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Trends in Routine First-Dose Human Papillomavirus Vaccination Coverage in Wakayama Prefecture, Japan, Fiscal Years 2020–2025

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Abstract

Background

In Japan, proactive recommendations for human papillomavirus vaccination were suspended in 2013 and resumed in fiscal year 2022 alongside a catch-up program, whose first-dose eligibility ended in fiscal year 2024. Coverage among subsequent routine-vaccination cohorts remains unclear. We described first-dose vaccination coverage in Wakayama Prefecture during fiscal years 2020–2025, focusing on grade-specific differences between 2024 and 2025.

Methods

This descriptive epidemiological study used aggregated administrative data. Age-specific first-dose counts were obtained from e-Stat for fiscal years 2020–2021 and the Wakayama Prefectural Government for 2022–2025. Denominators were age-specific female populations from the 2020 Population Census. Vaccination counts and population data were reconstructed by birth fiscal year using a published method. Annual and cumulative coverage were estimated for the 2004–2013 birth cohorts.

Results

Between fiscal years 2024 and 2025, annual coverage changed from 3.8% to 4.1% in sixth-grade elementary school students, 20.6% to 15.4% in first-year junior high school students, 2.2% to 7.7% in second-year junior high school students, 30.5% to 16.4% in third-year junior high school students, and 13.1% to 6.1% in first-year high school students. Cumulative coverage by the end of first-year high school was 46.5% and 49.9% for the 2008 and 2009 birth cohorts, respectively. The highest-coverage grade shifted from first-year high school to third-year junior high school.

Conclusions

The predominant timing of first-dose vaccination shifted toward younger grades during fiscal years 2020–2025. However, annual coverage in 2025 was lower than in 2024 among first- and third-year junior high school students and first-year high school students.

Background

Human papillomavirus (HPV) vaccination has been shown to be an effective means of preventing cervical cancer [1, 2]. HPV vaccination has reportedly been incorporated into national immunization programs in 162 of the 194 World Health Organization member states [3].

In Japan, public funding for HPV vaccination began in FY2010, and the vaccine was incorporated into the routine immunization program in April 2013. However, in June 2013, the Ministry of Health, Labor and Welfare (MHLW) suspended proactive recommendations for HPV vaccination because of concerns about various diverse symptoms reported after vaccination [4]. HPV vaccination coverage sharply declined nationwide thereafter [5, 6].

Although later studies did not support a causal association between HPV vaccination and the diverse symptoms reported after vaccination, the suspension of proactive recommendations remained in place [7–9].

In FY2022, proactive recommendations for HPV vaccination resumed, and a catch-up vaccination program was launched for women who had missed vaccination opportunities during the suspension period [10, 11]. Eligibility to receive the first dose under the catch-up program ended in FY2024, so the MHLW, local governments, medical associations, and other organizations conducted public information and outreach campaigns in FY2024 in an effort to increase catch-up vaccination uptake.

An increase in vaccination coverage during FY2024 has already been reported [12], but vaccination patterns from FY2025 onward remain unclear.

In this study, we aim to determine trends in first-dose HPV vaccination coverage by birth cohort in Wakayama Prefecture between FY2020 and FY2025 and to characterize school grade-specific vaccination patterns in FY2024 and FY2025. We also examined Google Trends as a supplementary indicator of public interest.

Materials and Methods

Study Design and Population

In this descriptive epidemiological study, we used aggregated administrative data compiled by Wakayama Prefecture. Among women born between FY2004 and FY2013, we calculated annual and cumulative first-dose vaccination coverage by birth cohort for FY2020-FY2025 and specifically compared vaccination proportions by birth fiscal year (school grade) between FY2024 and FY2025.

Data Sources

Age-specific first-dose vaccination counts for FY2022-FY2025 were provided by the Wakayama Prefectural Government. Corresponding data for FY2020 and FY2021 could not be obtained from the prefecture, so they were retrieved from e-Stat [13, 14]. The data provided by Wakayama Prefecture covered recipients of routine vaccination, so the count of vaccinated 16-year-olds did not include second-year senior high school students (16–17 years). The target population was based on the age-specific female population of Wakayama Prefecture reported in the 2020 Population Census as of October 1, 2020, and published in e-Stat [15].

Estimation of the Number of Vaccine Recipients by Birth Fiscal Year

Both the e-Stat data and the data provided by Wakayama Prefecture were aggregated by age at vaccination; the number of vaccine recipients by birth fiscal year could not be directly determined. We therefore used a previously-described method to estimate vaccination counts by school grade and birth fiscal year from age-specific counts [16]. The calculations were performed as follows (Fig. 1):

Number of sixth-grade elementary school vaccine recipients = number of vaccinated 11-year-olds x 2

Number of first-year junior high school vaccine recipients = (number of vaccinated 12-year-olds - number of sixth-grade elementary school vaccine recipients / 2) x 2

Number of second-year junior high school vaccine recipients = (number of vaccinated 13-year-olds - number of first-year junior high school vaccine recipients / 2) x 2

Number of third-year junior high school vaccine recipients = (number of vaccinated 14-year-olds - number of second-year junior high school vaccine recipients / 2) x 2

Number of first-year senior high school vaccine recipients = total number of vaccine recipients aged 11–16 years - number of sixth-grade elementary school vaccine recipients - number of first-year junior high school vaccine recipients - number of second-year junior high school vaccine recipients - number of third-year junior high school vaccine recipients

Estimation of the Population by Birth Fiscal Year

The target population by birth fiscal year was estimated using the female population of Wakayama Prefecture by age and birth-month category as of October 1, 2020. For example, the population born in FY2008 was calculated as the sum of 12-year-old girls born between April and September and 11-year-old girls born between October and March at that date. Specifically, the estimate combined 966 girls aged 12 years born between April and June, 952 born between July and September, 943 girls aged 11 years born between October and December, and 1012 born between January and March, for a total of 3873 girls (Table 1). For all observation years, we used the birth-fiscal-year-specific population estimated from the 2020 population census using this method as a fixed denominator.

Outcome Measures

Outcome Measures

Annual first-dose vaccination coverage was calculated by dividing the estimated number of individuals who received a first dose in each fiscal year by the estimated population of the corresponding birth cohort. Cumulative first-dose coverage was calculated by dividing the cumulative estimated number of first-dose recipients through the relevant fiscal year by the same birth-cohort population. For first-year senior high school students (15–16 years) we additionally calculated, as a secondary measure, the proportion receiving a first dose

among those estimated to be unvaccinated at the start of the fiscal year (conditional first-dose uptake). Conditional first-dose uptake was calculated as annual first-dose coverage / (100% - cumulative first-dose coverage at the start of the fiscal year) x 100.

Google Trends as an Indicator of Public Interest

We used Google Trends as a supplementary indicator of public search activity. Data were retrieved on August 13, 2026. The search term was ‘HPV vaccine’, the region was Japan, the period was April 1, 2024-March 31, 2026, the category was ‘All categories’, and the search type was ‘Web Search’. Search interest is a relative index normalized from 0 to 100 according to the proportion of searches within the specified period and region (Fig. 2). For comparisons among prefectures, we used the relative index and ranking in which the prefecture with the highest proportion of searches under the same conditions was assigned a value of 100.

Results

Annual First-Dose Vaccination Coverage

Annual and cumulative first-dose HPV vaccination coverage in Wakayama Prefecture between FY2020 and FY2025 is shown in Table 2. Between FY2024 and FY2025, annual first-dose coverage changed from 3.8% to 4.1% among sixth-grade elementary school students (11–12 years), from 20.6% to 15.4% among first-year junior high school students (12–13 years), from 2.2% to 7.7% among second-year junior high school students (13 or 14 years), from 30.5% to 16.4% among third-year junior high school students (14–15 years), and from 13.1% to 6.1% among first-year senior high school students (15–16 years).

Table 2
First-dose HPV vaccination coverage among girls in Wakayama Prefecture, by fiscal year of birth and fiscal year of vaccination (%)

		FY							
		2020	2021	2022	2023	2024	2025	Total (%)	Cumulative vaccination coverage through FY2024 (%)
Birth FY	2004	5.3						5.3	
	2005	4.1	16.5					20.6	
	2006	0.1	4.4	14.1				18.6	
	2007	2.4	3.0	10.2	8.4			24.0	
	2008	0.1	4.3	6.2	22.8	13.1		46.5	
	2009		0.7	8.8	3.8	30.5	6.1	49.9	43.8
	2010			2.2	15.8	2.2	16.4	36.6	20.2
	2011				3.3	20.6	7.7	31.6	23.9
	2012					3.8	15.4	19.2	3.8
	2013						4.1	4.1	

Cumulative First-Dose Vaccination by Birth Fiscal Year

Cumulative first-dose coverage by the end of the first year of senior high school was 46.5% for the FY2008 birth cohort (first-year senior high school students in FY2024) and 49.9% for the FY2009 birth cohort (first-year senior high school students in FY2025).

For the FY2008 birth cohort, cumulative first-dose coverage before the start of the first year of senior high school was 33.4%, and annual first-dose coverage during that school year was 13.1%. The corresponding values for the FY2009 birth cohort were 43.8% and 6.1%, respectively.

Secondary Analysis Using the Unvaccinated Population at the Start of the Fiscal Year as the Denominator

Based on the reported estimated coverage values, conditional first-dose uptake among students estimated to be unvaccinated at the start of the first year of senior high school was 19.7% for the FY2008 birth cohort [13.1 / (100 − 33.4) x 100] and 10.9% for the FY2009 birth cohort [6.1 / (100 − 43.8) x 100].

Changes in the School Grade at Vaccination

Between FY2020 and FY2025, there was a shift in the main school grade in which vaccination occurred from the first year of senior high school to the third year of junior high school, and there was also an increase in the proportion vaccinated during the first year of junior high school. In FY2020 and FY2021, the highest coverage was observed among first-year senior high school students, at 5.3% and 16.5%, respectively. In FY2022, coverage was 14.1% among first-year senior high school students, 10.2% among third-year junior high school students, and 8.8% among first-year junior high school students. From FY2023 onward, vaccination was concentrated among third-year junior high school students (22.8%) and first-year junior high school students (15.8%); in FY2024, the corresponding values were 30.5% and 20.6%. In FY2025, coverage among first-year junior high school students and third-year junior high school students (the group with the highest coverage) was similar, at 15.4% and 16.4%, respectively.

Google Trends

Nationwide search interest reached its highest value during the observation period in September 2024 and remained low throughout FY2025. In the prefecture-level comparison of relative search interest, Wakayama Prefecture had a value of 60 while Tokyo, the highest-ranked prefecture, was assigned a value of 100; Wakayama ranked 40th among the 47 prefectures [17].

Discussion

In Wakayama Prefecture, annual first-dose coverage in FY2025 was lower than in FY2024 among first-year and third-year junior high school students and in first-year senior high school students, but higher among sixth-grade elementary school students and second-year junior high school students. During the observation period, the grade with the highest annual first-dose coverage shifted from the first year of senior high school to the third year of junior high school, and there was also an increase in vaccination during the first year of junior high school.

Cumulative first-dose coverage by the end of the first year of senior high school was estimated at 46.5% for the FY2008 birth cohort and 49.9% for the FY2009 birth cohort. In contrast, annual first-dose coverage during the first year of high school declined from 13.1% in the FY2008 birth cohort to 6.1% in the FY2009 birth cohort. However, these were different birth cohorts, and cumulative coverage at the start of the first year of senior high school was 33.4% and 43.8%, respectively. The difference in annual first-dose coverage calculated using the entire birth cohort as the denominator was therefore shown to be influenced by differences in the proportion remaining unvaccinated at the start of the first year of senior high school. When conditional first-dose uptake was calculated using the population estimated to be unvaccinated at the start of the fiscal year as the denominator, the values were 19.7% for the FY2008 birth cohort and 10.9% for the FY2009 birth cohort.

HPV vaccination behavior is reportedly influenced not only by perceptions of vaccine effectiveness and safety, but also by individual notifications from local governments, recommendations from healthcare professionals, and media coverage [18–20]. FY2024 was the final fiscal year in which public funding was available for the first dose under the catch-up program, and the MHLW requested local governments and other organizations to conduct public information and outreach activities [21, 22].

Quantitative data showing how national and local awareness-raising activities or media coverage actually changed in FY2025 were unavailable. Therefore, we could not assess the extent to which changes in these activities contributed to the difference in conditional first-dose uptake between the FY2008 birth cohort (19.7%) and the FY2009 birth cohort (10.9%).

The FY2010 birth cohort, who were third-year junior high school students in FY2025 and will enter their final year of routine vaccination eligibility as first-year senior high school students in FY2026, had cumulative coverage of 36.6% by the end of FY2025. Even if this cohort achieved annual coverage of 6.1% in FY2026, which is equivalent to that of the FY2009 birth cohort during the first year of senior high school, its final cumulative coverage by the end of that school year would be 42.7%, which is approximately the same level as the FY2009 birth cohort. This may suggest that, under current conditions, HPV vaccination uptake could remain at approximately 50%, even with extensive promotion.

Recently released national coverage data through the end of FY2025, which was estimated by the MHLW using the same method as in this study, showed cumulative first-dose coverage through the first year of senior high school of 53.1% for the FY2008 birth cohort (first-

year senior high school students in FY2024) and 55.1% for the FY2009 birth cohort [23]. Coverage in Wakayama Prefecture was therefore lower than the national estimates. In the Google Trends prefecture-level measure of interest in HPV vaccination, Wakayama had a relative value of 60 compared with 100 for Tokyo and it ranked 40th among the 47 Japanese prefectures. However, the age and sex of search users and their relationship to the vaccination-eligible population could not be identified, so this indicator does not directly reflect vaccination intentions among eligible individuals or their parents.

This study also showed that the primary grade at HPV vaccination shifted from the first year of senior high school to the third year of junior high school, and that there was an increase in vaccination during the first year of junior high school. Although the factors underlying this change cannot be determined from our data, the broader public awareness of HPV vaccination associated with the catch-up program and increased dissemination of information about the first year of junior high school as the standard vaccination period may have contributed to this result [24].

A study conducted in the United Kingdom that compared individuals vaccinated against HPV at ages 12–13 years with those vaccinated at ages 14–16 years reported a greater reduction in the incidence of cervical intraepithelial neoplasia grade 3 (CIN3) among those vaccinated at ages 12–13 years [25]. Accordingly, the trend toward vaccination at younger ages is thought to be favorable from the perspective of completing vaccination before sexual debut and preventing cervical cancer.

Limitations

In this study, the number of vaccine recipients by birth fiscal year was reconstructed from age-specific aggregate counts under the assumption that births and vaccination timing were approximately evenly distributed within each fiscal year. In addition, we used the 2020 census population as the denominator for all observation years, so the estimates did not account for migration, deaths, or temporal changes in birth-cohort size and there may be a difference from the actual eligible population in each fiscal year. Estimation error may therefore have had a relatively larger effect in birth cohorts with small populations. The source of vaccination-count data also differed between FY2020-FY2021 and FY2022 onward, and we cannot exclude differences in aggregation specifications. Google Trends is a supplementary indicator of relative nationwide search interest and it could not be used to directly measure interest or individual vaccination behavior among eligible individuals or their parents in Wakayama Prefecture. Finally, we assessed first-dose vaccination coverage but could not evaluate series-completion coverage.

Analysis of HPV vaccination coverage in Wakayama Prefecture showed that annual coverage in FY2025 was lower than in FY2024 among first-year and third-year junior high school students and first-year senior high school students, but it was higher among sixth-grade elementary school students and second-year junior high school students. The school grade with the highest vaccination coverage shifted from the first year of senior high school to the third year of junior high school, and coverage during the first year of junior high school also showed an increasing trend. Continued assessment of vaccination patterns is required, together with evaluation of indicators such as local information provision and vaccination recommendations.

Declarations

Conflict of Interest

Kayoko Katayama received research funding from MSD K.K. Kazuhiko Ino received lecture honoraria from MSD K.K. The other authors have no conflict of interest.

Ethics Statement

Approval of the research protocol: The study protocol was reviewed and approved by the Wakayama Medical University Ethics Committee (approval no. T4731). Permission to use the aggregated administrative data was obtained from the Wakayama Prefectural Government.

Informed consent:

Individual informed consent was not required because this study used only aggregated data.

Registry and registration number

N/A.

Animal studies

N/A.

Funding Information

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Author Contributions

N.S.: Formal analysis (lead); Writing – original draft (lead). K.H., S.T., M. Kanno, S.I., and A.Y.: Formal analysis (supporting). M. Kuno and M.H.: Data curation (equal). All authors: Writing – review and editing (equal).

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Data availability

Age-specific first-dose HPV vaccination data for fiscal years 2020–2021 and population data from the 2020 Population Census are publicly available through e-Stat [13–15]. Google Trends data are publicly available [17]. Aggregated vaccination data for fiscal years 2022–2025 were provided by the Wakayama Prefectural Government and are available from the corresponding author upon reasonable request and with permission from the Wakayama Prefectural Government.

Abbreviations

FY, Fiscal Year; HPV, Human papillomavirus; MHLW, Ministry of Health, Labor and Welfare

Table 1

Table 1: Example Calculation of the Number of Girls in Wakayama Prefecture When the FY2024 First-Year High School Cohort Was in Grade 6 Students in the first year of senior high school in FY2024 were in sixth grade in FY2020 and were born between April 2, 2008, and April 1, 2009 (the FY2008 birth cohort). As of October 1, 2020, the population of the FY2008 birth cohort was calculated as the sum of 12-year-old girls born from April through September and 11-year-old girls born from October through March. FY: fiscal year

age	Total	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec
0	2,744	649	713	657	725
1	2,797	670	709	690	728
2	2,968	746	686	762	774
3	3,058	760	758	766	774
4	3,259	825	779	816	839
5	3,480	847	819	915	899
6	3,404	831	782	931	860
7	3,528	860	820	938	910
8	3,649	945	818	959	927
9	3,654	884	921	960	889
10	3,657	936	917	963	841
11	3,825	1,012	865	1,005	943
12	3,875	957	966	952	1,000
13	3,685	870	924	956	935
14	3,893	940	1,008	1,017	928
15	3,865	992	890	1,001	982
16	3,952	1,033	962	948	1,009

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Figures

Figure1

Number vaccinated by age	
age	Number vaccinated
16	402
15	661
14	596
13	426
12	453
11	67

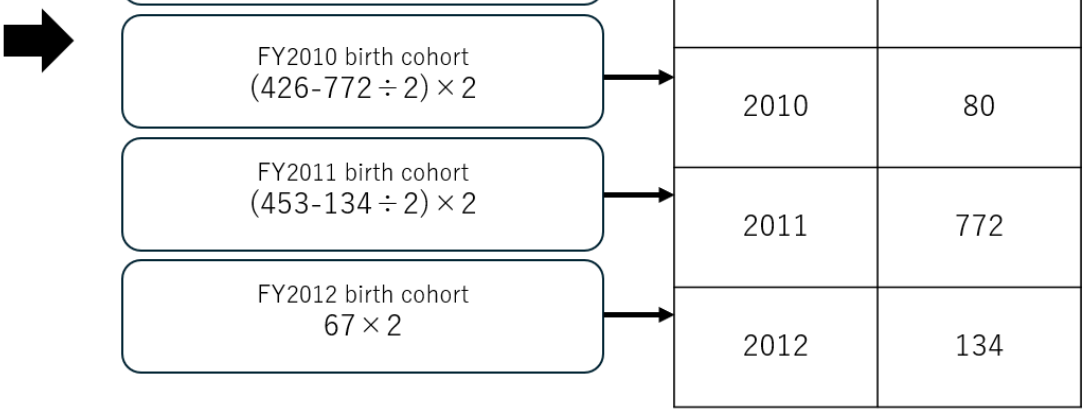


Figure 1

Method for Reaggregating Age-Specific Numbers of Vaccinated Individuals by Fiscal Year of Birth (FY2024)

Using the estimation method described by Nakagawa et al. and adopted by the MHLW, data aggregated by age at vaccination were allocated to school grades

FY: fiscal year

Figure2

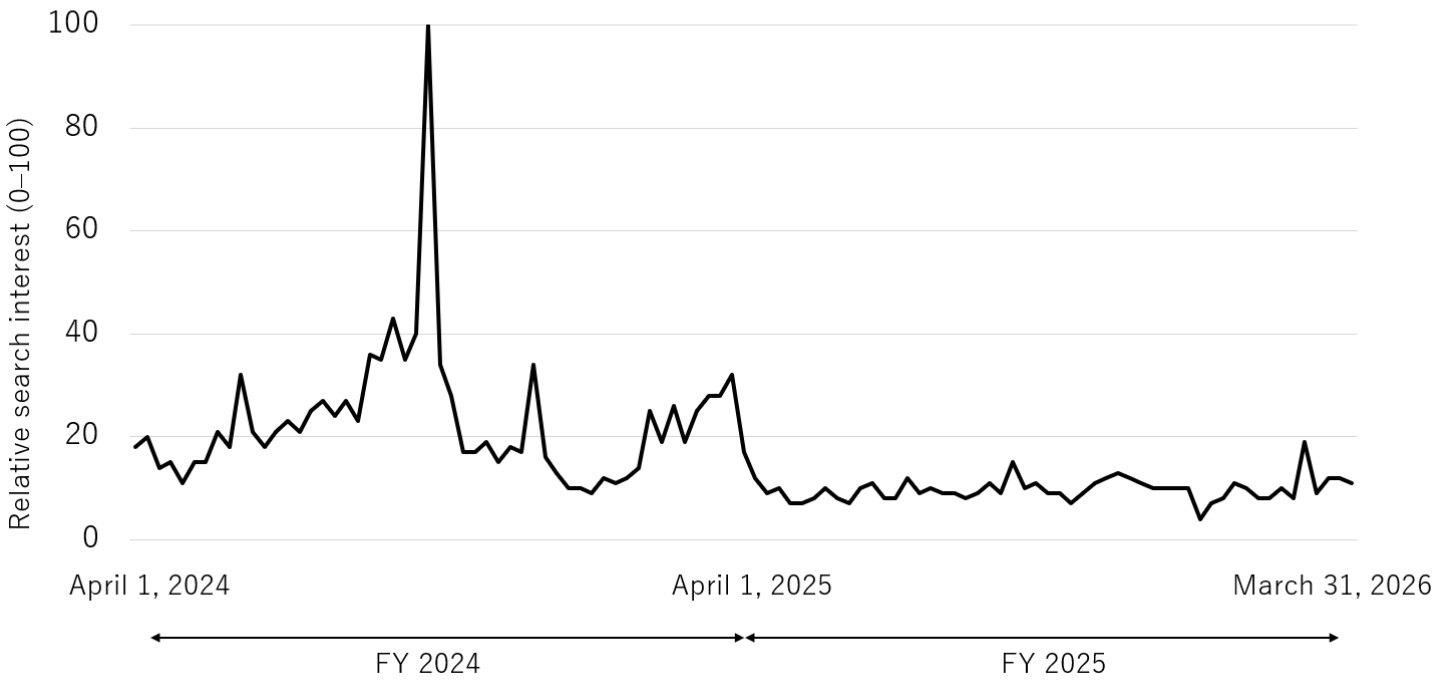


Figure 2

Trends in Google Trends search interest for ‘HPV vaccine’

The vertical axis shows a relative value, with 100 representing the point at which the proportion of searches for ‘HPV vaccine’ reached its maximum during the study period.

FY: fiscal year