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Original Research Article

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

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Abbreviations

HPV	Human papilloma virus
YAs	Adolescents and young adults
SES	Socioeconomic status
STD	Sexually transmitted disease
HCP	Health Care Practitioner

Word count: 8008 words

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 behavior, we performed bivariate analysis and multivariate regression.

Participants: 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.

Outcomes: The primary outcome of this study was to investigate HPV vaccination rates among female and male young adults 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%) than in the male group (7.8%). Non-Swiss parentage, higher family socioeconomic status, and having had a gynecological visit at a young age correlated with HPV vaccination uptake for female YAs. A higher incidence of sexual risk behavior was observed in the male vaccination group. Knowledge about the benefits of catch-up vaccination was very limited between both genders.

Conclusion: Especially among the male population, there is a lack of knowledge that contributes to low vaccination rates, and this issue must be addressed.

Article Summary

- 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 behavior, a topic often regarded as sensitive. Although the results are based on a large representative sample, the limited response rate does not allow full exclusion of over- or under-estimation 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 over- or under-estimation 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 minimize uncertainty.

Key words

HPV vaccination, male vaccination, young adults, initiation of sexuality, gender-related differences

Introduction

Human papilloma virus (HPV) is the most common sexually transmitted disease (STD) in the world for both genders. The risk of transmission is highest shortly after sexual debut, 75% of new infections occur in 15-24-year-olds [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 World Health Organization (WHO) since 2009 [5]. They have been progressively introduced in many national immunization schedules and by 2008, all Swiss cantons had implemented HPV vaccination programs targeting 11-14-year-old girls 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 20–26-year-old young women. 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 nonavalent vaccine, Gardasil 9, was introduced to the Swiss market. Based on the Intercontinental Medical Statistics (IMS) data of Monitoring and Administration Tool (MAT) June 2017, at the time of our study, the quadrivalent vaccine led the HPV vaccines market, with almost 95% of HPV vaccinations employing this vaccine [6]. The Swiss HPV vaccination program 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-year-olds from deciding whether or not to receive vaccination, health care practitioners and schools do not carry out vaccination without consulting parents. HPV vaccination is mainly promoted by school-based vaccination programs, 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, gynecologists, and pediatricians, 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. First results indicate, that vaccination rates in the male population are substantially lower than in women, and revealed lower support of 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 are lacking [11].

To approach the coverage rate needed for adequate protection, it is mandatory to better understand how different vaccination programs 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 analyzed 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 (i) investigate the prevalence of HPV vaccination, (ii) evaluate key factors influencing HPV vaccination uptake, and (iii) identify reasons for non-vaccination in a representative sample of male and female YAs in Switzerland. The main purpose of this investigation was to reveal gender-related differences affecting the decision for or against HPV vaccination 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 behaviors, a cross-sectional study conducted in 2017 among a representative sample of YAs (mean age 26.3 years) living in Switzerland; i.e. 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 years 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. Written informed consent was given by all participants. The questionnaire was available in German, French and Italian. The survey collected sociodemographic, sexual health and behavior 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 [15] for further details. The manuscript was drafted following STROBE criteria [16].

In- and exclusion criteria: For the present evaluation, young adults 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.

For sexual orientation, we used a multidimensional approach [17]. 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”. 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 toward 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.

Independent variables: Sociodemographic and personal characteristics included age, gender, Swiss nationality, origin of parents, 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 dichotomized the 7 possible answers into below average, average, or better.

As gynecologists 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 gynecological visit before and, if yes, how old they were at their first gynecological 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 (MHI-5) with five items referring to the last four weeks [18]. We used a cut-off of ≤ 52 to differentiate between reduced and normal mental health [18].

Sexual health was represented by own age at first steady partnership, as well as the number of lifetime sex partners, the age at first sexual intercourse and diagnosis of sexually transmitted diseases (STDs). 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 behavior.

We assessed the reasons for hesitancy toward 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.

Ethics*:* The Ethics committee of the canton of Vaud approved the study and it was realized in accordance with the Declaration of Helsinki.

Statistics: Encrypted data were entered into an access database specifically developed for the study. We performed bivariate analysis to compare the characteristics of vaccinated versus non-vaccinated male and female participants. Chi-Square (X^2) test was used to assess differences in categorical variables and t-test was applied to compare means. A p-value of less than 0.05 was considered statistically significant. 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 Odds-ratios (OR). All analyses were done using the R-Software, Version 4.1.2 and performed separately by gender.

Results

Out of a total of 7142 questionnaires 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%) versus 158 (7.8%), $p < 0.001$). First, we will present results of the bivariate analysis, followed by those of the multinomial regression analysis.

Bivariate analysis

At bivariate level own Swiss nationality 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 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 summarizes mental health and behavioral 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 gynecological visit and younger age when presenting for this visit were associated with being vaccinated. Sexual risk behavior as represented by sex after the consumption of drugs/alcohol, with someone met online and without contraception were 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 behavior more frequently. They reported significantly higher

numbers of lifetime sex partners, e.g. nearly 30% of vaccinated male YAs had more than 10 lifetime sex partners compared to 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 STD history was not associated with vaccination.

Multivariate regression analysis

Female young adults

After performing multivariate regression analysis female participants with both parents being Swiss were less likely to be vaccinated against HPV (OR 0.55, p-value < 0.001) (Table 4). A SES below average at the age of 15 years strongly correlated with a negative vaccination status, while female participants reporting average social circumstances were more likely to be vaccinated (OR 1.31, p-value 0.045) and those who answered a SES above average had the highest probability of being vaccinated (OR 1.97, p-value < 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-value < 0.001) compared to those being from the German or Italian parts of Switzerland. A younger age at the first gynecological visit was a statistically significant factor associated with a higher likelihood of being vaccinated against HPV (OR 0.85, p-value 0.006). Risky sexual behavior showed no significant association with vaccination among the female population of our studies in the multivariate regression model.

Male young adults

For male participants sociodemographic factors were not significantly associated with vaccination uptake (Table 5). Instead, in contrast to the female population risky sexual behavior, such as a younger age at first steady relationship was more likely to occur in the HPV-vaccinated group (OR 0.84, p-value 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-value 0.005; OR 1.78, p-value 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 to male YAs (Table 5).

Among reasons against future vaccination, “being generally against vaccination” was named by approximately one third of the female YAs compared to 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 analyzed data from a substantial number of female and male YAs in a national survey of a representative sample of the Swiss population. Our analysis suggests that attitudes toward HPV vaccination among YAs are influenced by a multifaceted interplay of various factors, notably differing between genders. A primary objective of this research was to scrutinize HPV vaccine uptake and attitudes toward it, following the vaccine’s inclusion in the Swiss vaccination plan for both genders. We particularly aimed to determine the uptake of catch-up vaccination, especially among males, given their delayed inclusion in national immunization programs compared with their female counterparts.

Prevalence of vaccination

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 [10,19]. It is very likely that this discrepancy in vaccination uptake results from a higher average age in our study population consisting of YAs who were already considerably older than 11-14 years when HPV vaccination was officially recommended. Furthermore, study populations varied between studies as in our study the Swiss Federal Office of Statistics provided participants, while they recruited patients from private offices as well as 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)*[20], Germany (47,2% for girls and 5% for boys aged 15 years in 2019)[21] and the USA (*55.2% for girls and 34.1 % for boys in 2018)*[22].

Contrastingly, in Australia mainly school-based HPV vaccination programs have achieved meaningful outcomes, reaching 80.5% and 77.6% of all boys and girls aged 15 years in 2020 [23,24]. Australia rolled out a national HPV vaccination program in 2007 for girls and included boys in 2013 focusing on constantly improving the information flow to the children's parents by offering consent materials with culturally appropriate language and with consideration regarding the best means of providing information (e.g., online information on a tablet device versus written resources) [24]. In Switzerland, cantonal programs differ considerably with regard to the activities of school within the framework of school services. The methods and effort used to disseminate information (information materials used, personnel available) greatly vary between cantons and schools [25]. It is very likely that more intensive contact with parents, better organized follow-up strategies and clearer education are needed to achieve adequate vaccination rates. Other underlying factors why vaccination rates are rather limited in Switzerland is that HPV vaccination programs focus mainly on its realization before initiation of sexual activity, so that less effort may be invested into counselling of YAs beyond this target group and benefits of vaccination at later stages might be insufficiently known. This leads to the fact that YAs might stay unvaccinated if school-based vaccination programs fail to reach them. Especially male HPV vaccine uptake is frequently very limited and often hard to interpret since countries released recommendations to vaccinate boys against HPV later than for girls. Generally, reported vaccination rates for the male population are rather rare and knowledge about vaccination attitudes in this group is still very limited. Considering the average age of our male study participants at the time of the study, they perfectly qualified for uptake of catch-up vaccination but did not take it. School-based sexual education is already well established in Switzerland and efforts to promote basic-vaccination through school-based vaccination programs have been made, but catch-up vaccination rather takes place in primary health care settings. According to our results, HPV catch-up vaccination is severely underutilized, especially in the male population. Although the lifetime risk for acquiring an HPV infection is 80% for sexually active people from both genders, but parents and healthcare providers have been found to support HPV vaccination more in girls than in boys [26]. As consequences of HPV infection, especially cervical cancer are more well-known in women, and gynecological controls are routinely performed by most women, it is likely that male YAs receive less counselling on HPV vaccination as they do not only see health professionals more rarely but pediatricians and family doctors as the main health care providers in contact with male YAs do likely also not address

the topic of HPV vaccination with the same effort as in females [27]. The findings from other Swiss studies showing higher male vaccination rates in younger age groups [10] suggest that the Swiss HPV vaccine recommendation for boys in 2015 led to a higher HPV vaccine uptake among younger eligible men. The substantial gender-related disparity of vaccination rates is further supported by the fact that half of the male YAs (50.15%) did not know their vaccination status, i.e. despite the vaccine recommendations being official since 2015. Higher educational status correlated positively with existing knowledge of vaccination status among male participants, as among the non-vaccination group almost 60% of male YAs were highly educated (University or High school diploma). This finding implicates that those participants were aware that HPV vaccination existed but actively decided to not take it, most probably due to a lack of knowledge about its benefits. Obviously, knowledge on importance of vaccination and conditions supporting informed decision taking are still not very developed in male YAs, although they are well educated. It is highly possible, that this group of YAs considered vaccination as unnecessary since they were not part of the recommended age group anymore. Our findings clearly implicate that efforts to increase knowledge are currently insufficient and education about HPV needs to better inform about vaccine benefits for boys/men and for higher age groups that have already been sexually active. The lower HPV vaccine uptake among older male youths suggests a need for more public health campaigns designed to increase awareness of catch-up vaccinations for said demographic. Previous research has shown that various interventions improve HPV vaccination coverage, including narrative education, financial incentives plus reminders, and brief motivational behavioral interventions, but, usually, the importance of catch-up vaccination is not sufficiently underlined [28]. Most studies focus on the benefits of receiving HPV vaccination before the initiation of sexuality, and the importance of catch-up vaccination is rarely emphasized. Whether health campaigns that focus solely on the benefits of catch-up vaccination might improve its uptake needs further investigation, ideally within a longitudinal study design.

Factors influencing vaccination status

Ethnic background

We found no correlation between Swiss nationality and vaccination status, while other studies showed higher vaccination rates in non-Swiss YAs [4]. In women, ethnicity, for example being Hispanic in the US [26] or being Chinese [9] has been found to be associated with limited knowledge on HPV vaccination.

Our study provided no data on ethnicity of study participants but on origin of parents as female YAs with both parents being Swiss reported more frequently a negative vaccination status, while for male YAs we tendentially found the opposite but without statistical significance. This might implicate that families with origins outside Switzerland are more likely to accept vaccination for their daughters, while they seem not to be aware of vaccine recommendation for their sons. Furthermore, general vaccine hesitancy might contribute to negative attitudes of Swiss parents towards HPV vaccination. A recently published Swiss study analyzing vaccine hesitancy found 36% of parents in Switzerland being vaccine hesitant and more likely to consult with complementary and alternative medicine-oriented primary providers than with biomedical providers [27]. Vaccine hesitancy is an attractive field of research and data from other European countries support our findings, showing tendentially increasing vaccine hesitancy in for example France, Germany or Austria [29].

Regional differences

Furthermore, our data indicate geographic 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 programs in all French-speaking regions and lower acceptance of vaccination laws in German-speaking regions [4].

Family socioeconomic status

A family SES above the mean was positively correlated with vaccination status in female participants, which is in accordance with results from a large Danish study [30] showing lower vaccination rates in girls with mothers in lower income categories and also findings from a French study [20]. For the male population, irrespective of SES knowledge on the possibility of HPV vaccination and the total number of vaccinations was low, so that any measures addressing improvement of vaccination rates need to cover all levels of SES.

Education

Interestingly a higher education level was associated with reduced vaccination rates in male YAs. 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. In contrast to other results, in our female participants no correlation between educational level and vaccination status could be demonstrated. A previous German study targeting girls aged 18-25 years found a higher HPV-vaccine initiation in girls with more than 11 years of school education than in those with less education [31], while in an Italian study vaccination rates were higher among girls with at least a high school degree compared to lower education [32]. These discrepancies are likely resulting from differences in study populations since the German study examined girls from vocational school and the Italian study recruited participants from local health units. However, we suggest that strategies to improve vaccination rates should be multifaceted enough to reach young adults independent of their educational levels. To ensure that a substantial number of young adults learns about the importance of HPV vaccination schools, universities, health care practitioners and global health campaigns could be used to reach people independent from their educational background.

Mental health status

According to our results mental health scores were significantly lower in non-vaccinated female YAs, but this correlation was not found for the male population. Since poor mental health is frequently linked to anxiety, fear of possible side effects might cause avoidance of vaccination uptake. For male YAs, mental health scores did not correlate with vaccination status. These results might implicate that YAs with poor mental health need additional support to make informed choices.

Gynecological health

Having had at least one gynecological visit and a younger age at this first gynecological visit positively correlated with vaccine uptake in female YAs, which supports previous literature and emphasizes that recommendations of health care professionals represent a valuable resource to improve vaccination uptake [34]. Healthy boys see medical providers less often than girls and do therefore, often not receive any regular information on the benefits of HPV vaccines [35–38]. Further investigation is needed to examine whether parents taking their sons to a health care professional for vaccination counseling, ideally

before the sons have their first sexual intercourse experience, could contribute to increasing awareness of HPV vaccination.

Partnership experiences and Sexual risk behavior

Our findings indicate that HPV vaccination initiation is not associated with sexual risk behavior for female YAs, which is in line with existing literature [33,34]. Previous studies repeatedly found that being vaccinated against HPV does not make a change in sexual behavior among girls, a known concern in discussion on the promotion of HPV vaccination [35]. In contrast, male YAs with a positive vaccination status reported more often having sex without contraception and with someone met on the internet as well as higher numbers of lifetime sex partners and a younger age at first steady partnership. Our data do not allow to conclude whether the higher vaccination rate is a cause or a consequence for riskier behavior. It is highly possible that male YAs who engage in sexual risk behavior are more likely to decide for HPV-vaccination aiming to protect themselves better.

Reasons for non-vaccination

With more than 20% in the female and more than 60% in the male group the number of YAs not knowing about the vaccination was unexpectedly high. Contrary to our expectations, that regular gynecological check-ups would ensure a sufficient counselling on HPV vaccination, a significant proportion of the female participants was found to be poorly informed.

This shows that further actions need to be taken to better inform both genders about HPV vaccination. 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.

Regarding future vaccination, about 60% of the male participants reported a general negative attitude toward vaccination. This finding is in contrast with a previous Swiss study detecting significantly higher vaccine hesitancy among female adolescents [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 [36], a proper comparison cannot be made with the existing literature as attitudes most likely change with increasing age.

While women also frequently (35.53%) reported to be generally against vaccination, in contrast to other studies [37], fear of side effects, was reported as a reason against vaccination to a little extent (15.29%). To improve future counselling future studies should include proper investigation of reasons resulting in such a general attitude. Here again strategies should be taken that adolescents and adults eligible for vaccination should not only be aware of the possibility but also understand benefits of vaccination after initiation of sexual contacts bearing the risk for HPV infection. 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. Obviously, they were not aware that even in case of infection with one or several subtypes the vaccination helps to decrease total risk of transmission and cancer development in the person himself and his/her partners.

Strengths and Limitations of this study

The generalizability of our findings is limited since we focused on a specific age group shortly after the official recommendation for HPV vaccination in male YAs. This age group is now likely better informed due to the implementation of school-based vaccination programs and increased awareness among health care practitioners since the time of our study. Furthermore, since the study was conducted in Switzerland, its findings may only be directly applicable to countries with similar vaccination policies. Given the significant variations in vaccination policies both among countries and within the European Union, caution must be exercised when extrapolating these findings to other regions. One of the primary strengths of this study is its utilization of data from a nationwide representative sample encompassing both female and male young YAs. Notably, this study sheds light on male YAs, a demographic that has been understudied in the context of HPV vaccination. Despite a modest response rate of 15.1% for the overall study, the analysis was conducted on a substantial representative sample. Furthermore, the study examined a diverse range of characteristics, including sociodemographic and behavioral aspects, to identify key factors associated with vaccination uptake across genders. The integration of male YAs, who may have surpassed the age range for basic vaccination when HPV vaccination programs were extended to young men, provided valuable insights into the extent of catch-up vaccination among this cohort.

Several limitations warrant consideration. First, the cross-sectional design of the study precludes the inference of causation. The lower-than-expected response rate may be attributed to the detailed nature of questions regarding sexual behavior, 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. Although the results are based on a large representative sample, the limited response rate does not allow full exclusion of over- or under-estimation in explored correlations.

Another significant limitation pertains to the absence of information regarding participants' counseling on HPV vaccination, which may influence their vaccination decisions. Furthermore, 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. The absence of information regarding the completeness of vaccination doses received further limits the accuracy of the vaccination status assessment.

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 minimize uncertainty.

Although the study explored attitudes toward HPV vaccination by examining the reasons for non-vaccination and hesitancy toward future vaccination, it did not discern whether vaccination decisions were autonomously made by participants or influenced by parental decisions. Additionally, the participants were restricted to selecting a single reason for non-vaccination and hesitancy, potentially oversimplifying complex motivations.

Regarding the questions about sexual behavior, a social desirability bias cannot be disregarded. Among the general population, several studies have found that even with anonymous responses, there are significant correlations between a variety of self-reported sexual behaviors (e.g., use of condoms, sexual fantasies, exposure to pornography, penis size, etc.) and social desirability, with evidence suggesting that

significant under- or over-reporting is common [38]. Previous research has indicated that women tend to under-report, for example, the number of sexual partners, receptive anal intercourse, or condom use [38]. Contrastingly, the male population has been found to over-report their own sexual activity [39]. Since a social desirability bias may have influenced our results to a certain extent, our findings on the association between sexual behavior and HPV vaccination have to be interpreted with caution. The association between HPV vaccination and sexual behavior needs further investigation, and future research should include a measure of social desirability when asking highly sensitive questions [39]. Furthermore, inquiries about early sexual experiences during adolescence may be subject to memory bias. In such situations, using the life history calendar (LHC) method could minimize this bias by facilitating more accurate and candid responses [40].

Conclusion

Our results show that vaccination coverage in the male population is very low, which can be mostly attributed to the lack information on HPV vaccination. Altogether, our findings highlight the need for and importance of appropriate counseling supporting informed decisions on HPV vaccination, especially in the male population.

Parents have been shown to play a pivotal role in ensuring vaccine uptake, since in most countries including Switzerland, parental consent is required for adolescent vaccination in schools [41]. Previous research has underlined that parents' knowledge, attitudes, and beliefs about vaccination in general strongly influence their decision-making about HPV vaccination for their adolescent children [42,43]. More intensive communication strategies targeting parents to improve their HPV vaccine knowledge and to promote vaccine decision-making with adolescents might substantially contribute to higher vaccination rates. Although the study participants were adults, i.e., they no longer needed their parents' consent, parental attitudes might have influenced vaccination decisions.

In Switzerland, HPV vaccination is mainly promoted through school-based vaccination programs, 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

[27]. It seems that the assumption of HPV vaccination being only beneficial for those who are yet to become sexually active or/and those who are not infected with any type of HPV substantially contributes to the low vaccine uptake. In Switzerland, health care practitioners are already encouraged to inform people about the indications and benefits of vaccination, but no systematic approach has been defined yet. Also, better communication between the school-based vaccination program and key persons in primary care would help identify adolescents who have missed vaccination at school.

Since school-based education programs might fail to achieve sufficient coverage, additional strategies that promote the importance of catch-up vaccination in universities and colleges should be implemented to reach the male population. Furthermore, strategies must be carried out to also reach YAs outside of educational institutions, for example, through primary care to eliminate the lack of public awareness about this catch-up option. Based on our results, it is highly possible that the assumption of HPV vaccination being only beneficial to those who are not sexually active or/and those who are not infected substantially contributes to the low vaccine uptake. Research should be conducted on whether educational programs and efforts to increase knowledge should provide a greater focus on the benefits of HPV vaccination for those who have already engaged in sexual intercourse or for those infected with HPV.

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Conflicts of interest

All authors declare that they have no conflicts of interest.

Author Statement

YB, AB, JA and BL contributed to the conceptualization and the design of the study. SE, MS, and AB planned and performed the statistical analyses. SE and BL drafted a first version of the manuscript. All authors SE, MS, YB, AB, DM, JA, BL critically revised drafts of the manuscript, and read and approved of the final version.

Data availability statement

The data that support the findings of this study are available from the corresponding author, [Samia El-Hadad], upon reasonable request.

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Tables

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

	Female YAs			Male YAs		
	vaccinated n = 1110	**not vaccinated n = 1045**	**p-value**	**vaccinated n = 158**	**not vaccinated n = 838**	**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
Own Swiss nationality (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
Father born in CH (yes, %)	72.61	79.81	**< 0.001**	78.6	74.2	0.192
Parents born in CH (%)			**< 0.001**			0.447
Both Swiss-born	63.69	72.61		70.89	68.50	
One Swiss-born	16.77	13.59		14.56	14.44	
Both non Swiss-born	19.55	13.78		14.56	17.06	
Linguistic region (%)			**< 0.001**			**< 0.001**
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[1]	43.15	46.12		51.27	44.87	
Rural[2]	56.85	53.88		48.73	55.13	
Perception of family socio-eco-nomic status at age of 15 (%)			**<0.001**			0.433
> 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**
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	

[1] Urban: city, suburb of a city (more than 10,000 inhabitants), [2] Rural: mountains, countryside, village (less than 10,000 inhabitants)

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

Data presented as n (%) or mean (± SD) using chi- square and independent t-tests. SD = standard deviation. The bold values indicate statistical significance

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%)	

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

	Female YAs N=2718			**Male YAs N=2016**		
	vaccinated n = 1110	**not vaccinated n = 1045**	**p-value**	**vaccinated n = 158**	**not vaccinated n = 838**	**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
Realization of at least one gynecological visit (yes, %)	97.30	93.68	**< 0.001**	-	-	-
Age at 1st gynecological visit (mean ± SD)	16.70±2.85	17.04±3.35	**0.013**	-	-	-
Partnership experiences						
Age at 1st steady partnership (mean ± SD)	17.50±2.80	17.39±2.96	0.387	17.39±3.21	18.05±3.31	**< 0.005**
Nb lifetime sex partners (%)			0.547			**< 0.001**
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 behavior						
Age 1st 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**
Sex without contraception (>= sometimes %)	21.04	23.36	0.329	37.42	26.77	**0.003**
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.

Data presented as n (%) or mean (± SD) using chi- square and independent t-tests. SD = standard deviation. The bold values indicate statistical significance.

Table 3: Multinomial regression analysis for female young adults with the "HPV-vaccinated"- group as the reference category (Zurich,Switzerland,2024)

	Estimate	p-value	Odds ratio (OR)
Swiss parents			
Both parents Non-Swiss	Reference category		
One Swiss parent	-0.24929936	0.157	0.77934663
Both Swiss parents	-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 gynecological visit	-0.04848103	**0.006**	0.85267541
Age at first steady partnership	0.03042511	0.111	1.03089268
Sexual behavior			
Number of lifetime sex partners	-0.06295419	0.260	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

Table 4: Multinomial regression analysis for male young adults with the "HPV-vaccinated"- group as the reference category (Zurich,Switzerland,2024)

	Estimate	p-value	Odds ratio (OR)
Swiss parents			
Both parents Non-Swiss	Reference category		
One Swiss parent	0.1793543	0.630	1.196444574
Both Swiss parents	0.40021762	0.168	1.492149382
Educational level			
Education high	Reference category		
Education low	0.07648343	0.712	1.079484302
Socioeconomic status			
Family socioeconomic status < mean	Reference category		
Family socioeconomic status = mean	-0.16149366	0.576	0.85087193
Family socioeconomic status > mean	-0.16446531	0.610	0.84834719
Linguistic region			
German	Reference category		

French	- 0.45632100	0.062	0.87654351
Italian	0.006723910	0.076	1.14567618
Health status			
Mental health score (MHS)	6.7552E-05	0.992	1.000067554
Age at first steady partnership	-0.05427716	**0.050**	0.847169552
Sexual behavior			
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

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

	Female YAs n =1 045	**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)[1]	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)[2]	13.41	13.08	

[1] 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: Learned too late about the vaccination, had already had the first sexual intercourse, missing long term studies.

[2] 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.

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Original Research Article

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

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Abbreviations

HPV	Human papilloma virus
YAs	Young adults
SES	Socioeconomic status
STI	Sexually transmitted infection
HCP	Health Care Practitioner

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 behavior, 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 young adults 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 gynecological 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.

Conclusion: 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 the 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 behavior, 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 over- or under-estimation 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 over- or under-estimation 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 minimize uncertainty.

Key words

HPV vaccination, male vaccination, young adults, initiation of sexuality, gender-related differences

Introduction

Human papilloma virus (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-year-olds [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 World Health Organization (WHO) since 2009 [5]. They have been progressively introduced in many national

immunization schedules and by 2008, all Swiss cantons had implemented HPV vaccination programs targeting 11-14-year-old girls 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 20–26-year-old young women. 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 nonavalent vaccine, Gardasil 9, was introduced to the Swiss market. Based on the Intercontinental Medical Statistics (IMS) data of Monitoring and Administration Tool (MAT) June 2017, at the time of our study, the quadrivalent vaccine led the HPV vaccines market, with almost 95% of HPV vaccinations employing this vaccine [6]. The Swiss HPV vaccination program 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-year-olds from deciding whether or not to receive vaccination, health care practitioners and schools do not carry out vaccination without consulting parents. HPV vaccination is mainly promoted by school-based vaccination programs, 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, gynecologists, and pediatricians, 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. First results indicate that vaccination rates in the male population are substantially lower than in women and revealed lower support of 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 programs 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 analyzed 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 (i) investigate the prevalence of HPV vaccination, (ii) evaluate key factors influencing HPV vaccination uptake, and (iii) identify reasons for non-vaccination in a representative sample of male and female cisgender 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 behaviors, a cross-sectional study conducted in 2017 among a representative sample of YAs (mean age 26.3 years) living in Switzerland; i.e. 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 years 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

differentiated analysis of the number of questions answered were realized. While possible answers were pre-selected for some questions other questions allowed free text answers which were analyzed 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 to the first question of the survey The questionnaire was available in German, French and Italian. The survey collected sociodemographic, sexual health and behavior 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 [15] for further details. The manuscript was drafted following STROBE criteria [16].

In- and exclusion criteria: For the present evaluation, young adults 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 behaviors in detail. It has been frequently proven that homosexual and transgender individuals exhibit different sexual behaviors and associated risks. To avoid skewing the correlations between HPV vaccination and sexual behavior, 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 toward 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 dichotomized the 7 possible answers into below average, average, or better.

As gynecologists 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 gynecological visit before and, if yes, how old they were at their first gynecological 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 (MHI-5) with five items referring to the last four 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 sexually transmitted infections (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 behavior.

We assessed the reasons for hesitancy toward 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.

Ethics*:* The Ethics committee of the canton of Vaud approved the study and it was realized in accordance with the Declaration of Helsinki.

Statistics: Encrypted data were entered into an access database specifically developed for the study. We performed bivariate analysis to compare the characteristics of vaccinated versus non-vaccinated male and female participants. Chi-Square (X^2) test was used to assess differences in categorical variables and t-test was applied to compare means. A p-value of less than 0.05 was considered statistically significant. For all variables being significant on bivariate level we analyzed 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 Odds-ratios (OR). All analyses were done using the R-Software, Version 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 questionnaires 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%) versus 158 (7.8%), $p < 0.001$). First, we will present 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 summarizes mental health and behavioral 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 gynecological visit and younger age when presenting for this visit were associated with being vaccinated. Sexual risk behavior as represented by sex after the consumption of drugs/alcohol, with someone met online and without contraception were 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 behavior more frequently. They reported significantly higher

numbers of lifetime sex partners, e.g. nearly 30% of vaccinated male YAs had more than 10 lifetime sex partners compared to 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 STD history was not associated with vaccination.

Comparison of factors associated with HPV-vaccination among female and male young adults

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 socioeconomic status (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 behaviors were associated with higher HPV vaccine uptake. However, for females, sexual behavior 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 behaviors, 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 young adults

After performing multivariate regression analysis female participants with both parents being Swiss-born were less likely to be vaccinated against HPV (OR 0.55, p-value < 0.001) (Table 4a). A 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-value 0.045) and those who answered a SES above average had the highest probability of being vaccinated (OR 1.97, p-value < 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-value < 0.001) compared to those being from the German or Italian parts of Switzerland. A younger age at the first gynecological visit was a statistically significant factor associated with a higher likelihood of being vaccinated against HPV (OR 0.85, p-value 0.006). Risky sexual behavior showed no significant association with vaccination among the female population of our studies in the multivariate regression model.

Male young adults

For male participants sociodemographic factors were not significantly associated with vaccination uptake (Table 4b). Instead, in contrast to the female population risky sexual behavior, such as a younger age at first steady relationship was more likely to occur in the HPV-vaccinated group (OR 0.84, p-value 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-value 0.005; OR 1.78, p-value 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 to male YAs (Table 5).

Among reasons against future vaccination, “being generally against vaccination” was named by approximately one third of the female YAs compared to 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 analyzed data from a large sample of young adults (YAs) in a national survey of the Swiss population. Our findings indicate that attitudes toward 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 immunization programs.

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 young adults 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 United States in 2021 systematically analyzed HPV vaccination status among a representative sample of 6,606 female and 6,038 male young adults, revealing higher vaccination rates among females (46%) compared to 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 programs have been more successful, achieving 80.5% coverage for boys and 77.6% for girls by age 15 in 2020. Australia's program, 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 programs vary widely in their approach to school-based vaccination activities and in the resources 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 young adults often receive less counseling and are less aware of vaccination benefits. Although the 2015 HPV vaccine recommendation for boys increased uptake among younger males, about 50% of male young adults remain unaware of their vaccination status. Since the consequences of HPV infection, particularly cervical cancer, are more familiar and routinely monitored in women, male young adults likely receive less HPV vaccination counseling. They visit health professionals less frequently, and pediatricians and family doctors may not emphasize 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 young adults 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 emphasized. 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 US [26] or being Chinese [9] has been found to be associated with limited knowledge on HPV vaccination. While our study did not collect data on ethnicity, we observed that female young adults with both parents being Swiss-born were more likely to have a negative vaccination status, whereas male young adults showed a trend in the opposite direction, though not statistically significant. This suggests that fparents 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, general vaccine hesitancy could affect Swiss-born parents' attitudes toward HPV vaccination. A recent Swiss study found that 36% of parents were vaccine hesitant and preferred alternative 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 area 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- and middle-income countries, vaccine uptake varies depending on the residential area, as economically disadvantaged individuals often reside in rural regions. Our data revealed geographic 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 programs 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 are 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 to the male population. Higher education in male young adults 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 have been previously found to be especially applicable to depressed patients [35]. In female YAs, having had at least one gynecological 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, 38, 39, 40]. Further research needs to determine if parental involvement in early vaccination counseling could enhance awareness of HPV vaccination before the sons' first sexual experience. Our findings show that HPV vaccination initiation in female young adults is not linked to sexual risk behavior, consistent with existing literature [36, 41]. Previous studies repeatedly found that HPV vaccination does not alter sexual behavior in girls, a known concern in discussion on the promotion of HPV vaccination [37]. Conversely, vaccinated male young adults reported more risky sexual behaviors, 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 behavior. It is possible that males engaging in risky behaviors 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 gynecological 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 toward 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 generalizability 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 programs 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- 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 analyzed a substantial sample and explored various sociodemographic and behavioral factors related to vaccination uptake. Including male young adults, 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 behavior, 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 over- or under-estimation in explored correlations. Another major limitation is the lack of data on participants' counseling 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 may not be 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 young adults 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 behavior questions, leading to potential under- or over-reporting. Several studies found that even with anonymous responses, there are significant correlations between a variety of self-reported sexual behaviors (e.g., use of condoms, sexual fantasies, exposure to pornography, penis size, etc.) 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 life history calendar (LHC) method could minimize this bias by facilitating more accurate and candid responses [45].

Conclusion

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 counseling 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 programs, 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. Health care practitioners should be encouraged to inform individuals about vaccination benefits, and improved coordination between school programs and primary care could identify missed vaccinations.

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

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Author Statement

JCS,YB and BL contributed to the conceptualization and the design of the study. SE and MS planned and performed the statistical analyses. SE and BL drafted a first version of the manuscript. All authors SE, MS, AN, YB, JCS and BL critically revised drafts of the manuscript, and read and approved of the final version. SE is responsible for the overall content as guarantor.

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Conflicts of interest

All authors declare that they have no conflicts of interest.

Data availability statement

The data that support the findings of this study are available from the corresponding author, [Samia El-Hadad], upon reasonable request.

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Tables

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	0.806**
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**	0.321**
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[1]	43.15	46.12		51.27	44.87		
Rural[2]	56.85	53.88		48.73	55.13		
Perception of family socio-eco-nomic 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		

[1] Urban: city, suburb of a city (more than 10,000 inhabitants), [2] Rural: mountains, countryside, village (less than 10,000 inhabitants)

Significant p-values are marked in bold, p-values are presented as adjusted p-values. For all variables being significant on bivariate level we analyzed the difference of its presence in the female and male population; p-values for this analysis are presented with **.

Data presented as n (%) or mean (± SD) using chi- square and independent t-tests. SD = standard deviation. The bold values indicate statistical significance

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

Table 3: Health and behavioral 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**
Realization of at least one gynecological visit (yes, %)	97.30	93.68	**< 0.001**	-	-	-	
Age at 1st gynecological visit (mean ± SD)	16.70±2.85	17.04±3.35	**0.013**	-	-	-	
Partnership experiences							
Age at 1st 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 behavior							
Age 1st 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 analyzed the difference of its presence in the female and male population; p-values for this analysis are presented with **.

Data presented as n (%) or mean (± SD) using chi- square and independent t-tests. SD = standard deviation. The bold values indicate statistical significance.

Table 4a: Multinomial regression analysis for female young adults with the "HPV-vaccinated"- group as the reference category (Zurich,Switzerland,2024)

	Estimate	p-value	Odds ratio (OR)
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 gynecological visit	-0.04848103	**0.006**	0.85267541
Age at first steady partnership	0.03042511	0.111	1.03089268
Sexual behavior			
Number of lifetime sex partners	-0.06295419	0.260	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

Table 4b: Multinomial regression analysis for male young adults with the "HPV-vaccinated"- group as the reference category (Zurich,Switzerland,2024)

	Estimate	p-value	Odds ratio (OR)
Parents born in CH (%)			
Both parents Non-Swiss born	Reference category		
One parent Swiss-born	0.1793543	0.630	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
Socioeconomic status			
Family socioeconomic status < mean	Reference category		
Family socioeconomic status = mean	-0.16149366	0.576	0.85087193
Family socioeconomic status > mean	-0.16446531	0.610	0.84834719
Linguistic region			

German	Reference category		
French	- 0.45632100	0.062	0.87654351
Italian	0.006723910	0.076	1.14567618
Health status			
Mental health score (MHS)	6.7552E-05	0.992	1.000067554
Age at first steady partnership	-0.05427716	**0.050**	0.847169552
Sexual behavior			
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

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

	Female YAs n =1 045	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)[1]	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)[2]	13.41	13.08	

[1] 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: Learned too late about the vaccination, had already had the first sexual intercourse, missing long term studies.

[2] 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.