BMJ Open

HPV vaccination among young adults in Switzerland: a cross-sectional study

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To cite: El-Hadad S, Sachs MK, Barrense-Dias Y, *et al*. HPV vaccination among young adults in Switzerland: a cross-sectional study. *BMJ Open* 2025;**15**:e089681. doi:10.1136/bmjopen-2024-089681

► Prepublication history for this paper is available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-089681).

Received 05 June 2024
Accepted 11 December 2024

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ABSTRACT

Objective This study aimed to evaluate the human papillomavirus (HPV) vaccination status among a representative sample of young adults (YAs) with a special focus on the catch-up vaccination uptake among the male population in Switzerland.

Design and setting Data were extracted from an online self-administered questionnaire survey, conducted as a representative cross-sectional study in 2017. To understand correlations between vaccination uptake and sociodemographic characteristics, sexual health, and sexual behaviour, we performed bivariate analysis and multivariate regression analysis.

Participants Out of a total of 7142 participants, 2155 female and 996 male cisgender participants remained for statistical evaluation after excluding homosexual/bisexual study participants, those with gender dysphoria or those without knowledge of their vaccination status.

Outcomes The primary outcome of this study was to investigate HPV vaccination rates among female and male YAs in Switzerland. As secondary outcomes, we assessed uptake of catch-up vaccination and identified key factors influencing HPV vaccination uptake.

Results Vaccination rates were significantly higher in the female group (40.9%), while not wanting to be vaccinated and doubting benefits and necessity of the vaccine were main reasons for non-vaccination. Vaccination coverage among male YAs was very low (7.8%), primarily due to insufficient information. Parents not being Swiss-born, a higher family socioeconomic status and having had a gynaecological visit at a younger age correlated with HPV vaccination uptake for female YAs. In the male group, participants with a higher number of lifetime partners and a younger age at first steady partnership were more likely to report a positive vaccination status. Knowledge about the benefits of catch-up vaccination was very limited among both genders.

Conclusions The lack of knowledge about benefits of HPV vaccination contributes to low vaccine uptake, especially occurring among the male population, must be addressed. Given the number of people who reported not knowing whether they were vaccinated or not, it is crucial to ensure that there is a thorough discussion about HPV and the protection the vaccine provides when presenting for vaccination.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The cross-sectional design of the study precludes the inference of causation.
⇒ The response rate of 15.1% was lower than expected and may be attributed to the detailed nature of questions regarding sexual behaviour, a topic often regarded as sensitive. Additionally, factors such as the timing of the survey coinciding with the summer holidays in Switzerland and the use of postal mail for participant recruitment may have influenced the response rate. Although the results are based on a large representative sample, the limited response rate does not allow full exclusion of overestimation or underestimation in explored correlations.
⇒ The reliance on self-reported vaccination status, including the age at first dose, may have introduced a potential for recall bias, as data were not corroborated with documented records.
⇒ Although the results are based on a large representative sample, the limited response rate does not allow full exclusion of overestimation or underestimation in explored correlations.
⇒ Regarding the classification of the participants into vaccination status groups, the exclusion of an 'I don't know' response category poses challenges in data analysis, as the vaccination status of this subgroup remains uncertain. While incorporating this subgroup into the statistical analysis could have provided additional insights, it was omitted to maintain the clarity of the results and minimise uncertainty.

INTRODUCTION

Human papillomavirus (HPV) is the most common sexually transmitted infection (STI) in the world for both genders. The risk of transmission is highest shortly after sexual debut, 75% of new infections occur in 15–24 years.[1] Even though most HPV infections are asymptomatic and resolve spontaneously within 2 years, the link between malignancies in men and women is well established. High-risk 'oncogenic' types, for example, HPV types 16 and 18, are the cause of the majority of cervical cancers, about 90% of anal cancers, 50% of penile caners,[2] 40% of vulvar and vaginal cancers, at least 12% of oropharyngeal cancers and 3% of oral cancers.[3] Infection with low-risk HPV types may cause anogenital warts of the anus, vulva, vagina and penis, which in addition

to impairment of health are psychosocially stressful and reduce quality of sexual life.[4] Infected men and women do not only increase their own health risks but also those of their partners.

Vaccines against HPV have been available since 2006 and recommended by the WHO since 2009.[5] They have been progressively introduced in many national immunisation schedules and by 2008, all Swiss cantons had implemented HPV vaccination programmes targeting girls, aged 11–14 years, for basic vaccination and young women up to the age of 26 years for complementary vaccination. Costs of HPV vaccination were initially covered for girls aged 11–19 years; in 2011, this was extended to young women aged 20–26 years. Although men are equally carriers and vectors of HPV, it was not until 2015 that the same recommendation was issued for boys and young men.

The quadrivalent Gardasil has been used in Switzerland since 2008, and in 2016, the non-avalent vaccine, Gardasil 9, was introduced to the Swiss market. Based on the Intercontinental Medical Statistics data of Monitoring and Administration Tool June 2017, at the time of our study, the quadrivalent vaccine led the HPV vaccine market, with almost 95% of HPV vaccinations employing this vaccine.[6] The Swiss HPV vaccination programme follows a two-dose regimen for girls and boys aged 11–14 years and a three-dose regimen for persons aged 15–26 years.

In Switzerland, the vaccination of persons under the age of 14 requires parental consent. Although the law does not prohibit 14–18 years from deciding whether or not to receive vaccination, healthcare practitioners and schools do not carry out vaccination without consulting parents. HPV vaccination is mainly promoted by school-based vaccination programmes, with measures ranging from distributing educational material and informing parents about the availability of vaccination to delivering school-based vaccination. It is also endorsed by family doctors, gynaecologists and paediatricians, but geographical disparities exist among the 26 cantons. Sufficient vaccination coverage is estimated to be at least 70%.[7] Previous studies revealed large geographical disparities between and within countries,[8] with most countries being far below the intended coverage rate. The first results indicate that vaccination rates in the male population are substantially lower than in women and revealed lower support for HPV vaccination among young men.[9] A recently published study investigating vaccine uptake among 415 Swiss male and 259 female youths aged 15–26 years reported a coverage of 58% among female participants and 15% among male participants.[10] Knowledge is still very limited when it comes to identification of reasons for non-vaccination among youths. To date, most studies investigating HPV vaccination attitudes have focused on women resulting in a lack of insight into male perspectives.[10] Especially knowledge on uptake and attitudes towards catch-up vaccination in young men is poor since the recommendation for them to be vaccinated was released almost a decade later. Previous comparisons of vaccine hesitancy between female and male participants were mainly performed in high-income countries, frequently among collectives of university students but data from representative samples of the population are lacking.[11]

To approach the coverage rate needed for adequate protection, it is mandatory to better understand how different vaccination programmes and strategies to provide information affect the possibility of vaccination in different background situations. Information about gender-related differences leading to discrepancies in HPV vaccine hesitancy and uptake is insufficient but might be a substantial contribution to develop strategies of improving vaccination coverage. Besides the later recommendation for the male population to receive HPV vaccination, it is very likely that various other factors contribute to the low vaccination rates among this population. Especially male vaccination uptake needs to be further analysed to reach optimal coverage with a special focus on the catch-up vaccination up to the age of 26 years since a high percentage of the male young ad had no possibility to receive the vaccination before being sexually active.

Therefore, this study aimed to (1) investigate the prevalence of HPV vaccination, (2) evaluate key factors influencing HPV vaccination uptake and (3) identify reasons for non-vaccination in a representative sample of male and female cisgender young adults (YAs) in Switzerland. The main purpose of this investigation was to reveal gender-related differences affecting HPV vaccination status and to understand the uptake of catch-up vaccination, especially in the male population, to inform strategies for increased vaccine uptake.

METHODS

Study design

Data were drawn from the Swiss national survey on youth sexual behaviours, a cross-sectional study conducted in 2017 among a representative sample of YAs (mean age 26.3 years) living in Switzerland; that is, 6 years after the HPV vaccine was recommended and fully covered for women up to the age of 26, and 2 years after the same recommendation and coverage was valid for young men. The initial sample representative for gender; language: French, Italian or German; canton of residence in the 24–28-year-old population was provided by the Swiss Federal Office of Statistics. Study participants were invited with a postal information letter together with a unique login code to participate in an online self-administrated questionnaire. The electronic version of the questionnaire allowed to capture how much time the respondents spent on answering the questionnaire and whether they completed it continuously or provided their answers in several sessions with pauses in between. For each section of the questionnaire, a differentiated analysis of the number of questions answered was conducted. While possible answers were preselected for some questions,

other questions allowed free-text answers which were analysed in a second step where requested. Only respondents who had answered at least 80% of the relevant questions were considered in our present analysis. The questionnaire used internationally validated previously used questionnaires wherever possible so that we refrained from further tests to reevaluate reliability and validity. Informed consent was given by all participants by answering the first question of the survey The questionnaire was available in German, French and Italian. The survey collected sociodemographic, sexual health and behaviour data using a life history calendar (LHC) approach. The LHC is a highly structured, still very flexible approach to data collection that facilitates recall of past events by using the individual's own past experiences as cues for remembering.[12] These cues provide context for retrieval of autobiographical memory and increment the precision of reports.[12 13] The final sample included 7142 participants (response rate 15.1%). The design of the present study was based on a previous survey conducted in 1996[14]; please see Leeners *et al*[15] for further details. The manuscript was drafted following Strengthening the Reporting of Observational Studies in Epidemiology criteria.[16]

Inclusion and exclusion criteria

For the present evaluation, YAs without gender dysphoria who described themselves as heterosexually oriented were evaluated. Out of a total of 7142 participants, 2155 female and 996 male participants remained for statistical evaluation after excluding homosexual/bisexual study participants, those with gender dysphoria, or those without knowledge of their vaccination status. We chose to exclude individuals with sexual orientations other than heterosexual and those with gender dysphoria from our analysis, as we also examined sexual risk behaviours in detail. It has been frequently proven that homosexual and transgender individuals exhibit different sexual behaviours and associated risks. To avoid skewing the correlations between HPV vaccination and sexual behaviour, we decided to exclude this group from the analysis.[17]

For sexual orientation, we used a multidimensional approach.[18] Three measures were used and combined: sexual orientation identity, attraction and sex of sexual partner(s). Sexual orientation identity was measured through the question 'How would you describe yourself?' with four answers: 'heterosexual', 'gay/lesbian', 'bisexual', 'I do not know/I am not sure'. Participants answering anything else than heterosexual were classified as non-heterosexual and were excluded from the analysis. Attraction was assessed with the question 'What best describes how you feel?' with answers ranging from 'I am only attracted to people of the opposite sex' to 'I am only attracted to people of the same sex as me'.

Dependent variables

We asked the study participants to report their HPV vaccination status by asking the questions 'Are you vaccinated against HPV?' (yes/no/I don't know) and 'At which age did you receive the first vaccination dose?' Information about the number of vaccinations received in total, needed to assess whether or not the participants were fully vaccinated, was not provided. Further, the motivations behind the decision to receive HPV vaccination were not investigated. Unvaccinated participants were asked to report their reason for non-vaccination using preselected answers and additionally. To better understand the attitudes towards vaccination, the participants who did not want to get vaccinated were asked to explain their decision by choosing preselected answers. For both questions, the option of adding free-text answers was given.

We selected the independent variables based on factors we deemed clinically relevant, as well as those identified as potentially significant in previous research. Independent variables: Sociodemographic and personal characteristics included age, gender, place of birth, parents' place of birth, place of residence (urban, rural), linguistic region of Switzerland and attained education level. Family socioeconomic status (SES) was measured with the question '*Compared to other families in Switzerland, your family financial situation when you were 15 was…*' and we dichotomised the seven possible answers into below average, average or better.

As gynaecologists should be a constant source of information by systemically increasing their patients' awareness about the benefits of HPV vaccination, we asked the female participants whether they had a gynaecological visit before and, if yes, how old they were at their first gynaecological visit. Looking for a possible impact of reduced mental health on making decisions concerning one's own health, we assessed mental health (depression and anxiety) using the mental health inventory-5 with five items referring to the last 4 weeks.[19] We used a cut-off of ≤52 to differentiate between reduced and normal mental health.[19]

Sexual health was represented by the number of lifetime sex partners, the age at first sexual intercourse and diagnosis of STIs. Study participants estimated themselves, what they considered as a long-term relationship. Frequently or sometimes having sex after consummation of drugs or alcohol, with someone met online, without contraception as well as having >10 lifetime sex partners were classified as sexual risk behaviour.

We assessed the reasons for hesitancy towards HPV vaccination and future vaccination to gain insights. For reporting reasons for non-vaccination, the participants were provided with preselected single choice and were given the opportunity to provide free-text responses.

Statistics

Encrypted data were entered into an access database specifically developed for the study. We performed bivariate analysis to compare the characteristics of vaccinated vs non-vaccinated male and female participants. χ^2 test was used to assess differences in categorical variables and t-test was applied to compare means. A p<0.05 was considered

statistically significant. For all variables being significant on bivariate level, we analysed separately the differences between the female and male population. Subsequently, we performed a multinomial logistic regression analysis including all significant variables at the bivariate level (p<0.05) using the 'HPV-vaccinated' group as the reference category. Results are presented as adjusted p values and OR. All analyses were done using the R-Software, V.4.1.2 and performed separately by gender.

Patient and public involvement

The study's design did not involve patients or the general public. However, all participating patients were informed of the research objectives and their informed consent was obtained. The survey was completed by participants voluntarily and no input from patients was sought in interpreting or writing up the results. The results of the research will not be disseminated to the patients.

RESULTS

Out of a total of 7142 participants, 2155 female and 996 male participants were included in our statistical analysis. Altogether, 20.6% of female and 50.2% of male YAs did not know about their vaccination status. We found significantly higher HPV vaccination rates in female than in male participants (1110 (40.9%) vs 158 (7.8%), p<0.001). First, we will present the results of the bivariate analysis, followed by those of the multinomial regression analysis.

Bivariate analysis

At bivariate level being Swiss-born was not associated with vaccination status, but origin of parents significantly correlated with vaccination status among female YAs (table 1). One or both parents being Swiss-born was significantly more frequently reported by non-vaccinated female participants. The largest proportion of our study population resided in the German-speaking regions of Switzerland (table 1). When examining vaccination rates in relation to the linguistic regions, we observed that female YAs from the French-speaking part of Switzerland reported the highest vaccination rate, while the vaccination coverage for male YAs was highest in the German-speaking regions (table 2). No significant difference in vaccination uptake was noted between urban and rural areas for both genders. Female YAs who perceived their family SES as above average were more likely to report HPV vaccination, but educational levels did not show any association with vaccination status. In male YAs, origin of parents and family SES did not differ, but educational level was slightly higher in non-vaccinated YAs.

Table 3 summarises mental health and behavioural factors potentially associated with vaccination status. Mental health scores were significantly lower in non-vaccinated female YAs, while among male YAs, no significant correlation was found. For female YAs, having decided for at least one gynaecological visit and younger age when presenting for this visit were associated with being vaccinated. Sexual risk behaviour as represented by sex after the consumption of drugs/alcohol, with someone met online and without contraception, was not associated with vaccination status in female YAs. Also, age at the first partnership or the number of lifetime sexual partners did not show any correlation with vaccination status. Contrastingly, male YAs in the vaccination group had a lower age at their first stable relationship and presented different forms of risky sexual behaviour more frequently. They reported significantly higher numbers of lifetime sex partners, for example, nearly 30% of vaccinated male YAs had more than 10 lifetime sex partners compared with nearly 20% in non-vaccinated male YAs. Furthermore, they had more often sex with someone met on the internet or without contraception. In both genders, age at first sexual intercourse and sexually transmitted disease (STD) history was not associated with vaccination.

Comparison of factors associated with HPV vaccination among female and male YAs

In bivariate analysis, the factors associated with HPV vaccination status varied significantly between genders. For the female population, having both parents of Swiss origin, a higher SES and living in a German-speaking region of Switzerland were associated with a higher likelihood of HPV vaccination. In contrast, for the male population, parental origin and SES did not correlate with vaccine uptake. Instead, male participants residing in French-speaking cantons were more likely to have a positive vaccination status. A higher educational level was associated with non-vaccination among males but showed no significant correlation in females. Although the distribution of parental origin and linguistic region was similar across the study population, SES was slightly higher and educational levels were somewhat lower among males (see p values marked with **). In the female population, a higher mental health score was significantly associated with an increased likelihood of HPV vaccination, while no such correlation was observed in males. Among males, a younger age at first partnership, a greater number of sexual partners and engagement in risky sexual behaviours were associated with higher HPV vaccine uptake. However, for females, sexual behaviour did not differ based on vaccination status. Overall, mental health status was lower among female participants, who also reported a younger age at first partnership and a higher incidence of risky sexual behaviours, such as having sex without contraception or with a partner met online. The total number of lifetime sexual partners was slightly higher among male participants in the study.

Multivariate regression analysis

Female YAs

After performing multivariate regression analysis, female participants with both parents being

Table 1 Sociodemographic characteristics in relation to vaccination status and gender (Zurich, Switzerland, 2024)

	Female YAs			Male YAs			Male vs female YAs
	Vaccinated n=1110	Not vaccinated n=1045	P value	Vaccinated n=158	Not vaccinated n=838	P value	P value*
Age (mean±SD in years)	26.26±1.7	26.35±1.9	0.013	26.44±2.1	26.38±2.0	0.43	
Swiss-born (yes, %)	87.03%	89.57%	0.067	89.24%	88.66%	0.83	
Mother born in CH (yes, %)	71.53	79.7	**<0.001**	76.58	75.54	0.777	0.415*
Father born in CH (yes, %)	72.61	79.81	**<0.001**	78.6	74.2	0.192	0.808*
Parents born in CH (%)			**<0.001**			0.447	0.750*
Both parents Swiss-born	63.69	72.61		70.89	68.50		
One parent Swiss-born	16.77	13.59		14.56	14.44		
Both parents non Swiss-born	19.55	13.78		14.56	17.06		
Linguistic region (%)			**<0.001**			**<0.001**	0.324*
German	65.14	77.80		82.91	73.96		
French	30.72	18.37		13.29	23.87		
Italian	4.14	3.83		3.80	2.15		
Residence area (%)			0.166			0.142	
Urban†	43.15	46.12		51.27	44.87		
Rural‡	56.85	53.88		48.73	55.13		
Perception of family socioeconomic status at age of 15 (%)			**<0.001**			0.433	**<0.001***
>Mean	23.06	15.12		23.32	25.66		
Mean	61.89	66.22		58.23	60.02		
<Mean	13.96	17.32		13.29	13.48		
I do not know	1.08	1.34		3.16	0.84		
Highest education level (%)			0.231			**0.044**	**<0.001***
Mandatory school	0.99	0.48		1.27	1.43		
Apprenticeship	15.95	17.0.3		31.01	22.19		
Vocational diploma	6.58	9.28		7.59	10.02		
Intermediate school certificate	4.44	3.16		5.70	2.86		
High school diploma	5.95	6.89		7.59	7.99		
University	62.61	59.81		43.67	52.27		
Others	3.51	3.35		3.16	3.22		

Significant p values are marked in bold, p values are presented as adjusted p values. For all variables being significant on bivariate level we analysed the difference of its presence in the female and male population.
Data are presented as n (%) or mean (±SD) using $\chi 2$ and independent t-tests. The bold values indicate statistical significance.
*P values for this analysis.
†Urban: city, suburb of a city (more than 10 000 inhabitants).
‡Rural: mountains, countryside, village (less than 10 000 inhabitants).
CH, Switzerland; YAs, young adults.

Swiss-born were less likely to be vaccinated against HPV (OR 0.55, p<0.001) (Table 4A/B). An SES below average at the age of 15 years strongly correlated with a negative vaccination status, while female participants reporting average SES were more likely to be vaccinated (OR 1.31, p=0.045) and those who answered an SES above average had the highest probability of being vaccinated (OR 1.97, p<0.001). Those being in the vaccinated group were more likely to be from a French-speaking canton of the country (OR 2.13, p<0.001) compared with those being from the German or Italian parts of Switzerland. A younger age at the first gynaecological visit was a statistically significant factor associated with a higher likelihood of being vaccinated against HPV (OR 0.85, p=0.006). Risky sexual behaviour showed no significant association with vaccination among the female population of our studies in the multivariate regression model.

Table 2 Vaccination status of female and male young adults based on the linguistic region of residence in Switzerland (Zurich, Switzerland, 2024)

Linguistic region (%)				
Female				**P value**
	Female German n=2051	Female French N=569	Female Italian n=98	**<0.001**
Yes	723 (35.25%)	341 (59.93%)	46 (46.94%)	
No	813 (39.64%)	192 (33.74%)	40 (40.82%)	
I don't know	515 (25.11%)	36 (6.33%)	12 (12.24%)	
Male				
	Male German n=1571	Male French n=379	Male Italian n=66	**<0.001**
Yes	131 (8.34%)	21 (5.54%)	6 (9.09%)	
No	620 (39.47%)	200 (52.77%)	18 (27.27%)	
I don't know	813 (51.75%)	156 (41.16%)	42 (63.64%)	

Significant p values are marked in bold, p values are presented as adjusted p values.

Male YAs

For male participants, sociodemographic factors were not significantly associated with vaccination uptake (table 4B). Instead, in contrast to the female population, risky sexual behaviour, such as a younger age at first steady relationship, was more likely to occur in the HPV-vaccinated group (OR 0.84, p=0.05). Those who reported a higher number of lifetime sex partners and who frequently had sex with a person from the internet were more likely to be vaccinated (OR 1.23, p=0.005; OR 1.78, p=0.031).

Reasons for refraining from vaccination

For female YAs 'did not want to be vaccinated' and for male YAs 'did not know about the vaccination' were the most frequent given reasons for not being vaccinated. 'Not being in the suggested age group' and 'family/friends being against vaccination' were more likely to have substantial influence on the decision not to be vaccinated for female compared with male YAs (table 5).

Among reasons against future vaccination, 'being generally against vaccination' was named by approximately one-third of the female YAs compared with two-thirds in the male group indicating more frequent vaccine hesitancy in male YAs. 'Fear of side effects' and the fact that 'HPV vaccination does not protect against all subtypes' were further factors negatively influencing attitudes towards future vaccination in both genders, especially in the female group.

DISCUSSION

This study analysed data from a large sample of YAs in a national survey of the Swiss population. Our findings indicate that attitudes towards HPV vaccination among YAs are shaped by a complex interplay of factors that vary by gender. The primary goal was to examine HPV vaccine uptake and attitudes after its inclusion in the Swiss vaccination plan for both genders, with a focus on the catch-up vaccination rates, especially among males, due to their later inclusion in national immunisation programmes.

With 40.84% of female and 7.84% of male YAs being vaccinated against HPV, vaccine coverage in our study was slightly lower than in another recently published Swiss study on 415 male and 259 female participants aged 15–26 years (average 19.1 years) who found 53% of the female and 15% of the male population to be vaccinated.[10 20] This discrepancy in vaccination uptake is likely due to the higher average age of our study population, which consisted of YAs who were older than 11–14 years when HPV vaccination was first recommended. Additionally, study populations differed, as our participants were provided by the Swiss Federal Office of Statistics, whereas other studies recruited patients from private offices and during military enlistment in the Swiss Army. Anyway, vaccination rates in Switzerland are still far lower than the intended coverage rate, as well as are vaccination rates in France (45.8% for girls and 6% for boys in 2021)[21] and in Germany (47.2% for girls and 5% for boys aged 15 years in 2019).[22] A study published in the USA in 2021 systematically analysed HPV vaccination status among a representative sample of 6606 female and 6038 male YAs, revealing higher vaccination rates among females (46%) compared with males (29%). However, this study included participants aged 18–21 years, and the recommendation for HPV vaccination in males was not released until 2009. The inclusion of a younger age group and differences in vaccination policies make direct comparisons with our results challenging.[23] In contrast, Australia's school-based HPV vaccination programmes have been more successful, achieving 80.5% coverage for boys and 77.6% for girls by age 15 in 2020. Australia's programme launched for girls in 2007 and expanded to boys in 2013, effectively improved parental consent processes using culturally sensitive and accessible information.[24 25] In Switzerland, cantonal programmes vary widely in their approach to school-based vaccination activities and in the resources

Table 3 Health and behavioural factors potentially associated with vaccination status (Zurich, Switzerland, 2024)

	Female YAs N=2718			Male YAs N=2016			Male vs female YAs
	Vaccinated n=1110	Not vaccinated n=1045	P value**	Vaccinated n=158	Not vaccinated n=838	P value	P value*
General health							
Mental health sum score (mean±SD)	68.5±14.3	67.46±14.7	**0.026**	72.18±13.9	72.01±14.6	0.888	**<0.001***
Realisation of at least one gynaecological visit (yes, %)	97.30	93.68	**<0.001**	–	–	–	
Age at first gynaecological visit (mean±SD)	16.70±2.85	17.04±3.35	**0.013**	–	–	–	
Partnership experiences							
Age at first steady partnership (mean±SD)	17.50±2.80	17.39±2.96	0.387	17.39±3.21	18.05±3.31	**<0.005**	**<0.001***
Nb lifetime sex partners (%)			0.547			**<0.001**	0.139*
0	3.33	5.65		4.43	6.21		
1	17.21	17.70		7.59	15.39		
2–3	23.60	20.38		17.72	20.05		
4–7	25.22	24.11		26.58	27.08		
8–10	10.27	12.34		12.66	9.90		
>10	19.64	19.23		28.48	19.81		
Sexuality/sexual risk behaviour							
Age first sexual intercourse (mean±SD)	17.54±2.66	17.46±2.74	0.526	17.40±2.87	17.90±2.91	0.084	
Sex after consummation of drugs/ alcohol (≥sometimes %)	15.87	19.28	0.171	23.81	23.81	0.592	
Sex with someone met online (≥sometimes %)	8.44	7.55	0.389	19.72	15.44	**0.034**	**<0.001***
Sex without contraception (≥sometimes %)	21.04	23.36	0.329	37.42	26.77	**0.003**	**<0.001***
STDs ever diagnosed (%)			0.170			0.477	
No	65.86	69.19		91.77	92.60		
Yes	31.89	28.61		6.96	6.92		
Do not know/no answer	2.25	2.20		1.26	0.48		

Significant p values are marked in bold, p values are presented as adjusted p values. For all variables being significant on bivariate level, we analysed the difference of its presence in the female and male population. Data are presented as n (%) or mean (±SD) using $\chi 2$ and independent t-tests. The bold values indicate statistical significance.
*P values for this analysis.

used to disseminate information, such as educational materials and available personnel.[26] Improving vaccination rates likely requires more direct engagement with parents, better follow-up strategies and clearer educational efforts. Low vaccination rates may also stem from a primary focus on vaccinating before sexual activity, with less emphasis on educating about the benefits of later vaccination. As a result, many YAs, particularly males, remain unvaccinated due to a lack of awareness or insufficient outreach. Additionally, HPV vaccine uptake among males is particularly low and difficult to interpret, partly because recommendations to vaccinate boys were issued later than those for girls. Overall, vaccination rates and attitudes among males are not well documented or understood. Despite being eligible for catch-up vaccination, our male participants did not take advantage of it. School-based HPV education in Switzerland is established, but catch-up vaccination occurs mainly in primary care settings. Despite an 80% lifetime HPV risk for sexually active individuals, vaccination support among parents and healthcare providers has been shown to be stronger for girls.[27] Male YAs often receive less counselling and are less aware of vaccination benefits. Although the 2015 HPV vaccine recommendation for boys increased uptake

Table 4 (A) Multinomial regression analysis for female young adults with the 'HPV-vaccinated' group as the reference category (Zurich, Switzerland, 2024); (B) Multinomial regression analysis for male young adults with the 'HPV-vaccinated' group as the reference category (Zurich, Switzerland, 2024)

	Estimate	P value	OR
A			
Parents born in CH (%)			
Both parents Non-Swiss-born	Reference category		
One parent Swiss-born	−0.24929936	0.157	0.77934663
Both parents Swiss-born	−0.59154948	<0.001	0.55346903
Educational level			
Education high	Reference category		
Education low	−0.06951904	0.531	0.93284237
Socioeconomic status			
Family socioeconomic status<mean	Reference category		
Family socioeconomic status=mean	0.26959086	0.045	1.30942861
Family socioeconomic status>mean	0.68051124	<0.001	1.97488712
Linguistic region			
German	Reference category		
French	0.72551131	<0.001	2.13452167
Italian	0.00534521	0.076	1.01577618
Health status			
Mental health score (MHS)	0.00575956	0.088	1.00577618
Age at first gynaecological visit	−0.04848103	0.006	0.85267541
Age at first steady partnership	0.03042511	0.111	1.03089268
Sexual behaviour			
Number of lifetime sex partners	−0.06295419	0.26	0.93898648
STDs diagnosed ever			
No	Reference category		
Yes	0.06273372	0.504	1.06474329
Sex without contraception			
Never	Reference category		
Rarely	−0.03563246	0.791	0.9649949
Sometimes	−0.20286837	0.281	0.81638569
Often	−0.01101245	0.968	0.98904796
Sex with a person from the internet			
Never	Reference category		
Rarely	0.10833413	0.484	1.11442005
Sometimes	0.33037521	0.134	1.39149013
Often	0.3299555	0.341	1.39090623
B			
Parents born in CH (%)			
Both parents Non-Swiss-born	Reference category		
One parent Swiss-born	0.1793543	0.63	1.196444574
Both parents Swiss-born	0.40021762	0.168	1.492149382
Educational level			
Education high	Reference category		
Education low	0.07648343	0.712	1.079484302

Continued

Table 4 Continued

	Estimate	P value	OR
Socioeconomic status			
Family socioeconomic status<mean	Reference category		
Family socioeconomic status=mean	−0.16149366	0.576	0.85087193
Family socioeconomic status>mean	−0.16446531	0.61	0.84834719
Linguistic region			
German	Reference category		
French	−0.456321	0.062	0.87654351
Italian	0.00672391	0.076	1.14567618
Health status			
MHS	6.76E-05	0.992	1.000067554
Age at first steady partnership	−0.05427716	0.05	0.847169552
Sexual behaviour			
Number of lifetime sex partners	0.03381315	0.005	1.234391313
STDs diagnosed ever			
No	Reference category		
Yes	−0.05145032	0.872	0.949850834
Sex without contraception			
Never	Reference category		
Rarely	0.31720525	0.268	1.373284416
Sometimes	0.43687909	0.249	1.547868918
Often	0.61502341	0.187	1.8496999
Sex with a person from the internet			
Never	Reference category		
Rarely	0.57480203	0.471	1.374844184
Sometimes	−0.02755492	0.935	0.972821251
Often	0.3183404	0.031	1.776778752

CH, Switzerland ; HPV, human papillomavirus; STD, Sexually transmitted disease .

among younger males, about 50% of male YAs remain unaware of their vaccination status. Since the consequences of HPV infection, particularly cervical cancer, are more familiar and routinely monitored in women, male YAs likely receive less HPV vaccination counselling. They visit health professionals less frequently, and paediatricians and family doctors may not emphasise HPV vaccination as much for males as they do for females.[28] The significant gender disparity in vaccination rates is highlighted by the fact that 50.15% of male YAs were unaware of their vaccination status, despite official recommendations since 2015. Higher educational levels correlated with better awareness, suggesting that well-educated males may still avoid vaccination due to insufficient knowledge about its benefits. This indicates a need for improved educational efforts targeting HPV vaccine benefits for older and sexually active males. Current public health campaigns often overlook the importance of catch-up vaccinations. Most studies focus on the benefits of receiving HPV vaccination before the initiation of sexuality, and the importance of catch-up vaccination is rarely emphasised. Future research should investigate whether targeted health campaigns can enhance catch-up vaccination rates, ideally within a longitudinal study design.

We found no correlation between being Swiss-born and vaccination status, unlike other studies which reported higher vaccination rates among non-Swiss-born YAs.[4] In previous studies, ethnicity, for example being Hispanic in the USA[26] or being Chinese[9] has been found to be associated with limited knowledge of HPV vaccination. While our study did not collect data on ethnicity, we observed that female YAs with both parents being Swiss-born were more likely to have a negative vaccination status, whereas male YAs showed a trend in the opposite direction, though not statistically significant. This suggests that parents being non-Swiss-born, who are more likely to have grown up in other countries and cultures, may be more receptive to vaccinating their daughters but less aware of recommendations for their sons. Additionally,

Table 5 Reasons for not being vaccinated and against future vaccination among female and male YAs Health and behavioural factors potentially associated with vaccination status (Zurich, Switzerland, 2024)

	Female YAs n=1045	Male YAs n=838	P value
Reason for not being vaccinated (%)			**<0.001**
Did not know about vaccination	26.41	66.11	
Did not want to be vaccinated	40.67	12.77	
Was not in the suggested age group	9.86	5.02	
Was already infected	2.10	0.60	
Family/friends were against it	10.33	1.31	
Other (free text answers)*	10.62	14.20	
Reasons against future vaccination (%)			0.372
Fear of side effects	15.29	7.48	
Being generally against vaccination	35.53	58.88	
Vaccination protects only against some HPV subtypes	35.76	20.56	
Other (free text answers)†	13.41	13.08	

Significant p values are marked in bold, p values are presented as adjusted p values. For all variables being significant on bivariate level, we analysed the difference of its presence in the female and male population. Data are presented as n (%) using $\chi 2$ test. The bold values indicate statistical significance.
*Female YAs: Had already had the first sexual intercourse, missing long-term studies, presenting for annual PAP smears, feeling pushed by the doctor, doctor told me it was not necessary; male YAs: Learnt too late about the vaccination, had already had the first sexual intercourse, missing long-term studies.
†Female and male YAs: Doubts on the benefit of the vaccination, living in a monogamous partnership, vaccination does not cover all subtypes, not being in the risk group.
HPV, human papillomavirus; PAP smere, Papanicolaou test; Routinely collecting cells from the cervix for testing; YAs, young adults.

general vaccine hesitancy could affect Swiss-born parents' attitudes towards HPV vaccination. A recent Swiss study found that 36% of parents were vaccine-hesitant and preferred complementary medicine providers over biomedical ones.[29] This trend is consistent with increasing vaccine hesitancy observed in other European countries like France, Germany and Austria.[30]

According to our findings, residential areas did not correlate with vaccination uptake, which contrasts with results from a Chinese study that reported low vaccination rates among women living in rural areas.[31] It is highly likely that in low-income and middle-income countries, vaccine uptake varies depending on the residential area, as economically disadvantaged individuals often reside in rural regions. Our data revealed geographical disparities in vaccination rates, as for male YAs living in German-speaking parts and for female YAs living in French-speaking parts vaccination uptake was higher than in those from other regions. Differences in female YAs may be explained by more extensive school-based vaccination programmes in all French-speaking regions being performed by professionals while in the German and French-speaking regions sex education is performed by the teachers. Furthermore, there is lower acceptance of vaccination laws in German-speaking regions.[4] Higher family SES was positively correlated with vaccination status in female participants, consistent with a Danish[32] and a French[21] study showing lower vaccination rates among lower-income groups. For males, regardless of SES, awareness and uptake of HPV vaccination were low, indicating that efforts to improve vaccination rates must address all SES levels. This might also indicate that the social background influences vaccination status stronger in the female compared with the male population. Higher education in male YAs was linked to lower vaccination rates, though it improved knowledge of vaccination status. However, higher education was found to result in better knowledge about the own vaccination status, but not in a higher probability to be vaccinated against HPV information. Unfortunately, we had no possibility to clarify whether the decision against HPV vaccine uptake resulted from a lack of knowledge about its benefits or from a higher degree of vaccine hesitancy in those male YAs. Unlike other studies, we found no correlation between education level and vaccination status in our female participants. A previous German study showed higher HPV vaccination rates among girls with over 11 years of education,[33] while an Italian study found higher rates among those with at least a high school diploma.[34] These differences likely stem from varying study populations: the German study focused on vocational school students, while the Italian study included participants from local health units. To improve vaccination rates, strategies should be multifaceted and target all educational levels through schools, universities, healthcare providers and global health campaigns. Our results showed significantly lower mental health scores in non-vaccinated female YAs, but no such correlation was found in male YAs. This suggests that poor mental health, often linked to anxiety, might contribute to avoiding vaccination. Additional

support might be necessary for YAs with poor mental health to help them make informed vaccination choices. Enhancing positive psychological resources could be particularly effective at reducing stress and fear of side effects linked to the vaccine among patients and has been previously found to be especially applicable to depressed patients.[35] In female YAs, having had at least one gynaecological visit and a younger age at the first visit were positively associated with HPV vaccine uptake, supporting the previously highlighted importance of healthcare recommendations in improving vaccination rates.[36] In contrast, healthy boys visit medical providers less frequently and often miss information on HPV vaccines.[37–40] Further research needs to determine if parental involvement in early vaccination counselling could enhance awareness of HPV vaccination before the sons' first sexual experience. Our findings show that HPV vaccination initiation in female YAs is not linked to sexual risk behaviour, consistent with existing literature.[36 41] Previous studies repeatedly found that HPV vaccination does not alter sexual behaviour in girls, a known concern in discussion on the promotion of HPV vaccination.[37] Conversely, vaccinated male YAs reported more risky sexual behaviours, such as unprotected sex, meeting partners online, more lifetime partners and younger age at first steady partnership. Our data do not determine whether the higher vaccination rate is a cause or consequence of riskier behaviour. It is possible that males engaging in risky behaviours are more inclined to get vaccinated for protection.

Over 20% of female and more than 60% of male YAs were unaware of HPV vaccination, revealing inadequate information even among female participants despite regular gynaecological check-ups. Many females cited a lack of necessity due to incomplete protection as the main reason for not vaccinating. For female YAs 'did not want to be vaccinated' was the main reason for non-vaccination and they largely doubted the necessity of HPV vaccination because it does not protect against all subtypes. Approximately 60% of males exhibited a general negative attitude towards vaccination, contrasting a Swiss study that found higher vaccine hesitancy among female YAs,[10] but the latter's study population was significantly younger with an average age of 19 years. Since most Swiss studies investigate vaccine hesitancy in younger age groups, mainly adolescents,[38] a proper comparison cannot be made with the existing literature as attitudes most likely change with increasing age. Furthermore, future research should include the assessment of the 'Psychological Maturity Scale' to determine whether psychological maturity correlates with vaccine hesitancy since it seems to be a phenomenon shaped by a complex interplay of internal and external factors. This concept is integral to studying human development and includes an individual's commitment to their own values and inclinations.[42] Although 35.53% of women were generally opposed to vaccination, fear of side effects was a minor factor (15.29%), contrasting other studies.[39] Future efforts should address both awareness and understanding of HPV vaccination benefits, even after initiation of sexuality. Such approach is confirmed by the free-text answers given by male and female participants (table 3) reporting to be against future vaccination because they are living in a monogamous relationship, are not in the risk group or are not protected against all subtypes of HPV.

Strengths and limitations of this study

Our findings may have limited generalisability as they focus on a specific age group shortly after the HPV vaccination recommendation for males. This group is likely better informed now due to school-based vaccination programmes and increased awareness. Additionally, since the study was conducted in Switzerland, its relevance may be limited to countries with similar vaccination policies. Variations in vaccination policies across countries and within the EU mean that caution is needed when applying these results to other regions. Many studies on HPV vaccine uptake and attitudes have been conducted in low-income or middle-income countries, limiting their applicability to high-income countries. Although more recent research has focused on high-income countries, these studies frequently involve biased populations, such as university students or specific age groups, which do not provide comprehensive insights into catch-up vaccination uptake.[43]

A key strength of this study is its use of data from a nationwide representative sample of both female and male YAs, focusing particularly on the often-overlooked male demographic. Despite a modest response rate of 15.1%, the study analysed a substantial sample and explored various sociodemographic and behavioural factors related to vaccination uptake. Including male YAs, who may have missed the initial vaccination period, provided valuable insights into catch-up vaccination rates.

Several limitations warrant consideration. The cross-sectional design prevents causation inference. The lower-than-expected response rate may be attributed to the detailed nature of questions regarding sexual behaviour, a topic often regarded as sensitive. Additionally, factors such as the timing of the survey coinciding with the summer holidays in Switzerland and the use of postal mail for participant recruitment may have influenced the response rate. To mitigate those weaknesses in the study structure, efforts were made to initiate the study with a large initial sample size, ensuring adequacy for statistical analysis. Still, the limited response rate does not allow full exclusion of overestimation or underestimation in explored correlations. Another major limitation is the lack of data on participants' counselling about HPV vaccination, which could affect their vaccination decisions. Additionally, relying on self-reported vaccination status and age at first dose introduces potential recall bias, as these data were not verified with records. The study also lacks information on the completeness of vaccination doses, limiting the accuracy of the vaccination status assessment.

Our findings do not allow any conclusions on non-heterosexual or non-cisgender people. To reach a more comprehensive conclusion about HPV vaccination status, attitudes and influencing factors, it is important to study YAs with diverse sexual orientations and gender identities. These factors can change during adolescence and young adulthood, and they may influence the results. Excluding an 'I don't know' category in vaccination status classification complicates data analysis, leaving the status of this subgroup unclear. While including this subgroup might have provided additional insights, it was omitted to maintain result clarity. The study also did not differentiate between autonomous vaccination decisions and those influenced by parents. Participants could only select one reason for non-vaccination or hesitancy, potentially oversimplifying complex motivations. Social desirability bias likely affected responses to sexual behaviour questions, leading to potential under-reporting or over-reporting. Several studies found that even with anonymous responses, there are significant correlations between a variety of self-reported sexual behaviours (eg, use of condoms, sexual fantasies, exposure to pornography and penis size) and social desirability.[40] Women often under-report the number of sexual partners, receptive anal intercourse or condom use,[40] while men may over-report sexual activity.[44] This potential bias may have influenced our results to a certain extent, thus our findings need to be interpreted with caution. Future research should include a measure of social desirability when asking highly sensitive questions.[44] However, using the LHC method could minimise this bias by facilitating more accurate and candid responses.[45]

CONCLUSIONS

Our results reveal that HPV vaccination coverage among males is very low, primarily due to insufficient information about the vaccine. This underscores the need for better counselling to support informed decision-making, especially for males. Parents have been shown to significantly impact vaccine uptake, as parental consent is required for adolescent vaccinations in many countries, including Switzerland.[46] Previous research found that parents' knowledge and attitudes about vaccines strongly influence their children's vaccination decisions.[47 48] Enhanced communication strategies to educate parents and promote vaccine decision-making could boost vaccination rates.

In Switzerland, HPV vaccination is mainly promoted through school-based vaccination programmes, which have previously been found to result in the highest vaccination rates.[4] In countries such as Sweden, which has achieved an almost satisfactory vaccination coverage rate, school nurses are responsible for all aspects of HPV vaccination. Still, there is a need for improved HPV education outside the school setting.[29] Assumptions that HPV vaccination is only for those not yet sexually active or not infected with HPV contribute to low uptake. Healthcare practitioners should be encouraged to inform individuals about vaccination benefits and improved coordination between school programmes and primary care could identify missed vaccinations.

Since school programmes may not reach all individuals, additional strategies are needed to promote catch-up vaccinations in universities, colleges and primary care settings. Educational efforts should emphasise the benefits of HPV vaccination for those who are already sexually active or infected with HPV.

Acknowledgements We thank all study participants for supporting our research.

Contributors JCSG, YB-D and BL contributed to the conceptualisation and the design of the study. SE-H and M-KS planned and performed the statistical analyses. SE-H and BL drafted a first version of the manuscript. All authors SE-H, M-KS, AN, YB-D, JCSG and BL critically revised drafts of the manuscript, and read and approved of the final version. SE-H is responsible for the overall content as guarantor.

Funding This research was supported by a grant from the Swiss National Science Foundation (Schweitzer Nationalfonds zur Förderung der Wissenschaftlichen Forschung, Grant Nb162538).

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. The study protocol was submitted to the Ethics Commission of the Canton of Vaud (CER-VD), which granted a waiver, as the study did not require evaluation under Swiss law. As a result, we are unable to provide an approval number. According to the Ethics Commission of the Canton of Vaud, no official approval was necessary because the data were sufficiently anonymised. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. The data that support the findings of this study are available from the corresponding author (SE-H) on reasonable request.

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