Prevalence of HPV infection among 157,038 Chinese females in Hunan Province, central-south China: Research article

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Human papillomavirus; HPV infection rate; HPV genotype
Abstract
Background: In the present study, we aimed to investigate the human papillomavirus (HPV) infection rate in females of Hunan Province, China, as well as the common HPV genotype distribution. Moreover, we also explored the differences in HPV infections among females of different ages.

Methods: Clinical data were collected from 157,038 females who had tested HPV infection in the Third Xiangya Hospital of Central South University from November, 2010 to May, 2017. Results: The overall HPV infection rate was 19.91%. The most commonly detected genotypes were HPV52 (4.62%), HPV16 (3.52%), HPV 58 (3.12%), HPVCp8304 (2.91%), and HPV53 (2.06%). The highest infection rate was found in females under the age of 20 (30.33%), the second highest infection rate was found in females over the age of 60 (24.72%), and females aged 30-39 showed the lowest HPV infection rate (18.11%). In addition, 71.32% of the infections were single HPV infections. Among the multiple HPV infections, HPV16/HPV6 co-infection was the most commonly detected combination (0.52%).

Conclusions: In this study, we examined the epidemiology of HPV and the prevalence of the common HPV infection in Hunan Province, central-south China. We have revealed the prevalence and distribution of the different HPV types. Our study showed that females under the age of 20 and over the age of 60 were at higher risk of HPV infection than females of other ages. Moreover, our region should make extra efforts to the prevention and treatment of HPV52, HPV16 and HPV58 infections.

Background
Cervical cancer is one of the most common malignant tumors in female reproductive system. More than 500,000 patients are diagnosed with cervical cancer worldwide every year, resulting in an average of 270,000 deaths annually. Moreover, 85% of cervical cancer patients are from developing countries or regions. According to the latest cancer statistics in China, there are 9,900 new cases of cervical cancer in 2012, and 10,100 new cases in 2013, accounting for 19% of the global cervical cancer cases. There were 25,000 cervical cancer deaths in China in 2012, and 26,000 deaths in 2013, accounting for 9% of the deaths worldwide of cervical cancer. In addition, cervical cancer is one of the major threat to women’s health in developing countries. There is a growing tendency in morbidity and mortality of cervical cancer, leadings to impaired patients’ families and the society.
Massive current studies have revealed that HPV infections play an important role in the occurrence and development of cervical lesion, especially high-risk HPV infections.\textsuperscript{5} Multiple studies have shown that HPV16 and HPV18 are the most commonly detected high-risk HPV genotypes.\textsuperscript{6–8} However, there are very few studies on the HPV infection in Chinese population. Meanwhile, HPV vaccine has entered the Chinese market. Therefore, in order to provide supportive evidence for public health decision-making, it is urgently necessary to launch a large-scale epidemiological study in regards to genotype distribution characteristics of HPV, such as infection rate and genotype distribution.

Methods

Subjects

Clinical data were collected from 157,038 females who had tested HPV infection in the Third Xiangya Hospital of Central South University from November, 2010 to May, 2017. Inclusion criteria were set as follows: the HPV genotype was identified in the Third Xiangya Hospital of Central South University. The earliest test result of the patient should be adopted if multiple HPV genotyping tests were performed. Exclusion criteria were set as follows: males, and/or patients out of age range of 0 - 100 years old.

HPV genotyping

HPV GenoArray Diagnostic Kit (HBGA-21PKG) was purchased from Hybribio Limited Corp. By employing PCR amplification, flow-through hybridization and gene chip, this kit can detect 21 common types of HPV, including 15 types of high-risk HPV (HPV 16, 18, 31, 33, 35, 39, 45, 51, 52, 53, 56, 58, 59, 66 and 68) and six types of low-risk HPV (HPV 6, 11, 42, 43, 44 and 81)(CP8304).

Statistical analysis

Le9 Magician 1.0 is a self-service data access tool designed to query clinical data repositories and return tabular data for analysis and visualization. Le9 Magician allows data analysts and researchers with minimal computer training to find patient cohorts of interest and then extract clinical data from data warehouse by specifying queries using simple click techniques. More complex queries can be achieved by experienced users with Structured Query Language (SQL). Le9 Magician outputs data in
comma-separated, tab-separated, and attribute-related file formats are suitable for data analysis and visualization tools.

Data were input into SPSS 23.0 for analysis and expressed as mean ± SD, and was determined by one-way ANOVA. Categorical variables were presented as a rate or composition ratio, and significance was determined with chi-squared test ($\chi^2$). A $p<0.05$ was considered statistically significant.

**Results**

**The overall prevalence of HPV**

A total of 157,038 females participated in the HPV genotyping program, among which the mean age was 39.20 ±11.06. Data of Table 1 showed that 31,278 females were diagnosed with HPV infection with a mean age of 39.90. Meanwhile, the mean age of HPV-negative females was 39.03. As shown in Table 1, the overall HPV prevalence rate was 19.91% (31,278/157,038). The prevalence of high-risk HPV types was 14.83% (23,286/157,038), the low-risk infection rate was 2.55% (399/157,038), and the co-infection rate of low-risk/high-risk HPV was 2.54% (3,993/157,038).

Among the HPV positive infected females, 71.32% of them were diagnosed with single HPV infection, and the infection rate was 14.20 % (Table 2). Moreover, 24.40% of HPV positive females were diagnosed with double HPV infections, and the infection rate was 4.26%. The infection rate of triple HPV infections was 1.03%. Only 655 females were diagnosed with quadruple or more HPV infections, accounting for 2.09% of the total infected patients, and the HPV infection rate was 0.42%. In the cases of multiple HPV infections, the most commonly detected combination was HPV16/HPV6, followed by HPV52/HPVCP8304, HPV52/HPV58, HPV52/HPV16 and HPV52/HPV53 (Table 3).

As shown in Table 4, patients were divided into six groups according to age range as follows: <20, 20–29, 30–39, 40–49, 50–59, or ≥ 60 (3,214 patients whose ages were unknown were excluded). The age of group of <20 had the highest rate of HPV infection (30.33%), followed by the age group of ≥ 60 with an HPV infection rate of 24.72%, while the age group of 30–39 had the lowest rate of HPV infection (18.11%). The differences of HPV infection rates among different groups were statistically significant, as well as high-risk HPV infection rates. The age group of <20 had the highest rate of high-risk HPV infection (25.00%), followed by the age group of ≥ 60 (23.01%) and the age group of
The distribution of HPV genotypes

The top five HPV genotypes with a high infection rate were HPV52 (4.62%), HPV16 (3.52%), HPV58 (3.12%), HPVCP8304 (2.91%) and HPV53 (2.06%). Table 4, shows that the top three HPV genotypes with a high infection rate in the age group of <20 and the age group of 20–29 were HPV52, HPV16 and HPV58. In contrast, the top three HPV genotypes with a high infection rate in the age groups of 30–39, 40–49 and 50–59 were HPV52, HPV16 and HPV58. In the age group of ≥ 60 years, three HPV genotypes with a high infection rate were HPV16, HPV58 and HPV52.

Discussion

It is difficult to obtain information about HPV prevalence in general population. To better understand the HPV prevalence in general population, researchers speculate the HPV prevalence and the differences among HPV genotypes based on the cervix uteri ThinPrep cytological test. Multiple epidemiological studies worldwide have revealed that the HPV prevalence rate ranges from 6.1% to 33.5% among different regions, and the average rate is around 10%.\textsuperscript{9} A large scale meta-analysis with 1 million cases\textsuperscript{10} has shown that all of the females are HPV negative in cytologic evaluation. However, the final results have indicated that the overall HPV infection rate in females is about 12%, and the top five HPV genotypes are HPV16, HPV18, HPV52, HPV31 and HPV58. Moreover, 70% of the population are infected with 12 common and high-risk HPVs, and about 22% of the population are infected with HPV16, which is the most common type in HPVs. HPV18 infection is nearly the most common one in different regions, and he second and third most common HPV genotypes in Europe and Latin America are is HPV31 and HPV18. HPV52 and HPV18 are the second and third most common HPV genotypes in North America, Africa and Asia. According to the early reports, 10% of the populations in China are diagnosed with HPV infection, and the most common HPV genotypes in our country are HPV16, HPV52 and HPV58.\textsuperscript{11}

Chinese population significantly varies in terms of habit, living environment and economic culture in different regions of China, leading to different status of HPV infection. In southeast China, Liu et al.
have reported that the five most commonly detected types of HPV infection in Zhejiang Province are HPV16 (4.4%), HPV58 (2.9%), HPV52 (2.7%), HPV33 (2.2%) and HPV11 (1.9%), with an overall infection rate of 22.8%. In southwest China, Li et al. have revealed that the overall infection rate among 28,457 females in Yunnan Province is 12.9%, and the top three most commonly detected HPV genotypes are HPV52, HPV16 and HPV58. In southern China, Jing et al. have reported that the overall HPV infection rate among 78,355 women in Guangdong Province is 7.3%, and the top six most commonly detected HPV genotypes are HPV16 (1.5%), HPV52 (1.2%), HPV58 (1.0%), HPV18 (0.7%), HPV45 (0.5%) and HPV6 (0.5%). In northeast China, LK Li et al reported that female HPV infection rate was 16.8% in Shenyang area, HPV16, HPV52, and HPV58 were the 3 most common HPV genotypes, with an infection rate of 3.4 %, 2.5 %, and 1.9 % respectively. In northern China, Zhi et al. have shown that the overall infection rate of HPV is 23.98% among 14,873 women in Henan Province, with an overall infection rate of 23.98%, and HPV 16, HPV58, HPV52 and HPV56 are the four most commonly detected HPV genotypes. In the present study, the female participants were mainly from Hunan, China, 157,038 females completed the HPV genotyping test, the overall infection rate was 19.91%, and the top five HPV genotypes were HPV52 (4.62%), HPV16 (3.52%), HPV58 (3.12%), HPVVP8304 (2.91%) and HPV53 (2.06%). HPV52. HPV16 and HPV58 are the most commonly detected HPV genotypes in China, HPV 16 is the most commonly detected HPV genotype in northern and eastern China, while HPV52 is the most commonly detected HPV genotype in central and southwest China.

The national reports on genotypes of HPV are different from overseas studies, which might be attributed to following reasons. 1. The constitution of the study populations are different. Most of the cases in this study were from physical examination center, better representing the general population. 2. The susceptibility of different genotypes of HPV is based on the region or race of patients, indicating that the susceptibility of different genotypes of HPV in Chinese females is different from that of other counties. 3. There are differences in the age of objects in different studies. In our current study, the age the patients ranged from 11 to 96 years. The most commonly detected
genotype of HPV in the age group of over 60 was HPV16 instead of HPV52 in this study. However, the objects in most epidemiologic studies are limited within certain age range. Although the bivalent and tetravalent HPV vaccines are currently available in Chinese market, they are likely to be effective for HPV16/18 but not for HPV52/58, which are the most commonly detected HPV genotypes in China. Therefore, the 9-valent HPV vaccine should be introduced into Chinese market, and we should also speed up the research for an HPV vaccine in order to meet the medical needs in China.

Moreover, 71.32% of HPV infections are single infection. Consistent with the results of other studies, 17, 18 most of the multiple HPV infections were double infections. HPV6/HPV16 was the most common combination in multiple infections, followed by HPV52/HPVCP8304, HPV52/HPV58, HPV52/HPV16 and HPV52/HPV53. These four genotypes were in the list of top five most commonly detected HPV genotypes. Therefore, HPV16 was more likely to appear in multiple infections.

HPV is a sexually transmitted disease. Sexually active females are more susceptible to HPV, especially the high-risk HPV. Many epidemiologic studies have reported that females under the age of 24 are more susceptible to HPV infection than other ages, with an overall infection rate of 15%. Moreover, the infection rate in females aged of 25-29 is only 10%. However, the infection rate in females over the age of 35 is increased to 24%.11, 15, 19 The similar trend has been observed in high-risk HPV infections but not in low-risk HPV infections. With an epidemiologic studies of 20,000 females in Poland and 9,000 females in Costa Rica, the researchers have discovered that the HPV infection rate is higher in relatively young and relatively old females, while females in between these ages have a lower HPV infection rate.20, 21 Similar conclusions are also drawn by the domestic studies.12-15

Our study showed that females under the age of 20 had the highest HPV infection rate (30.33%), and the second highest HPV infection rate was observed in females over the age of 60. However, females aged of 30-39 had the lowest HPV infection rate. The similar correlation between age and infection rate was found in the high-risk HPV infections. The high-risk HPV infection rate was 25% in the females under the age of 20, which was 23.01% in the females over the age of 60, and females aged 30-39 had the lowest infection rate of 15.74%. This age-infection rate pattern did not apply to the
low-risk HPV infections. There are still some differences among different reports. The possible reason could be attributed to that the age distributions in the populations of studies were different, or the age range sets were different. Moreover, the objects in this study were patients who went to hospital for examination, and they should be different from general population. The higher infection rate in females under the age of 20 or over the age of 60 probably is attributed to following reasons. First, these cases were mainly from gynecological clinic, therefore some selection existed bias existed. Second, the females at these ages had a relatively low immunity and were susceptible to viral infection. Moreover, there might be a lack of the ideas of regular gynecological examination. Therefore, most of their conditions already reached the stage of cervical lesions when they went to the hospital. The final reason might be the openness about sex of the females under the age of 20. They might have early sexual activities or multiple sex partners, making them more susceptible to the HPV infection.

The latest ACOG guideline 2016 emphasizes the importance of HPV screening in females aged over 25, while the ASCCP guideline 2013 mainly focuses on the cancer screening for females aged over 20. In pace with the openness of sexuality, females tend to have early sexual activities, and females under the age of 20 have become the most susceptible group of HPV infections. Therefore, we should focus on the screening examination in females under the age of 20 who have sexual experiences.

Conclusions
In this study, we examined the epidemiology of HPV and the prevalence of the common HPV infection in Hunan Province, central-south China. We have revealed the prevalence and distribution of the different HPV types. Our study showed that females under the age of 20 and over the age of 60 were at higher risk of HPV infection than females of other ages. Moreover, our region should make extra efforts to the prevention and treatment of HPV52, HPV16 and HPV58 infections.

List Of Abbreviations
HPV: Human papillomavirus;
ACOG: American College of Obstetricians and Gynecologist;
Declarations

Ethics approval and consent to participate

All the participants were involved in the clinical studies after oral consent. All the participants under the age of 16 were involved after their parents’ oral consent. This retrospective study was approved by the ethics committee of Central South University (NO: 2018-S003).

Consent for publication

All the participants consented to their information in this study for publication.

Availability of data and material

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

C. W. conceived the study and drafted the article. S. S. X. and S. L. H. participated in the design of the study and performed the statistical analysis. Q. P. and J. Z. carried out the patients’ follow-up study. M. X. conceived the study, participated in its design and helped draft the article. All authors read and approved the final manuscript.

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References

1. Siegel, R., et al., *Cancer statistics, 2011: the impact of eliminating socioeconomic and racial disparities on premature cancer deaths*. CA Cancer J Clin, 2011. 61(4): p. 212–36.

2. Kyrgiou M, S. M., *Invasive cancer of the cervix*. Obstetrics, Gynaecology and Reproductive Medicine, 2010. 20(5): p. 147–154.

3. Chen WQ, Z. R., Zhang SW, *Report of cancer incidence and mortality in China, 2012*. China Cancer, 2016. 2(7): p. 61.

4. Chen WQ, Z. R., Zhang SW, *Report of cancer incidence and mortality in China, 2013*. China Cancer, 2016. 27(1): p. 1–8.

5. Walboomers, J. M., et al., *Human papillomavirus is a necessary cause of invasive cervical cancer worldwide*. J Pathol, 1999. 189(1): p. 12–9.

6. Humans, I. W. G.o.t.E.o.C. R.t., *Personal habits and indoor combustions. Volume 100 E. A review of human carcinogens*. IARC Monogr Eval Carcinog Risks Hum, 2012. 100(Pt E): p. 1–538.

7. Schiffman, M., et al., *Human papillomavirus and cervical cancer*. Lancet, 2007. 370(9590): p. 890-907.

8. Smith, J. S., et al., *Human papillomavirus type distribution in invasive cervical cancer and high-grade cervical lesions: a meta-analysis update*. Int J Cancer, 2007. 121(3): p. 621–32.

9. Smith, J. S., et al., *Age-specific prevalence of infection with human papillomavirus in females: a global review*. J Adolesc Health, 2008. 43(4 Suppl): p. S5–25, S25 e1–41.
10. Clifford, G. M., et al., Human papillomavirus types in invasive cervical cancer worldwide: a meta-analysis. Br J Cancer, 2003. 88(1): p. 63–73.

11. Wu, R. F., et al., Human papillomavirus infection in women in Shenzhen City, People’s Republic of China, a population typical of recent Chinese urbanisation. Int J Cancer, 2007. 121(6): p. 1306–11.

12. Liu, X. X., et al., Human papillomavirus prevalence and type-distribution among women in Zhejiang Province, Southeast China: a cross-sectional study. BMC Infect Dis, 2014. 14: p. 708.

13. Li, Z., et al., Prevalence of HPV infection among 28,457 Chinese women in Yunnan Province, southwest China. Sci Rep, 2016. 6: p. 21039.

14. Jing, L., et al., Prevalence of human papillomavirus infection in Guangdong Province, China: a population-based survey of 78,355 women. Sex Transm Dis, 2014. 41(12): p. 732–8.

15. Li, L. K., et al., Human papillomavirus infection in Shenyang City, People’s Republic of China: A population-based study. Br J Cancer, 2006. 95(11): p. 1593–7.

16. Zhi, Y. F., et al., Prevalence and genotype distribution of human papillomavirus in women in the Henan Province. Genet Mol Res, 2015. 14(2): p. 5452–61.

17. Dickson, E. L., et al., Multiple-type human papillomavirus (HPV) infections: a cross-sectional analysis of the prevalence of specific types in 309,000 women referred for HPV testing at the time of cervical cytology. Int J Gynecol Cancer, 2013. 23(7): p. 1295–302.

18. Wang, L., et al., Prevalence of human papillomavirus and its genotype among 1336 invasive cervical cancer patients in Hunan province, central south China. J Med Virol, 2015. 87(3): p. 516–21.

19. Dai, M., et al., Human papillomavirus infection in Shanxi Province, People’s Republic of China: a population-based study. Br J Cancer, 2006. 95(1): p. 96–101.

20. Herrero, R., et al., Population-based study of human papillomavirus infection and cervical neoplasia in rural Costa Rica. J Natl Cancer Inst, 2000. 92(6): p. 464–74.

21. Sherman, M. E., et al., Baseline cytology, human papillomavirus testing, and risk for cervical neoplasia: a 10-year cohort analysis. J Natl Cancer Inst, 2003. 95(1): p. 46–52.

22. Lawson, H. W., Practice Bulletin No. 157: Cervical Cancer Screening and Prevention. Obstet Gynecol, 2016. 127(1): p. e1-e20.
23. Saslow, D., et al., *American Cancer Society, American Society for Colposcopy and Cervical Pathology, and American Society for Clinical Pathology screening guidelines for the prevention and early detection of cervical cancer*. Am J Clin Pathol, 2012. 137(4): p. 516-42.

**Tables**

**Table 1. Distribution of Single and Multiple HPV infections for Any HPV Type**

| Genotype | Single Infectious cases | %   | Prevalence(%) | Multiple Infectious cases | %   | Prevalence(%) | Total cases | Prevalence(%) |
|----------|-------------------------|-----|---------------|---------------------------|-----|---------------|-------------|---------------|
| HPV52    | 4435                    | 61.10% | 2.82%          | 2823                      | 38.90% | 1.80%         | 7258        | 4.62%         |
| HPV16    | 2775                    | 50.17% | 1.77%          | 2756                      | 49.83% | 1.75%         | 5531        | 3.52%         |
| HPV58    | 2750                    | 56.19% | 1.75%          | 2144                      | 43.81% | 1.37%         | 4894        | 3.12%         |
| HPV53    | 1575                    | 48.69% | 1.00%          | 1660                      | 51.31% | 1.06%         | 3235        | 2.06%         |
| HPV39    | 1388                    | 54.71% | 0.88%          | 1149                      | 45.29% | 0.73%         | 2537        | 1.62%         |
| HPV6     | 549                     | 26.75% | 0.35%          | 1503                      | 73.25% | 0.96%         | 2052        | 1.31%         |
| HPV33    | 956                     | 47.63% | 0.61%          | 1051                      | 52.37% | 0.67%         | 2007        | 1.28%         |
| HPV51    | 875                     | 50.75% | 0.56%          | 849                       | 49.25% | 0.54%         | 1724        | 1.10%         |
| HPV18    | 898                     | 52.67% | 0.57%          | 807                       | 47.33% | 0.51%         | 1705        | 1.09%         |
| HPV68    | 793                     | 49.35% | 0.50%          | 814                       | 50.65% | 0.52%         | 1607        | 1.02%         |
| HPV31    | 675                     | 51.06% | 0.43%          | 647                       | 48.94% | 0.41%         | 1322        | 0.84%         |
| HPV66    | 458                     | 39.31% | 0.29%          | 707                       | 60.69% | 0.45%         | 1165        | 0.74%         |
| HPV11    | 382                     | 46.47% | 0.24%          | 440                       | 53.53% | 0.28%         | 822         | 0.52%         |
| HPV56    | 309                     | 38.58% | 0.20%          | 492                       | 61.42% | 0.31%         | 801         | 0.51%         |
| HPV59    | 280                     | 42.81% | 0.18%          | 374                       | 57.19% | 0.24%         | 654         | 0.42%         |
| HPV44    | 275                     | 45.91% | 0.18%          | 324                       | 54.09% | 0.21%         | 599         | 0.38%         |
| HPV45    | 165                     | 38.55% | 0.11%          | 263                       | 61.45% | 0.17%         | 428         | 0.27%         |
| HPV35    | 112                     | 44.62% | 0.07%          | 139                       | 55.38% | 0.09%         | 251         | 0.16%         |
| HPV42    | 106                     | 45.49% | 0.07%          | 127                       | 54.51% | 0.08%         | 233         | 0.15%         |
| HPV43    | 59                      | 50.00% | 0.04%          | 59                        | 50.00% | 0.04%         | 118         | 0.08%         |
| HR HPV Types only | 18444     | 79.21% | 11.74%         | 4842                      | 20.79% | 3.08%         | 23286       | 14.83%        |
| LR HPV Types only | 3863       | 96.60% | 2.46%          | 136                       | 3.40%  | 0.09%         | 3999        | 2.54%         |
| Mixed HR and LR HPV Types | 0.00% | 3993 | 100.00% | 2.54%  | 3993 | 2.54% |
| Total    | 22307                   | 71.32% | 14.20%         | 8971                      | 28.68% | 5.71%         | 31278       | 19.92%        |

**Table 2. Distribution of Single and Multiple HPV infections**
| HPV Infections     | HPV positive case | Percentage(x/31278) | Prevalence(x/157038) |
|-------------------|-------------------|---------------------|----------------------|
| Single HPV type   | 22307             | 71.32%              | 14.20%               |
| Two HPV types     | 6695              | 21.40%              | 4.26%                |
| Three HPV types   | 1621              | 5.18%               | 1.03%                |
| ≥Four HPV types   | 655               | 2.09%               | 0.42%                |
| Total             | 31278             | 100.00%             | 19.92%               |

Table 3. HPV types of Multiple Infection

| HPV types of Multiple Infection | HPV positive cases | Percentage(x/8971) | Percentage(x/31278) | Prevalence(x/157038) |
|--------------------------------|--------------------|--------------------|---------------------|--------------------|
| HPV16+HPV6                     | 822                | 9.16%              | 2.63%               | 0.52%              |
| HPV52+HPVCP8304                | 589                | 6.57%              | 1.88%               | 0.38%              |
| HPV52+HPV58                    | 558                | 6.22%              | 1.78%               | 0.36%              |
| HPV52+HPV16                    | 539                | 6.01%              | 1.72%               | 0.34%              |
| HPV52+HPV53                    | 442                | 4.93%              | 1.41%               | 0.28%              |
| HPV16+HPV58                    | 412                | 4.59%              | 1.32%               | 0.26%              |
| HPV58+HPVCP8304                | 382                | 4.26%              | 1.22%               | 0.24%              |
| HPV58+HPV33                    | 354                | 3.95%              | 1.13%               | 0.23%              |
| HPVCP8304+HPV53                | 321                | 3.58%              | 1.03%               | 0.20%              |
| HPV16+HPVCP8304                | 313                | 3.49%              | 1.00%               | 0.20%              |

Table 4. Prevalence and Distribution for Any HPV Type for Tested 157038 Women

| All ages | <20 | 20-29 | 30-39 | 40-49 | 50-59 | >=60 | unknown |
|----------|-----|-------|-------|-------|-------|------|---------|
| Overall total cases n=157038 | n=6 00 | n=3 359 0 | n=4 859 1 | n=4 473 6 | n=1 857 1 | n=7 736 | n=3 214 |

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| Genotypes | No. Positive cases | Prevalence (%) | No. Positive cases | Prevalence (%) | No. Positive cases | Prevalence (%) | No. Positive cases | Prevalence (%) | No. Positive cases | Prevalence (%) | No. Positive cases | Prevalence (%) | No. Positive cases | Prevalence (%) |
|-----------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|--------------------|----------------|
| HP V52    | 725 8              | 4.6 2%         | 40                 | 6.6 7%         | 160 9              | 4.7 9%         | 205 6              | 4.2 3%         | 196 4              | 4.3 9%         | 968 5.2%          | 1%             | 458 5.9%          | 2%             |
| HP V16    | 553 1              | 3.5 2%         | 34                 | 5.6 7%         | 104 7              | 3.1 2%         | 145 6              | 3.0 0%         | 160 1              | 3.5 8%         | 799 4.3%          | 0%             | 480 6.2%          | 0%             |
| HP V58    | 489 4              | 3.1 2%         | 24                 | 4.0 0%         | 920 2.7 4%        | 130 5          | 2.6 9%             | 134 3.0%        | 727 3.9%           | 1%             | 461 5.9%          | 6%             | 116 3.6%          | 1%             |
| HP VCP    | 456 3              | 2.9 1%         | 29                 | 4.8 3%         | 927 2.7 6%        | 119 1          | 2.4 5%             | 134 3.0%        | 695 3.7%           | 4%             | 261 3.3%          | 7%             | 115 3.5%          | 8%             |
| 830 4     |                    |                |                    |                |                    |                |                    |                |                    |                |                    |                |                    |                |
| HP V53    | 323 5              | 2.0 6%         | 21                 | 3.5 0%         | 638 1.9 0%        | 885 1.8 2%     | 878 1.9 6%        | 478 2.5 7%      | 255 3.3%           | 0%             | 80 2.4%           | 9%             |
| HP V39    | 253 7              | 1.6 2%         | 21                 | 3.5 0%         | 641 1.9 1%        | 656 1.3 5%     | 653 1.4 6%        | 331 1.7 8%      | 162 2.0%           | 9%             | 73 2.2%           | 7%             |
| HP V6     | 205 2              | 1.3 1%         | 25                 | 4.1 7%         | 608 1.8 1%        | 554 1.1 4%     | 491 1.1 0%        | 231 1.2 4%      | 121 1.5%           | 6%             | 22 0.6%           | 8%             |
| HP V33    | 200 7              | 1.2 8%         | 13                 | 2.1 7%         | 393 1.1 7%        | 503 1.0 4%     | 541 1.2 1%        | 305 1.6 4%      | 211 2.7%           | 3%             | 41 1.2%           | 8%             |
| HP V51    | 172 4              | 1.1 0%         | 17                 | 2.8 3%         | 472 1.4 1%        | 478 0.9 8%     | 412 0.9 2%        | 200 1.0 8%      | 90 1.1%            | 6%             | 55 1.7%           | 1%             |
| HP V18    | 170 5              | 1.0 9%         | 13                 | 2.1 7%         | 382 1.1 4%        | 444 0.9 1%     | 453 1.0 1%        | 257 1.3 8%      | 114 1.4%           | 7%             | 42 1.3%           | 1%             |
| HP V68    | 160 7              | 1.0 2%         | 5                  | 0.8 3%         | 360 1.0 7%        | 457 0.9 4%     | 435 0.9 7%        | 210 1.1 3%      | 112 1.4%           | 5%             | 28 0.8%           | 7%             |
| HP V31    | 132 2              | 0.8 4%         | 11                 | 1.8 3%         | 251 0.7 5%        | 365 0.7 5%     | 384 0.8 6%        | 182 0.9 8%      | 104 1.3%           | 4%             | 25 0.7%           | 8%             |
| HP V66    | 116 5              | 0.7 4%         | 16                 | 2.6 7%         | 317 0.9 4%        | 306 0.6 3%     | 254 0.5 7%        | 149 0.8 0%      | 96 1.2%            | 4%             | 27 0.8%           | 4%             |
| HP V11    | 822 2              | 0.5 2%         | 23                 | 3.8 3%         | 300 0.8 9%        | 194 0.4 0%     | 150 0.3 4%        | 107 0.5 8%      | 36 0.4 7%           | 12%            | 12 0.3%           | 7%             |
| HP V56    | 801 5              | 0.5 1%         | 8                  | 1.3 3%         | 188 0.5 6%        | 200 0.4 1%     | 207 0.4 6%        | 112 0.6 0%      | 69 0.8 9%           | 17%            | 17 0.5%           | 3%             |
| HP V59    | 654 4              | 0.4 2%         | 11                 | 1.8 3%         | 192 0.5 7%        | 152 0.3 1%     | 149 0.3 3%        | 93 0.5 0%       | 39 0.5%            | 0%             | 18 0.5%           | 6%             |
| HP V44    | 599 3              | 0.3 8%         | 3                  | 0.5 0%         | 117 0.3 5%        | 162 0.3 3%     | 185 0.4 1%        | 95 0.5 1%       | 26 0.3 4%           | 11%            | 0.3 4%            | 4%             |
| HP        | 428 0.2            | 5               | 0.8 85            | 0.2 110 0.2    | 131 0.2           | 53 0.2          | 38 0.4 6          | 1                | 0.1                |                |                |                |
## Figures

**Figure 1**

HPV prevalence by age among 157,038 Chinese females in Hunan Province