Preplanned Studies

Estimated Human Papillomavirus Vaccine Coverage Among Females 9–45 Years of Age — China, 2017–2022

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Summary

What is already known on this topic?

There is a lack of comprehensive data on the coverage of the human papillomavirus (HPV) vaccine in China. The limited published literature hampers our ability to accurately assess the current situation.

What is added by this report?

This study aimed to determine the rates of HPV vaccine coverage based on data from the electronic vaccination registry reported to the China Immunization Information System between 2017 and 2022. While there was an increase in HPV vaccine coverage each year, the overall coverage remained below the optimal level.

What are the implications for public health practice?

This study presents evidence of low HPV vaccine coverage when administered outside of a national immunization program. Therefore, it is recommended that the HPV vaccine be included in the National Immunization Program in order to meet the 2030 WHO target of achieving 90% vaccination coverage for girls by the age of 15.

Cervical cancer ranks fourth in both incidence and cancer-related deaths among women globally, with an estimated 604,000 new cases and 342,000 deaths in 2020 (*1*). In China, there were approximately 111,820 new cases and 61,579 deaths due to cervical cancer in 2022 (*2*). The high incidence and mortality rates of cervical cancer not only impose a health burden on individuals but also create a significant economic burden on families. To address this issue, the World Health Organization (WHO) set a global target in 2020, aiming for 90% of girls to receive full human papillomavirus (HPV) vaccination by the age of 15, as a step towards eliminating cervical cancer as a public health problem by 2030 (*3*). In alignment with these goals, China established a national target for 2030 to improve HPV vaccine coverage among young adolescent females, as part of their efforts to accelerate cervical cancer elimination (*4*). Although the first HPV vaccine was licensed in China in 2016, it has not yet been included in the National Immunization Program (NIP).

Assessing the current HPV vaccination coverage is essential for the development of effective HPV vaccination strategies for young adolescent females in China. However, the existing published literature is insufficient to provide an accurate representation of the national situation. In this study, we aimed to estimate the provincial-level HPV coverage among females aged 9–45 years old in China from 2017 to 2022. Additionally, we estimated the coverage among Chinese females by age group specifically for the year 2022.

Using data from the China Immunization Information System (CIIS) electronic vaccination registries, we analyzed the number of females aged 9–45 years who received the recommended doses of HPV vaccine from 2017 to 2022. Additionally, we recorded the number of vaccinations administered to each age group for the three types of HPV vaccine currently used in China. Detailed information about these HPV vaccines and their recommended schedules can be found in the provided reference (Table 1). The data on number of females aged 9–45 years was obtained from the China Disease Control and Prevention Information System (DCPIS) for the years 2017 to 2020.

We calculated two coverage rates: (1) the estimated cumulative coverage for first-dose and third-dose HPV vaccination among females aged 9–45 years. This was calculated by dividing the total number of females aged 9–45 years in a given study year who received one or three doses of the vaccine from 2017 to the study year, by the total number of females aged 9–45 years in the given study year. (2) The estimated cumulative coverage for first-dose, second-dose, or third-dose HPV vaccination among females by age group by 2022. This was calculated by dividing the number of

females in each age group in 2022 who received one or two doses or three doses of the vaccine, by the corresponding number of females in the population. First-dose coverage refers to having received at least one dose of the HPV vaccine, while third-dose coverage refers to having received all three doses of the vaccine.

Data were compiled and analyzed using Microsoft Excel 2010 (Microsoft Corporation, Redmond, WA, USA) to estimate the four coverage rates mentioned above, based on provincial-level administrative division (PLAD) and age group.

From 2017 to 2022, a total of 85,790,000 doses of the HPV vaccine were administered. The number of doses given each year was as follows: 44,000 in 2017, 1,454,000 in 2018, 4,519,000 in 2019, 10,769,000 in 2020, 21,738,000 in 2021, and 47,266,000 in 2022.

Table 2 presents the cumulative coverage levels by PLAD and year. From 2017 to 2022, the first-dose cumulative coverage increased from 0.01% to 10.15%, while the third-dose cumulative coverage increased from 0% to 6.21%. These findings indicate a consistent annual increase in coverage across all PLADs. The PLADs in the eastern region (Beijing, Shanghai, Guangdong) exhibited the highest coverage, while the PLADs in the western region (Xinjiang, Qinghai, Gansu) had the lowest coverage.

Table 3 presents the coverage levels for different age groups and types of HPV vaccines. In 2022, the highest first-dose coverage was observed among individuals aged 20–24 (14.02%), while the lowest first-dose coverage was found among those aged 9–14 (4.00%). First-dose coverage above 10% was only observed in the age group of 20–39. The age group with the highest third-dose coverage was 25–29 (9.39%), while the lowest third-dose coverage was observed among individuals aged 9–14 (0.31%). Bivalent HPV vaccine had the highest coverage among the three types, but it remained below 7% for all age groups.

DISCUSSION

We conducted a search in the CIIS electronic vaccination registries, encompassing all immunization clinics across China, to examine HPV vaccination rates. Our findings demonstrate a consistent increase in the number of administered doses and vaccination coverage in each of the six years since the introduction of HPV vaccine in China. However, despite this upward trend, the first-dose coverage was only 10.15%, and the third-dose coverage was only 6.21% by 2022. These rates notably lag behind the global coverage rates of 20% for the first dose and 15% for the full series among females in 2019 (*5*). A meta-analysis indicates that substantial indirect (herd) protection against HPV occurs when vaccine coverage exceeds 50% (*6*). Therefore, the current HPV vaccine coverage in China is far below the threshold required for achieving herd immunity.

The study revealed low vaccination coverage for HPV among females under 20 years old. In the 9–14-

TABLE 1. HPV vaccines available in China as of the end of 2022.

Item	2-valent HPV vaccine			4-valent HPV vaccine	9-valent HPV vaccine
Manufacturer	GlaxoSmithKline Biologicals S.A.	Xiamen Innovax Bio-Tech Co., Ltd.	Yuxi Walvax Bio-Tech Co., Ltd.	Merck Sharp & Dohme Corp.	
Licensing year	2016	2019	2022	2017	2018
Approved age range	9 to 45 years*	9 to 45 years	9 to 30 years	9 to 45 years†	9 to 45 years§
Number of doses in recommended schedule	3 doses; 2 doses also for 9 to 14 years			3 doses	
Recommended schedule	3-dose series, the second dose should be given 1 month after the first dose, and the third dose should be given 6 months after the first dose. 2-dose series is also available for female 9 to 14 years of age, the second dose should be given 6 months after the first dose.		3-dose series, the second dose should be given 2 months after the first dose, and the third dose should be given 6 months after the first dose. 2-dose series is also available for females 9 to 14 years of age, the second dose should be given 6 months after the first dose.	3-dose series, the second dose should be given 2 months after the first dose, and the third dose should be given 6 months after the first dose.	

Abbreviation: HPV=human papillomavirus.

* 2-valent HPV vaccine for females aged 9 to 25 years in 2016–2018. The age range was extended to 9–45 years in July 2018. 2-dose was also available for female aged 9 to 14 years in May 2022.

† 4-valent HPV vaccine for females aged 20 to 40 years in 2017–2019. The age range was extended to 9–45 years in December 2020.

§ 9-valent HPV vaccine for female aged 16 years to 26 years in 2018–2021. The age range was extended to 9–45 years in August 2022.

TABLE 2. HPV vaccination coverage among females aged 9–45 years in China, 2017–2022 (%).

PLAD	2017		2018		2019		2020		2021		2022	
	First dose	Third dose	First dose	Third dose	First dose	Third dose	First dose	Third dose	First dose	Third dose	First dose	Third dose
Beijing	0.02	0	1.50	0.38	4.75	2.86	10.28	5.90	17.64	12.25	25.40	20.29
Tianjin	0	0	0.50	0.15	1.49	0.93	3.65	2.20	7.34	4.39	13.67	9.50
Hebei	0	0	0.09	0	0.67	0.18	2.02	0.79	4.55	1.91	8.95	5.13
Shanxi	0	0	0.09	0.04	0.42	0.18	1.01	0.61	2.76	1.18	6.27	3.85
Inner Mongolia	0	0	0	0	0.10	0.03	0.90	0.19	3.11	1.17	6.60	4.22
Liaoning	0	0	0.05	0.02	0.33	0.16	0.76	0.48	2.90	1.14	7.12	4.28
Jilin	0	0	0.18	0.03	0.85	0.33	2.44	1.17	4.75	2.67	7.99	5.24
Heilongjiang	0	0	0.01	0	0.05	0.02	0.15	0.07	1.06	0.24	3.97	2.17
Shanghai	0.03	0	1.77	0.31	4.13	2.82	8.23	5.30	13.43	9.46	20.99	14.49
Jiangsu	0	0	0.15	0.02	1.43	0.52	3.26	1.96	6.71	3.60	13.05	8.44
Zhejiang	0.03	0	0.62	0.19	1.81	1.18	4.32	2.71	8.17	5.35	14.30	9.76
Anhui	0.01	0	0.08	0.01	0.45	0.18	1.19	0.58	3.71	1.40	8.65	5.33
Fujian	0.01	0	0.09	0.03	0.51	0.22	2.22	1.00	5.28	2.54	13.75	6.56
Jiangxi	0	0	0	0	0.01	0	0.11	0.02	1.72	0.69	4.99	3.16
Shandong	0.01	0	0.36	0.16	1.19	0.60	2.85	1.65	6.14	3.29	11.70	7.40
Henan	0	0	0.04	0.01	0.40	0.09	1.71	0.59	4.37	1.79	8.98	5.12
Hubei	0	0	0.02	0	0.19	0.06	1.44	0.29	4.96	1.61	10.14	5.84
Hunan	0.01	0	0.14	0.04	0.45	0.20	1.16	0.59	2.95	1.31	6.92	3.94
Guangdong	0.01	0	0.42	0.12	1.07	0.60	2.94	1.50	6.75	3.42	15.65	8.63
Guangxi	0.01	0	0.15	0.04	0.66	0.20	1.76	0.77	4.40	1.77	9.37	5.54
Hainan	0	0	0.04	0.01	0.39	0.24	2.24	0.95	6.02	2.96	14.04	7.15
Chongqing	0.07	0	0.47	0.14	1.42	0.67	3.37	1.77	6.96	3.75	12.16	8.29
Sichuan	0.03	0	0.20	0.06	0.62	0.32	1.75	0.99	5.54	2.65	11.36	7.61
Guizhou	0	0	0.03	0.01	0.29	0.09	0.84	0.43	2.04	0.95	4.74	2.74
Yunnan	0	0	0.04	0	0.28	0.08	0.92	0.41	2.66	1.03	6.31	3.66
Xizang	0	0	0	0	0	0	0.01	0	0.48	0.06	3.51	0.88
Shaanxi	0	0	0.07	0.01	0.48	0.14	1.99	0.77	5.78	2.39	11.67	7.12
Gansu	0	0	0.05	0	0.26	0.11	0.65	0.40	1.56	0.83	3.41	2.16
Qinhai	0	0	0	0	0	0	0.05	0	1.10	0.44	2.95	1.78
Ningxia	0	0	0	0	0.01	0	0.53	0.08	3.29	0.87	7.03	4.50
Xinjiang	0	0	0.01	0	0.04	0.01	0.33	0.05	1.17	0.31	2.55	1.27
Total	0.01	0	0.22	0.06	0.78	0.38	2.11	1.09	4.95	2.47	10.15	6.21

Abbreviation: HPV=human papillomavirus; PLAD=provincial-level administrative division.

year-old group, first-dose coverage was 4.00%, and third-dose coverage was 0.31%. In the 15–19-year-old group, first-dose coverage was 4.66% and third-dose coverage was 2.21%. These findings indicate that HPV vaccine coverage is significantly below the WHO's 2030 target of achieving 90% full vaccination among girls by the age of 15.

The low coverage observed in China may be attributed to the limited availability of vaccines during the study period and the exclusion of the HPV vaccine from China's National Immunization Program. Instead, the HPV vaccine is available on a non-program basis, requiring families to pay for it. However, the introduction of domestically produced bivalent HPV vaccines in 2019 and 2022 has helped mitigate vaccine supply challenges.

TABLE 3. HPV vaccination cumulative coverage by age group among females aged 9 to 45 years through the end of 2022.

Age group (years)	2-valent HPV vaccine			4-valent HPV vaccine			9-valent HPV vaccine			Cumulative		
	First dose	Second dose	Third dose	First dose	Second dose	Third dose	First dose	Second dose	Third dose	First dose	Second dose	Third dose
9–14	3.82	1.35	0.22	0.15	0.14	0.08	0.02	0	0	4.00	1.50	0.31
15–19	1.31	1.11	0.67	0.08	0.03	0.04	3.27	2.71	1.49	4.66	3.85	2.21
20–24	1.41	1.26	0.83	0.31	0.22	0.15	12.30	10.98	7.35	14.02	12.46	8.34
25–29	3.26	2.97	1.98	3.21	2.60	1.85	6.76	6.23	5.55	13.24	11.80	9.39
30–34	6.18	5.70	3.84	6.16	5.09	3.82	0.13	0.03	0.02	12.48	10.83	7.68
35–39	6.63	6.15	4.22	5.78	4.80	3.65	0.09	0.01	0.01	12.49	10.96	7.88
40–45	4.53	4.24	3.09	3.29	2.82	2.28	0.04	0.01	0	7.86	7.06	5.37
Total	4.14	3.54	2.35	3.07	2.55	1.93	2.93	2.60	1.94	10.15	8.69	6.21

Abbreviation: HPV=human papillomavirus.

A register-based observational study conducted in England has shown a significant decrease in cervical cancer cases among young women following the implementation of an HPV vaccination program (*7*). This reduction was particularly notable among those who received the vaccine between the ages of 12 and 18. This finding aligns with a nationwide cohort study in Denmark, which also found a high effectiveness of the HPV vaccine in preventing cervical cancer among girls vaccinated before the age of 20 (*8*). Collectively, these studies indicate that achieving high HPV vaccine coverage is crucial for ensuring its effectiveness in preventing cervical cancer at the population level.

In 2017, the WHO revised its guidance to suggest that countries should consider vaccinating multi-age cohorts (MAC) instead of a single birth cohort when introducing the vaccine, in order to enhance the impact and efficiency of the program (*9*). In 2022, the WHO further recommended a vaccination schedule for girls aged 9–14 years, consisting of either two doses or a single dose (*10*). This recommendation has the potential to expedite China's efforts to achieve the necessary high vaccine coverage for cervical cancer elimination.

In our study, we observed a significant difference in the vaccination coverage between the first and second doses in the 9–14-year-old age group. There are two main contributing factors to this discrepancy. First, the 2-valent HPV vaccine guidelines allow girls in this age group to choose between receiving either 3 doses or 2 doses to complete the full vaccination series. Second, in 2022, certain regions implemented a policy providing free HPV vaccines consisting of 2 doses for middle school girls (*11*). As a result, some girls have received the first dose but have not yet reached the recommended time for receiving the second dose.

There are significant disparities in HPV vaccine coverage between the eastern and western regions. Cervical cancer has a higher impact on women residing in economically underdeveloped western regions, mainly due to the natural environment and relatively weaker healthcare conditions. As a result, it is crucial to urgently introduce HPV vaccination in these lagging regions to mitigate vaccine-related inequalities (*12*).

Our study has several limitations. First, the CIIS makes efforts to collect vaccination records from immunization clinics to ensure compliance with the requirements of the vaccine management law for complete traceability. However, there may be cases where certain records are missing due to unsuccessful uploads or data discrepancies. Nonetheless, it is worth noting that the number of missing records is minimal and has minimal impact. Second, we lacked data on the size of the female population in 2021–2022, so we utilized 2020 female population data, which may have had a slight impact on our estimates. Lastly, we did not take into account deaths when calculating HPV vaccine coverage, which may have had a minor effect on our estimates.

In conclusion, our study identified both progress and gaps in the utilization and coverage of the HPV vaccine among females aged 9–45 years in China. However, it is concerning that the rates of HPV vaccination were significantly lower than the global average, particularly among females under 20 years of age, and well below the WHO 2030 target. To address these issues, we recommend incorporating the HPV vaccine into China's National Immunization Program. This should involve implementing routine vaccination across multiple age cohorts to rapidly increase coverage among a wide range of ages, reduce regional disparities, and ensure equitable access to this important vaccine.

The introduction of the HPV vaccine into the National Immunization Program should be supported by evidence of disease burden, immunization strategies to achieve high coverage, assessments of cost-effectiveness, proof of sufficient vaccine supply, and assurance of adequate vaccination service capacity.

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