest level by 2023 (Table 3).

The distribution of cervical lesions among patients across various age groups

Table 4 shows the age-stratified distribution of cervical lesions in Urumqi. The highest prevalence of patients in the CC group were observed among individuals aged ≥60 years (47.99%, 322/671), while the lowest prevalence were noted in the <30 years age group (6.84%, 18/263). In the cohort with inflammation, the 50~59 years age group exhibited the highest rate (18.54%, 214/1,154), whereas the lowest rate were recorded in the 30~39 years age group (6.86%, 64/933). Among women diagnosed with CIN I, the 40~49 years age group demonstrated the highest prevalence (17.69%, 242/1,368). Notably, within the CIN III group, a significant prevalence was also identified in the 30~39 years age group ($P<0.001$).

Comparison of colposcopy in different ethnic patients

Among the 4389 women in Xinjiang, the ethnic distribution included 2,068 Han, 1,702 Uighur, 326 Kazakh, 170 Hui, and 123 women from other ethnic minorities (Table 5). The HPV infection rates were observed to be 47.12%,

Table 3 Comparison of HPV prevalence across various age groups in different years [n(%)]

Year	*N*	<30	30 ~ 39	40 ~ 49	50 ~ 59	≥ 60
2016	310	9(2.90)	55(17.74)	119(38.39)	84(27.10)	43(13.87)
2017	415	23(5.54)	60(14.46)	156(37.59)	101(24.34)	75(18.07)
2018	428	20(4.67)	71(16.59)	166(38.79)	95(22.20)	76(17.75)
2019	462	21(4.55)	86(18.61)	156(33.77)	142(30.74)	57(12.33)
2020	478	17(3.56)	95(19.87)	155(32.43)	122(25.52)	89(18.62)
2021	834	49(5.88)	200(23.98)	218(26.14)	234(28.06)	133(15.94)
2022	532	44(8.27)	123(23.12)	151(28.38)	143(26.88)	71(13.35)
2023	886	75(8.47)	240(27.09)	231(26.07)	219(24.72)	121(13.65)
x^2		28.231	44.314	51.411	12.059	15.815
P		< 0.001	< 0.001	< 0.001	0.099	0.027

Table 4 Comparison of colposcopic pathology of different age groups [n(%)]

Age (years)	*N*	Inflammation (*n* = 522)	CIN I (*n* = 644)	CIN II (*n* = 1067)	CIN III (*n* = 1041)	CC (*n* = 1115)
<30	263	19(7.22)	41(15.59)	120(45.63)	65(24.72)	18(6.84)
30 ~ 39	933	64(6.86)	150(16.08)	346(37.08)	275(29.47)	98(10.51)
40 ~ 49	1368	146(10.67)	242(17.69)	327(23.90)	367(26.83)	286(20.91)
50 ~ 59	1154	214(18.54)	166(14.38)	183(15.86)	200(17.34)	391(33.88)
≥ 60	671	79(11.77)	45(6.71)	91(13.56)	134(19.97)	322(47.99)
x^2		78.700	45.683	234.750	55.773	396.081
P		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Table 5 Comparison of colposcopic pathology of different ethnicities [n(%)]

Type	*N*	Inflammation (*n* = 522)	CIN I (*n* = 644)	CIN II (*n* = 1067)	CIN III (*n* = 1041)	CC (*n* = 1115)
Han	2068	287(13.88)	322(15.57)	587(28.38)	502(24.28)	370(17.89)
Uighur	1702	164(9.64)	221(12.98)	292(17.16)	402(23.62)	623(36.60)
Kazakh	326	32(9.82)	66(20.25)	96(29.45)	66(20.24)	66(20.24)
Hui	170	23(13.53)	22(12.94)	58(34.12)	39(22.94)	28(16.47)
Other	123	16(13.01)	13(10.57)	34(27.64)	32(26.02)	28(22.76)
x^2		17.976	15.353	80.303	2.952	186.435
P		0.001	0.004	< 0.001	0.566	< 0.001

38.78%, 7.43%, 3.87%, and 2.80%, respectively. Statistically significant differences were identified in the rates of inflammation, CIN I, CIN II, and CC across the ethnic groups ($P < 0.001$). Within the CIN I group, Kazakh individuals represented the highest proportion at 20.25% (66/326). In the CIN II group, Hui individuals exhibited the highest prevalence rate at 34.12% (58/170). Conversely, in the CC group, Uighur individuals constituted the largest proportion at 36.60% (623/1,702).

Comparative analysis of colposcopy results across different years

The number of individuals undergoing colposcopy exhibited a progressive increase from 2016 to 2023 (Table 6). The proportion of cases diagnosed with CIN III + was 79.42% (247/311) in 2016, 76.12% (322/423) in 2017, 64.60% (281/435) in 2018, and 55.48% (258/465) in 2019. This trend continued with 56.79% (276/486) in 2020, followed by a notable decline to 33.81% (283/837) in 2021, 32.47% (175/539) in 2022, and 35.16% (314/893) in 2023, indicating a gradual decrease over the years. Conversely, the incidence of inflammation, CIN I, and CIN II have shown a consistent upward trend annually. It is noteworthy that the positive rate of CIN III in 2016 was significantly higher than in subsequent years. Furthermore, the positive rate of CC in 2017 was also markedly elevated compared to other years, with the difference reaching statistical significance ($P < 0.001$).

Discussion

In recent years, the incidence and mortality rates of CC in China have exhibited an increasing trend, with average annual increases of 8.5% and 5.4%, respectively, between 2000 and 2016 [16, 17]. China's extensive territory and substantial population contribute to significant variability in the prevalence of HPV across the country, with reported rates ranging from 6.2～50.64% [18, 19]. The incidence of CC in Xinjiang is significantly higher than

Table 6 Comparison of colposcopy biopsy results of different years [n(%)]

Year	*N*	Inflammation (*n* = 522)	CIN I (*n* = 644)	CIN II (*n* = 1067)	CIN III (*n* = 1041)	CC (*n* = 1115)
2016	311	12(3.86)	23(7.40)	29(9.32)	113(36.33)	134(43.09)
2017	423	21(4.96)	28(6.62)	52(12.29)	135(31.91)	187(44.21)
2018	435	16(3.68)	52(11.95)	86(19.77)	123(28.28)	158(36.32)
2019	465	26(5.59)	62(13.33)	119(25.59)	105(22.58)	153(32.90)
2020	486	38(7.82)	42(8.64)	130(26.75)	140(28.81)	136(27.98)
2021	837	122(14.58)	189(22.58)	243(29.03)	166(19.83)	117(13.98)
2022	539	114(21.15)	105(19.48)	145(26.90)	85(15.77)	90(16.70)
2023	893	173(19.37)	143(16.01)	263(29.45)	174(19.48)	140(15.68)
x^2		189.378	105.459	102.948	89.999	296.905
P		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

the national average, with an alarming trend showing a shift towards younger age groups at the time of diagnosis [20]. However, the available literature regarding the prevalence of HPV in the Xinjiang region is notably limited. Consequently, determining the prevalence and distribution of type-specific HPV is an essential component in formulating effective prevention and control strategies to reduce the incidence of CC.

The prevalence of HPV infection is known to vary significantly across different countries and regions [21–23]. A global study of 215,568 women with normal cytological results identified the most common HPV types to be 16, 18, 52, 31, 58, 39, 51, and 56 [24]. In this study, the predominant types were 16, 52, 58, 31, and 33, which differ from those reported in Shanghai (HPV 52, 16, 58, 53, and 61) [25], Zhejiang (HPV 52, 58, CP 8304, 16, and 51) [26], Guangzhou (HPV 52, 16, 58, 53, and 81) [27], and 37 other cities (HPV 16, 52, 6, 58, and 11) [28]. These variations underscore the regional differences in HPV genotype distribution that are influenced by regional healthcare awareness, economical conditions, and lifestyle factors. It is imperative that these regional differences in HPV genotype distribution be considered when developing vaccines tailored to specific geographic regions. The findings regarding HPV genotype distribution in this study may inform the development and implementation of vaccines in Xinjiang.

High-risk HPV infection is associated with developing precancerous lesions and CC [29]. Our findings indicate that the distribution of HR-HPV genotypes correlates directly with the severity of cervical biopsy results. A large prospective Danish study found that the absolute risk of developing CIN 3 or higher within eight years was 21.8% for HPV type 16 and 12.8% for HPV type 18 in women aged 30 years and older [30]. Furthermore, previous studies have established that persistent infection with HR-HPV within one to two years following the initial HPV infection serves as a significant predictor for the development of precancerous lesions and invasive CC [31]. In our study, HPV types 16 and 18 were the predominant subtypes, with incidences of 12.79%, 20.71%, 26.05%, and 32.11% observed in the CIN I, CIN II, CIN III, and CC groups, respectively. The incidence of HPV 16/18 infection exhibited a progressive increase corresponding to the severity of cervical lesions, underscoring the prevalence of these subtypes in more advanced stages of disease. Consequently, individuals with HPV 16/18positive infections should be prioritized for routine management.

Viral, host, and environmental factors significantly influence the trajectory of HPV infection. As a sexually transmitted infection, HPV predominantly affects sexually active women, particularly those with HR-HPV types. Wang et al. demonstrated that the prevalence of HPV infection exhibits a "U-shaped" distribution across different age groups, peaking in individuals under 16 years, followed by a gradual decline, reaching its nadir between the ages of 41～45, before rising again after the age of 50 [32]. In our study, women aged 40～59 exhibited a notably higher prevalence of HPV infection compared to other age groups, corroborating findings from previous research. This trend may be attributed to a reduced clearance rate of HPV associated with hormonal changes in middle-aged and older women. Additionally, the compromised functionality of the immune system in this demographic heightens the risk of persistent HPV infections. Conversely, the prevalence of HPV among younger women remains relatively low, potentially due to their limited awareness of the issue and subsequent neglect of screening practices. Furthermore, there has been a marked increase in the number of patients diagnosed with cervical lesions since 2021. Notably, within the CC cohort, the age group with the highest prevalence of HPV infection was ≥60 years (prevalence: 47.99%). This rate exceeds the prevalence in the 50～59 age group in a Taizhou study [33], as well as the prevalence in the 40～44 age group in Shanghai and Zhejiang studies [34]. Therefore, the implementation of a vaccination program prior to potential HPV exposure in adolescents may significantly reduce HPV infection rates. Additionally, in light of the increasing incidence of HPV infection among women over 60, it is advisable to reassess and potentially raise the upper age limit for CC screening.

Differences in genetic susceptibility to HPV infection may vary among racial and ethnic groups, an important factor to consider [35]. The Xinjiang Uyghur Autonomous Region, located in northwestern China, is a geographically extensive and culturally diverse area inhabited by various ethnic groups, including the Uyghur, Han, Kazakh, and Hui. Misconceptions regarding the significance of HPV testing and prevention, combined with inadequate healthcare infrastructure and the region's vast expanse, have impeded the establishment of effective diagnostic programs in Xinjiang. Therefore, it is essential to conduct a comprehensive analysis of the characteristics of HPV infection and cervical lesions among the different ethnic groups in this region. In this study, we identified significant variations in the prevalence of cervical lesions across ethnic groups, with notably higher rates observed in the Han and Uyghur populations compared to the Kazakh and Hui populations. Among the groups studied, the Uyghurs exhibited the highest prevalence in the CC category (26.60%), the Hui had the highest prevalence in the CIN II group (34.12%), and the Kazakhs had the highest prevalence in the CIN I group (20.25%). These variations may be attributed to differences in the rate of HPV integration into host genomes among different ethnic groups, which is closely related to the immune status of patients. Additionally, these disparities could be associated with factors such as genetic polymorphisms, sexual practices, immune system deficiencies, HPV vaccination coverage, and the geographic and cultural diversity within the studied population [36, 37].

The findings in this report are subject to at least three limitations. First, the study did not include all of the women with cervical lesions in Xinjiang because it was a hospital-based survey with a limited sample size. Secondly, vaccination rates among women were not accounted for, which precluded an assessment of the vaccine's specific impact on HPV infection rates. Additionally, patient information such as maternal history, education level, and lifestyle factors associated with HPV infection was not recorded, thereby limiting the comprehensive evaluation of factors influencing HPV prevalence. Future studies should aim to include a larger and more representative population.

Conclusions

In conclusion, this study systematically examines the prevalence of cervical lesions in Urumqi, Xinjiang, over an eight-year period, while also analyzing the distribution characteristics of various HPV genotypes. Additionally, it explores the prevalence of cervical lesions across different age groups, genders, and ethnicities. The findings offer significant insights into the early prevention and clinical management of CC and contribute essential data for the formulation of prevention strategies and vaccination programs aimed at addressing HPV infection in Xinjiang.

Abbreviations

CC	Cervical cancer
HR-HPV	High-risk human papillomavirus
TCT	Thinprep cytologic test
PCR	Polymerase Chain Reaction
LSIL	Low-grade cervical intraepithelial lesion
HSIL	High-grade cervical intraepithelial lesion
NILM	Negative for intraepithelial lesion or malignancy
ASC-US	Atypical squamous cells of undetermined significance
ASC-H	Atypical squamous cells cannot exclude high-grade squamous intraepithelial lesion
AGC	Atypical glandular cells
SCC	Squamous cell carcinoma
CIN	Cervical intra-epithelial neoplasia

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Author contributions

LLH and YW conceived and designed the study, taking responsibility for the content of the manuscript. YW, SHZ and YR collected clinical data. YW and RM analyzed the data and chart organization. YW wrote the first draft of the manuscript. LLH reviewed the paper. All authors were involved in the revision of the manuscript for important intellectual content and approved the final version to be published.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study has been approved by the Ethics Committee of the People's Hospital of Xinjiang Uygur Autonomous Region (KY2022080502). The study complied with the ethical requirements of the Declaration of Helsinki of the World Medical Association. Written informed consent was obtained from each patient.

Consent for publication

The authors agree to publication.

Competing interests

The authors declare no competing interests.

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