

ความชุกของการติดเชื้อ Human papillomavirus ชนิดความเสี่ยงสูง และความสัมพันธ์กับผลการตรวจ ทางเซลล์วิทยา ในสตรีจังหวัดกาฬสินธุ์

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กลุ่มงานเทคนิคการแพทย์และพยาธิวิทยาคลินิก โรงพยาบาลกาฬสินธุ์ จังหวัดกาฬสินธุ์

บทคัดย่อ

การศึกษานี้ตรวจหาความชุกของการติดเชื้อ HPV สายพันธุ์ความเสี่ยงสูง และประเมินความสัมพันธ์ระหว่างการติดเชื้อ HPV non 16, 18 กับผลตรวจทางเซลล์วิทยาของสตรี จำนวน 45,019 ราย ที่เข้าร่วมโครงการตรวจคัดกรองมะเร็งปากมดลูก ในจังหวัดกาฬสินธุ์ ระหว่างปี 2020-2023 ด้วยวิธี HPV DNA test ครอบคลุมทั้ง 14 จีโนไทป์ ในรายที่ติดเชื้อ HPV non 16, 18 ได้ส่งตรวจ liquid based cytology (LBC) เพิ่มเติม ผลการศึกษาพบว่าความชุกของการติดเชื้อ HPV ในการศึกษาครั้งนี้ คือร้อยละ 5.27 จีโนไทป์ที่พบความชุกมากที่สุด 3 อันดับแรก คือ HPV 16 (ร้อยละ 1.04) HPV 52 (ร้อยละ 0.90) และ HPV 58 (ร้อยละ 0.63) ตามลำดับ โดยร้อยละ 83.46 ของผู้เข้าร่วมงานวิจัยเป็นการติดเชื้อเพียงจีโนไทป์เดียวที่เหลือ (ร้อยละ 16.54) เป็นการติดเชื้อผสม ช่วงอายุ 30-34 ปี พบความชุกการติดเชื้อมากที่สุดคือ ร้อยละ 11.36 และความชุกการติดเชื้อลดลงเมื่อช่วงอายุมากขึ้น จากการศึกษาความผิดปกติของเซลล์ต่อการติดเชื้อ HPV non 16, 18 พบความผิดปกติของเซลล์ในการติดเชื้อผสม (ร้อยละ 33.14) มากกว่าการติดเชื้อจีโนไทป์เดียว (ร้อยละ 26.20) จีโนไทป์ที่พบเซลล์ผิดปกติมากที่สุดคือ HPV 33 (ร้อยละ 35.56) HPV 51 (ร้อยละ 34.52) และ HPV 56 (ร้อยละ 33.96) ตามลำดับ ช่วงอายุที่พบเซลล์ผิดปกติมากที่สุดคือ 45-49 ปี (ร้อยละ 32.34) การศึกษาความชุกของ HPV และความสัมพันธ์กับผลการตรวจทางเซลล์วิทยาในแต่ละภูมิภาคของประเทศไทยมีความสำคัญเพื่อการวางแผนการตรวจคัดกรอง และการรักษามะเร็งปากมดลูก รวมทั้งเป็นแนวทางในการใช้และพัฒนาวัดชี้ให้เหมาะสมกับพื้นที่ต่อไป

คำสำคัญ: ความชุกของการติดเชื้อ HPV มะเร็งปากมดลูก HPV สายพันธุ์ความเสี่ยงสูง

Prevalence of High-risk Human Papillomavirus Infection and Relationship with Cytological Results, among Women in Kalasin Province

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Abstract

This study investigated the prevalence of high-risk HPV infection and evaluated the relationship between the HPV non 16, 18 infections, and cytological results among 45,019 women who participated in the cervical cancer screening program in Kalasin Province during 2020–2023 using HPV DNA test covering all 14 genotypes. For those infected with HPV non-16, 18, liquid-based cytology (LBC) was used for further investigation. The results showed that HPV prevalence in this study was 5.27%. The top three prevalent HPV types were HPV 16 (1.04%), HPV 52 (0.90%), and HPV 58 (0.63%), respectively. Most participants (83.46%) had single infections and the others (16.54%) had multiple infections. The age group of 30–34 years had the highest infection prevalence at 11.36% and the prevalence decreased when age increased. From cellular cytology's results in HPV non 16, 18 infections, cell abnormalities were found higher in multiple infections (33.14%) than those in single infection (26.20%). The genotypes with the highest abnormal cells were HPV 33 (35.56%), HPV 51 (34.52%), and HPV 56 (33.96%), respectively. The age group with the highest abnormal cells was 45–49 years (32.34%). HPV prevalence study and its relationship with cytological results in each region is crucial as it can be used for cervical cancer screening and early treatment plan. Moreover, this data can be used for appropriate vaccine usage and development in specific areas.

Keywords: Prevalence of HPV infection, Cervical cancer, High-risk HPV

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Introduction

Cervical cancer is a major health problem among women in Thailand. It is the third most common cancer after breast cancer and liver and biliary tract cancer. The incidence is 11.1/100,000 women, accounting for approximately 5,422 new cases. Each year, around 2,300 women die from cervical cancer.⁽¹⁾ Moreover, in 2020, the Catalan Institute of Oncology (CIO) and the International Agency for Research on Cancer (IARC) reported that cervical cancer is the fourth most common cancer in women worldwide, following breast cancer, colon and rectum cancer, and lung cancer, which has an incidence of 15.6/100,000 women, with a mortality rate of 8.8/100,000 women.⁽²⁾ The major etiology of cervical cancer is the Human papillomavirus or HPV infection in the cervical area. Risk factors for HPV infection include having multiple sexual partners, early sexual initiation, and teenage pregnancy. Within 1-2 years after infection, most people can naturally recover. However, some people remain infected, which is an important cause of cervical cancer.⁽³⁾ HPV is divided into two groups according to the risk of causing cancer. The high-risk group, including HPV 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 66, and 68,^(4,5) especially HPV 16 and 18, are found up to 70% of

cervical cancer patients.^(6,7) In squamous cell carcinoma, HPV 16 (50-60%) is the most prevalent followed by HPV 18 (15-20%). In contrast, in adenocarcinoma, HPV 18 (50%) is the most prevalent, followed by HPV 16 (35-40%).⁽⁸⁾ The low-risk HPV group, which has a low carcinogenic potential, causes genital warts (condyloma) including HPV 6, 11, 42, 43, 44, 53, 55, 56, 62 and 70. The most prevalent types are HPV 6 and 11.^(9,10) Currently, according to the cervical cancer screening guidelines of the National Health Security Office (NHSO) using HPV DNA tests, it is recommended that the cases detected HPV type 16 or 18 should be further diagnosed by colposcopy. For cases detected HPV non 16-18, cytological examination should be the first investigation. If the results are ASCUS level of abnormal, colposcopy should be performed subsequently. In the fiscal year 2024, there has been a preventive campaign for HPV vaccination in Thai women aged 11-20 years. The first generation of vaccine was only for 2 high-risk genotypes, HPV 16 and 18. Then, the low-risk genotypes, HPV 6, 11, were added to prevent genital warts. The latest vaccine consists of 9 genotypes, adding 5 other high-risk genotypes including, HPV 31, 33, 45, 52 and 58 to cover more infections.⁽¹¹⁾ Studies have shown that there are various

HPV genotype distributions among different areas around the world.^(12,13) Therefore, this work aimed to study the prevalence of high-risk HPV infection and its relationship between HPV non 16, 18 infection and cytological results among women in Kalasin province. The outcome of this study will be used for cervical cancer screening and early treatment plan. Moreover, this data can be used for vaccine selection and development to cover more specific genotypes.

Materials and Methods

1. Sample Selection

This is a retrospective study of 45,019 Thai women inhabited in Kalasin province, who have been classified into age groups including, < 30, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, > 60 years, and an unidentified age group, and had a cervical cancer screening using HPV DNA test at Kalasin Hospital from October 1, 2020, to September 30, 2023, under the National Health Security Office (NHSO) project. All women had never had a screening test by HPV DNA before. They also provided information on their age, marital status, HPV vaccination, sexual history, pregnancy history, and cervical cancer screening history in the HPV Screening Program. This study was approved by the Human Research Ethics

Committee of Kalasin Hospital, Reference number: Kalasin Hospital 039/2023.

2. Sample collection

There are 2 methods of collecting cervical cell samples:

First, samples were collected by staff and placed in a cell preservation solution (PreservCyt® Solution ThinPrep Pap test, USA) using a cell collection device with a handle (Broom-type sampling device, Digene corporation, USA). Second, samples were self-collected from cervix and placed in a cell preservation solution (EASYPREP® YD Diagnostics, Korea).

3. HPV detection by Real-time PCR

The samples preserved in the solution were extracted DNA using a Nucleic Acid Extraction Kit (Magnetic Bead Method (Zybio), Germany). The 14 high-risk HPV DNA including HPV 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66 and 68 were detected using a ready-to-use test kit (Seegene Anyplex™ II HPV HR Detection, Korea) with a CFX96 Real-time PCR system®, Bio-Rad IVD, USA. The beta-globin gene was used as an internal cellular control. The results were evaluated using the Seegene viewer for Real-time Instrument program, Korea.

4. Cytological testing

Participants' samples detected HPV non 16, 18 were further investigated using liquid based cytology (LBC) at the Department of Pathology, Faculty of Medicine, Khon Kaen University, Khon Kaen Province, Thailand. For all cases, the results were reported according to the Bethesda system and approved by a pathologist.

5. Data collection and statistical analysis

HPV DNA results were collected from the Laboratory Information System (LIS) program of Department of Medical Technology and Clinical Pathology, Kalasin Hospital.

The information could not be analyzed differentially by sample collection methods due to lack of identification in the LIS program. Therefore, the prevalence of HPV infection was analyzed from samples with 2 collection methods using descriptive statistics and the Seegene SG STATS program and relationship analysis between HPV non

16, 18 infections and cytological results was analyzed using Chi-Square test. A *p*-value of less than 0.05 was statistically significant.

Results

1. Prevalence of high-risk HPV infections

From a total of 45,019 samples screened for high-risk HPV infection, samples were collected from women age group 50-54 years (*n* = 12,159, 27.00%), 55-59 years (*n* = 10,265, 22.80%), and 45-49 years (*n* = 9,272, 20.60%), respectively. There were 2,371 (5.27%) infected HPV cases divided into 468 cases (1.04%) of HPV 16, 154 cases (0.34%) of HPV 18, and 1,749 cases (3.53%) of non 16, 18. The top three genotypes were HPV 16 (468 cases, 1.04%), HPV 52 (404 cases, 0.90%) and HPV 58 (284 cases, 0.63%), respectively. The HPV 35 was found the least (36 cases, 0.08%). The highest HPV infection was found in the age group of 30-34 years (247 cases, 11.36%), as shown in Table 1.

Table1 The prevalence of high-risk HPV infection among women in Kalasin Province (2020-2023).

HPV infection N (%)	Age range (year)								Not specified	total
	<30	30-34	35-39	40-44	45-49	50-54	55-59	>60		
	85 (0.19)	2,174 (4.83)	3,529 (7.84)	5,382 (11.96)	9,272 (20.60)	12,159 (27.00)	10,265 (22.80)	409 (0.91)	1,744 (3.87)	45,019 (100)
HPV negative	78 (91.76)	1,927 (88.64)	3,246 (91.98)	5,026 (93.38)	8,844 (95.38)	11,657 (95.87)	9,854 (95.99)	399 (97.54)	1,617 (92.71)	42,648 (94.73)
HPV positive	7 (8.24)	247 (11.36)	283 (8.02)	356 (6.62)	428 (4.62)	502 (4.13)	411 (4.01)	10 (2.46)	127 (7.29)	2,371 (5.27)
HPV16	0 (0.00)	54 (2.48)	65 (1.84)	77 (1.43)	82 (0.88)	88 (0.72)	67 (0.65)	1 (0.24)	34 (1.95)	468 (1.04)
HPV18	0 (0.00)	15 (0.69)	14 (0.39)	33 (0.61)	26 (0.28)	26 (0.21)	24 (0.23)	2 (0.49)	14 (0.80)	154 (0.34)
Non 16, 18	7 (8.24)	178 (8.19)	204 (5.79)	246 (4.58)	320 (3.46)	388 (3.20)	320 (3.13)	7 (1.73)	79 (4.54)	1,749 (3.53)
HPV31	0 (0.00)	19 (0.87)	20 (0.56)	15 (0.27)	19 (0.20)	21 (0.17)	12 (0.11)	0 (0.00)	3 (0.17)	109 (0.24)
HPV33	0 (0.00)	5 (0.23)	13 (0.36)	20 (0.37)	22 (0.23)	17 (0.14)	21 (0.20)	1 (0.24)	4 (0.22)	103 (0.23)
HPV35	0 (0.00)	3 (0.13)	6 (0.17)	2 (0.03)	11 (0.11)	8 (0.06)	5 (0.04)	0 (0.00)	1 (0.05)	36 (0.08)
HPV39	1 (1.18)	23 (1.05)	37 (1.04)	31 (0.57)	38 (0.41)	41 (0.33)	48 (0.46)	0 (0.00)	9 (0.51)	228 (0.51)
HPV45	0 (0.00)	8 (0.36)	10 (0.28)	11 (0.20)	17 (0.18)	19 (0.15)	14 (0.13)	0 (0.00)	5 (0.28)	84 (0.19)
HPV51	0 (0.00)	19 (0.87)	22 (0.62)	30 (0.55)	37 (0.39)	57 (0.46)	44 (0.42)	1 (0.24)	9 (0.51)	219 (0.49)
HPV52	1 (1.18)	49 (2.25)	43 (1.21)	55 (1.02)	75 (0.80)	90 (0.74)	76 (0.74)	0 (0.00)	15 (0.86)	404 (0.90)
HPV56	0 (0.00)	12 (0.55)	16 (0.45)	26 (0.48)	22 (0.23)	35 (0.28)	28 (0.27)	3 (0.73)	4 (0.22)	146 (0.32)
HPV58	2 (2.35)	27 (1.24)	23 (0.65)	44 (0.81)	44 (0.47)	57 (0.46)	61 (0.59)	3 (0.73)	23 (1.31)	284 (0.63)
HPV59	0 (0.00)	21 (0.96)	15 (0.42)	15 (0.27)	29 (0.31)	22 (0.18)	21 (0.20)	0 (0.00)	1 (0.05)	124 (0.28)
HPV66	1 (1.18)	23 (1.05)	31 (0.87)	39 (0.72)	48 (0.51)	62 (0.51)	44 (0.42)	3 (0.73)	14 (0.80)	265 (0.59)
HPV68	2 (2.35)	21 (0.96)	24 (0.68)	29 (0.53)	49 (0.52)	44 (0.36)	40 (0.39)	0 (0.00)	15 (0.86)	224 (0.50)
Single- infection	7 (100)	202 (81.78)	238 (84.09)	294 (82.58)	357 (83.41)	435 (86.65)	331 (80.53)	7 (70.00)	108 (85.03)	1,979 (83.46)
Multiple- infection	0 (0.00)	45 (18.22)	45 (15.91)	62 (17.42)	71 (16.59)	67 (13.35)	80 (19.47)	3 (30.00)	19 (14.97)	392 (16.54)

Note: Values are presented as number (%).

Due to multiple infection, a total repeating 14 high-risk HPV genotypes in 2,371 HPV positive cases were 2,848. The most common genotypes were HPV 16 (16.43%), HPV 52 (14.19%), and HPV 58 (9.97%), respectively. Single and multiple

infections were 1,979 (83.46%) and 392 (16.54%) cases, respectively. In multiple infection, 323 (13.62%), 56 (2.36%), 10 (0.43%), and 3 (0.13%) cases were infected with two, three, four, and five genotypes, respectively, as shown in Fig. 1.

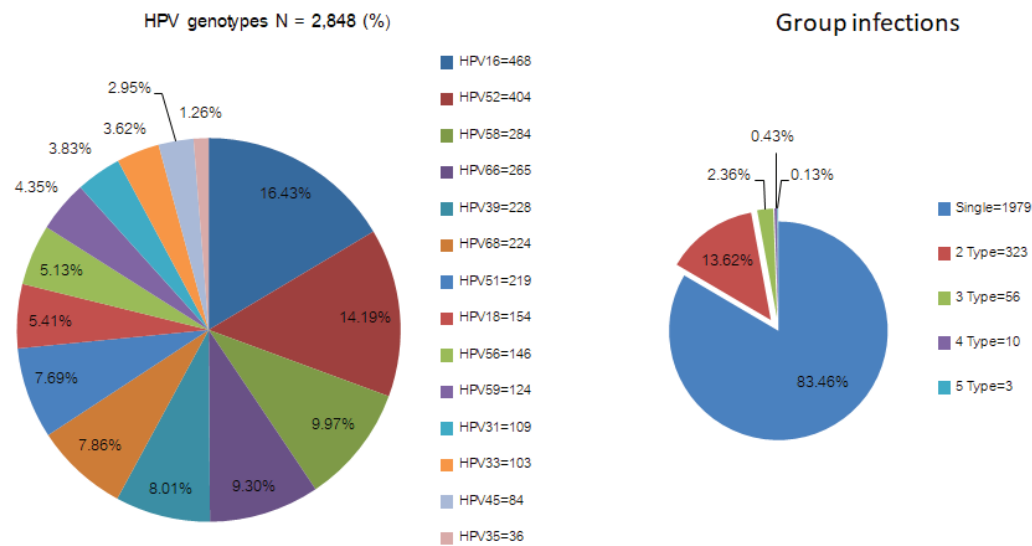


Fig. 1 The distribution of single and multiple HPV genotypes among women in Kalasin Province (2020-2023).

2. Cytology results

From 1,049 samples performed LBC in HPV non 16, 18 infections, the mean age was 46.9 years. The youngest and oldest ages were 23 and 59 years, respectively. Participants were divided into age groups including, < 30, 30-34, 35-39, 40-44, 45-49, 50-54, and 55-59 years. Samples in the age group of 50-54 (270/1,049 cases; 25.74%), 55-59 (205/1,049 cases; 19.54%), and 45-49 (204/1,049 cases; 19.45%) years were further investigated using LBC, respectively. There were 874/1,049 (83.32%) cases of single infection. The highest prevalent genotypes were HPV 52 (168/874 cases, 19.22%), HPV 39 (111/874 cases, 12.70%), and HPV 66 (107/874 cases, 12.24%), respectively. While there were 175/1,049 (16.68%) cases of multiple infections including, two (149/175 cases, 85.14%), three (22/175 cases, 12.57%), and four or more (4/175 cases, 2.29%) genotypes respectively. The cytological study showed that there were 287/1,049 (27.36%) abnormal cytological cases. The most common abnormal cells were in ASC-US (127/1,049 cases; 12.11%), LSIL (100/1,049 cases; 9.53%), HSIL (36/1,049 cases; 3.43%), ASC-H (18/1,049 cases; 1.72%), and AGC (6/1,049 cases; 0.57%) respectively. The abnormal cells were found highest in age groups of 45-49 (66/204 cases; 32.34%), 30-34 (29/96 cases; 30.20%), and 40-44 (47/156 cases; 30.13%) years, respectively. There was a significant relationship between age groups and cytological results ($p = 0.001$). The abnormal cytological results in the single infection were found in 229/874 (26.20%) cases. The most common genotypes with abnormal cells were HPV 33 (16/45 cases; 35.56%), HPV 51 (29/84 cases; 34.52%), HPV 56 (18/53 cases; 33.96%), HPV 52 (51/168 cases; 30.36%), and HPV 35 (3/10 cases; 30.00%), respectively. The relationship between single infection and cytological results was not statistically significant ($p = 0.116$). Moreover, abnormal cytological results were found in 58/175 (33.14%) cases of multiple infections which were commonly found in two-genotype infection (50/149 cases; 33.56%). The relationship between multiple infection and cytological results was not statistically significant ($p = 0.994$), as shown in Table 2 and Figs. 2 and 3.

Table 2 The relationship between high-risk HPV infection status and cytological grades (1,049 samples).

Parameter	Total N (%)	Unsat	NILM	Cytological grading						p
				ASC-US	ASC-H	LSIL	HSIL	AGC	total	
Age										
<30	6 (0.57)	0 (0.00)	5 (83.33)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (16.67)	1 (16.67)	0.001
30-34	96 (9.15)	0 (0.00)	67 (69.80)	11 (11.46)	5 (5.21)	10 (10.41)	3 (3.13)	0 (0.00)	29 (30.20)	
35-39	112 (10.68)	2 (1.79)	78 (69.64)	13 (11.61)	1 (0.89)	12 (10.71)	5 (4.46)	1 (0.89)	32 (28.56)	
40-44	156 (14.87)	0 (0.00)	109 (69.87)	14 (8.98)	2 (1.28)	21 (13.46)	10 (6.41)	0 (0.00)	47 (30.13)	
45-49	204 (19.45)	1 (0.50)	137 (67.16)	25 (12.25)	3 (1.47)	25 (12.25)	9 (4.41)	4 (1.96)	66 (32.34)	
50-54	270 (25.74)	1 (0.37)	204 (75.56)	35 (13.96)	3 (1.11)	22 (8.15)	5 (1.85)	0 (0.00)	65 (24.07)	
55-59	205 (19.54)	1 (0.49)	157 (76.58)	29 (14.15)	4 (1.95)	10 (4.88)	4 (1.95)	0 (0.00)	47 (22.93)	
Single-infection	874 (83.32)	4 (0.46)	641 (73.34)	102 (11.67)	15 (1.71)	76 (8.70)	30 (3.43)	6 (0.69)	229 (26.20)	0.116
HPV 31	35 (4.00)	0 (0.00)	25 (71.43)	3 (8.57)	1 (2.86)	3 (8.57)	3 (8.57)	0 (0.00)	10 (28.57)	
HPV 33	45 (5.15)	1 (2.22)	28 (62.22)	10 (22.22)	2 (4.45)	3 (6.67)	1 (2.22)	0 (0.00)	16 (35.56)	
HPV 35	10 (1.14)	0 (0.00)	7 (70.00)	2 (20.00)	0 (0.00)	0 (0.00)	1 (10.00)	0 (0.00)	3 (30.00)	
HPV 39	111 (12.70)	0 (0.00)	93 (83.78)	9 (8.11)	0 (0.00)	7 (6.31)	0 (0.00)	2 (1.80)	18 (16.22)	
HPV 45	31 (3.55)	1 (3.23)	25 (80.64)	2 (6.45)	0 (0.00)	1 (3.23)	1 (3.23)	1 (3.23)	5 (16.13)	
HPV 51	84 (9.61)	0 (0.00)	55 (65.48)	10 (11.90)	1 (1.19)	12 (14.29)	5 (5.95)	1 (1.19)	29 (34.52)	
HPV 52	168 (19.22)	1 (0.60)	116 (69.04)	23 (13.69)	5 (2.98)	10 (5.95)	12 (7.14)	1 (0.6)	51 (30.36)	
HPV 56	53 (6.06)	0 (0.00)	35 (66.04)	4 (7.55)	0 (0.00)	14 (26.41)	0 (0.00)	0 (0.00)	18 (33.96)	
HPV 58	102 (11.68)	0 (0.00)	75 (73.53)	10 (9.80)	5 (4.90)	6 (5.89)	5 (4.90)	1 (0.98)	27 (26.47)	
HPV 59	42 (4.81)	0 (0.00)	31 (73.81)	6 (14.29)	1 (2.38)	3 (7.14)	1 (2.38)	0 (0.00)	11 (26.19)	
HPV 66	107 (12.24)	1 (0.93)	81 (75.70)	14 (13.09)	0 (0.00)	11 (10.28)	0 (0.00)	0 (0.00)	25 (23.37)	
HPV 68	86 (9.84)	0 (0.00)	70 (81.40)	9 (10.46)	0 (0.00)	6 (6.98)	1 (1.16)	0 (0.00)	16 (18.60)	
Multiple-infections	175 (16.68)	1 (0.57)	116 (66.29)	25 (14.29)	3 (1.71)	24 (13.71)	6 (3.43)	0 (0.00)	58 (33.14)	0.994
2 Types infection	149 (85.14)	1 (0.67)	98 (65.77)	22 (14.77)	2 (1.34)	20 (13.42)	6 (4.03)	0 (0.00)	50 (33.56)	
3 Types infection	22 (12.57)	0 (0.00)	15 (68.18)	2 (9.09)	1 (4.55)	4 (18.18)	0 (0.00)	0 (0.00)	7 (31.82)	
4 Types infection	3 (1.72)	0 (0.00)	2 (66.67)	1 (33.33)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (33.33)	
5 Types infection	1 (0.57)	0 (0.00)	1 (100.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	
Total	1,049 (100.00)	5 (0.48)	757 (72.16)	127 (12.11)	18 (1.72)	100 (9.53)	36 (3.43)	6 (0.57)	287 (27.36)	

Note: Unsat, Unsatisfactory for evaluation; NILM, Negative for intraepithelial lesion or malignancy; ASC-US, Atypical squamous cell of undetermined significance; ASC-H, Atypical squamous cell cannot exclude HSIL; LSIL, Low grade squamous intraepithelial lesion; HSIL, High grade squamous intraepithelial lesion; AGC, Atypical glandular cells.

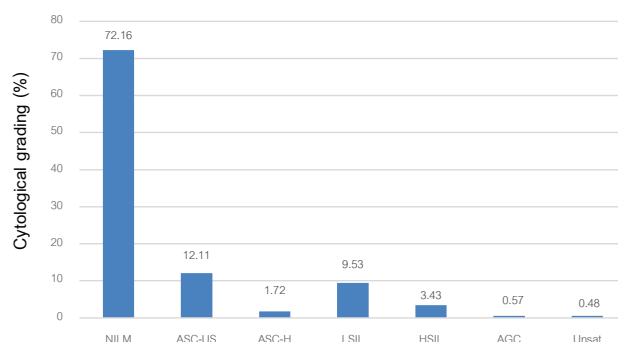


Fig. 2 The distribution of cytological results in HPV non 16, 18 type (N = 1,049).

Note: NILM, Negative for intraepithelial lesion or malignancy; ASC-US, Atypical squamous cell of undetermined significance; ASC-H, Atypical squamous cell cannot exclude HSIL; LSIL, Low grade squamous intraepithelial lesion; HSIL, High grade squamous intraepithelial lesion; AGC, Atypical glandular cells; Unsatisfactory, Unsatisfactory for evaluation

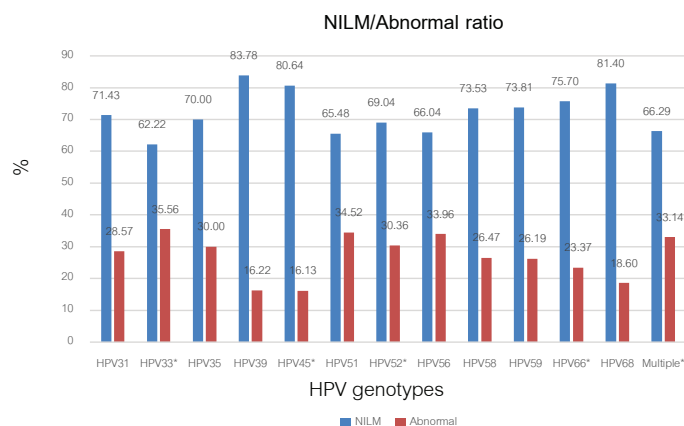


Fig. 3 Comparison of cytological results of 1,049 single and multiple infection samples.

Note: NILM, Negative for intraepithelial lesion or malignancy. The evaluation was unsatisfactory for HPV33, HPV45, HPV52, HPV66, and multiple infection, with rate 2.22, 3.23, 0.60, 0.93 and 0.57%, respectively

Discussions

The high-risk HPV prevalence among 45,019 women screened for cervical cancer using HPV DNA test with 14 HPV genotype detection kits at Kalasin Hospital since 2020 to 2023 was 5.27%, which is consistent with Duriya Phongmoon *et al.*⁽¹⁴⁾ who reported 6.00% of HPV prevalence at Lampang Cancer Hospital. In addition, Sirinya Phetpichai⁽¹⁵⁾ *et al.* also revealed 7.00% of HPV prevalence in Thai women located at Phichit, Uthai Thani, Chai Nat and Kamphaeng Phet provinces. Swangvaree *et al.* (2010) and Chansaenroj *et al.* (2009), also indicated 6.20 and 7.60% of HPV prevalence, respectively.^(16,17) However, the relatively high prevalence of HPV infection was reported at 20.70% in a study of Thumwadi Tangsiriwattana *et al.*⁽¹⁸⁾ This may be due to (1) the number of genotypes used in testing methods, (2) the number of samples, and (3) the study areas. The top three genotypes found in this study were HPV 16 (16.43%), HPV 52 (14.19%), and HPV 58 (9.97%), respectively, which are similar to those reported by Thumwadi Tangsiriwattana *et al.*⁽¹⁸⁾ (HPV 16 (17.50%), HPV 66 (11.20%), and HPV 52 (10.00%)). However, it is inconsistent with Duriya Fongmoon *et al.*⁽¹⁴⁾ and Sirinya Petchpichai *et al.*⁽¹⁵⁾ who found that their top three genotypes were HPV 52, HPV 16 and HPV 58, respectively. It may be due to the number of samples and different

sample collection methods. In addition, their study areas had different geographical, economic, and social conditions. In this study, the HPV prevalence was highest in the younger age group of 30-34 years, and the prevalence decreased when age increased, which is consistent with the specific pattern of infection in the Asian region.⁽¹⁹⁾ However, there was only 4.83% of samples in this age group. More sample collection from this age group could probably increase the chance of HPV infection detection. Of a total 1,749 cases of HPV non 16, 18, only 1,049 (60.00%) cases were further investigated for the cell abnormalities. Since the self-sampling specimens were mainly acquired for the screening test, it was difficult to trace and recollect samples from the participants for the cytological testing, resulting in almost 40.00% of cases being dropped out from the treatment. Higher abnormal cells were found in the multiple infections (33.14%) than in the single infection (26.20%); therefore, the treatment plan for multiple infection cases should be adjusted by performing colposcopy without tracing and recollecting samples for cytological testing. It may prevent dropouts from treatment and escalate the speed of treatment process. Moreover, it may reduce costs for both patients and the hospital as well.

Conclusion

The prevalence of high-risk HPV infections among Kalasin women in all age groups were 2,371/45,019 (5.27%) cases including, HPV 16 (468/45,019 cases, 1.04%), HPV 18 (154/45,019 cases, 0.34%), and HPV non 16, 18 (1,749/45,019 cases, 3.88%), which were detected covering all 14 genotypes. Among Kalasin women, the top three genotypes were HPV 16, 52, and 58 which were 468/45,019 (1.04%), 404/45,019 (0.90%), and 284/45,019 (0.63%), respectively. The age group with the highest infection was 30-34 years (11.36%). Compared with HPV non 16, 18 infection, there was a statistically significant relationship ($p = 0.001$) with Liquid Base Cytology results. The highest abnormal cells were found in the age group of 45-49 years (66/204 cases; 32.34%), 30-34 years (29/96 cases; 30.20%), and 40-44 years (47/156 cases; 30.13%), respectively.

The top three genotypes with the highest number of abnormal cells were HPV 33 (16/45 cases; 35.56%), HPV 51 (29/84 cases; 34.52%), and HPV 56 (18/53 cases; 33.96%). In addition, the results of abnormal cells were higher in the multiple infections group (58/175 cases; 33.14%) than in the single infection group (229/874 cases; 26.20%). Therefore, studying HPV prevalence and the relationship between HPV non 16,

18 and the cytological results in each region of the country is crucial for HPV screening and early treatment plan. Moreover, this data can be used for appropriate vaccine usage and development in specific areas.

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