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Providing parents with HPV vaccine information from a male perspective may render them more inclined to have their daughters vaccinated

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Abstract

Objectives

Several high-income countries have implemented a gender-neutral vaccination program against human papillomavirus (HPV) infections. The impact of a gender-neutral program (GNP) on parental intention to vaccinate their daughters has not been studied, especially in countries with low HPV vaccine coverage among girls.

Patients and methods

In July 2019, before a GNP was implemented in France (2021), the French National Cancer Institute (INCa) conducted a survey on HPV vaccine acceptance among parents of children aged 11-19 years living in France. In the sample of girls' parents (n=1424 parents, 1726 girls), we investigated whether parents who declared no initial intention to have their daughter(s) vaccinated changed their minds after reading information including a male perspective on HPV consisting in description of HPV-related disease among men and in ascertainment of the fact that in some countries, the HPV vaccine is recommended for boys, after which they were once again asked about their intentions "if the vaccine were recommended to boys and girls alike".

Results

As regards 295 (25.7%) of the 1147 unvaccinated girls, their parents declared no intention to have them vaccinated, while 509 (44.4%) were not sure. Among the parents of the 804 girls whose parents had not intended to have them vaccinated, 134 (16.7%) changed their minds after reading about HPV among men. Fathers were more likely than mothers to change their minds, and finally intend to have their daughters vaccinated (adjusted relative risk, 1.74 [95% confidence interval, 1.20,2.54]).

Conclusions

These results suggest that parents, and fathers in particular, could be more motivated to have their daughters vaccinated against HPV if the information with which they were provided included a male perspective and a recommendation of vaccination for boys as well as girls.

Keywords: Human Papillomavirus, vaccines, parents, intention, gender-neutral program

Introduction

Human papillomavirus (HPV)-related cancers are a public health issue, with 690,000 new cases per year occurring worldwide [1]. In France, around one quarter of HPV-related cancers occur among men [2]. HPV also causes genital warts, which are often recalcitrant and responsible for reduced quality of life [3]).

Substantial evidence supports the claim that HPV vaccines are safe and highly effective against HPV infections and precancerous cervical lesions [4]. In addition, recent evidence confirms that vaccination of girls could prevent 80% of cervical cancer cases that may occur up to the age of 30 [5]. Several clinical and modelling studies have also suggested that the nonavalent vaccine is effective at preventing other cancers and genital warts in men [6,7], leading to a substantial direct benefit in the male population [8].

HPV vaccination was initially recommended in 2007 in France for girls aged 14-16 years with catch-up until 24 years, followed in 2012 by an updated target age of 11-14 years with catch-up until 19 years. Up until 2018, coverage had remained below 30%, but by 2022, an

increase to 41.5% (fully vaccinated at the age of 16 years) had been observed [9]. In January 2021, France extended its recommendation to boys aged 11-14 years [10].

Many high-income countries including the USA (since 2011) and the UK (since 2019) have adopted a gender-neutral program (GNP) targeting adolescent boys as well as girls [11,12]. This strategy aims at directly protecting men against HPV-related cancers, including men having sex with men, who obviously would not benefit from a women-only strategy [13]. Another objective is to reduce transmission of oncogenic HPV towards women [14] and thereby accelerate control or even elimination of cervical cancer [15], particularly in populations where vaccine coverage among girls remains limited [16].

An additional hypothesis is that a gender-neutral program could help achieve higher uptake among girls, particularly through enhanced perception among parents and care providers or facilitated vaccine promotion [17]. However, the impact of a policy change from a girls-only program to a GNP on parental vaccine behaviors toward their daughters has not previously been studied. Because many more countries, some of them low and middle income, might one day consider GNP adoption, it is primordial that this policy change and its potentially positive impact on girls' vaccine uptake be carefully monitored.

To evaluate the hypothesis that a vaccine recommendation extended to boys could increase HPV vaccination intentions among parents of adolescent girls, we compared vaccine intentions before and after their having received information on HPV-related diseases and vaccination from a male as well as female perspective in a sample of parents of girls in France aged 11-19-years. Data collection was conducted in 2019, before introduction of the GNP.

Materials and methods

1. Data collection

The survey was conducted by the French national cancer institute (INCa) in collaboration with the *Haute Autorité de Santé* (HAS) and implemented between June 20, 2019 and July 12, 2019 by the BVA survey institute. The survey included a representative sample of parents in mainland France with least one daughter aged 11-19 years and/or son aged 11-14 years. The representative nature of the sample was ensured by using a quota method based on sex of the parent, age of the parent, number of children in the household, socio-professional category of the head of the household, size of urban area, and administrative region. Parents were recruited from within a web panel of 30,089 persons. Data were collected through an online questionnaire with a mean duration of 10 minutes. Parents were requested to complete one questionnaire for each child.

Because data collection was observational, anonymous and without risk of indirect identification, contained no sensitive (and only self-declared) biomedical information, no additional written informed consent or ethical approval was required for secondary analysis of the data according to the relevant French regulations. Individuals visiting the study website were provided with access to all study information and had to agree to study participation before starting the questionnaire.

All in all, 3265 persons followed the survey link (response rate: 10.9%) with 2002 fulfilling the quota criteria for completion of the online survey. For the present analysis, we included 1438 participating parents with one daughter aged 11-19 years, while excluding 564 parents without a daughter in the selected age range. We excluded would-be participants who declared not being parents after having agreed to fill out the questionnaire or declared a parent-child age difference inferior to 10 years ($n=14$). The final database consisted of the answers given by 1424 parents for 1726 girls aged 11-19 years.

2. Variables

We collected information on age and sex of the responding parent, geographical area, size of urban area, socioeconomic status of the household, family type (single- or two-parent family), and number and sex of children in the household (English-language questionnaire available in **Supplementary material A**). Socioeconomic status was estimated based on the professional category of the household reference person.

Parents were asked if they were in favor of vaccination in general and of various vaccinations including the one against HPV. They were also asked if they had heard of debates or doubts about the HPV vaccine, and what they thought of the vaccine in terms of safety and effectiveness. A few questions concerned information on the HPV vaccine itself: self-reported level of information, proactive search for information on this vaccine, and sources of information. Knowledge on HPV was assessed through questions on which diseases were prevented by the HPV vaccination. We constructed an HPV knowledge score using parents' answers (yes or no) to the following question "According to you, the vaccine against HPV-Papillomavirus infections is used to fight against..." and statements: cervical cancers, breast cancers, genital cancers (vagina, penis), some anal cancers, some head and neck cancers (tongue, throat), genital warts, acquired immunodeficiency syndrome (AIDS), genital herpes. The sum of correct answers (coded 1) and wrong answers (coded 0) was then computed and recoded into four categories: 1) zero to very low knowledge, 2) basic (knowledge of cervical cancer), 3) good, 4) very good.

For each daughter, parents were asked a series of questions about their HPV vaccine intentions. First, vaccination status was ascertained with the question: "Is your daughter vaccinated against HPV-Papillomavirus infections?". If the answer was negative or "I do not know/I am unsure", they were asked about whether they intended to have their daughter vaccinated if the vaccine were to be proposed to them today: "If today, it was proposed to update your daughter's HPV vaccination, would you agree to have her vaccinated?" All parents then received concise information on i) HPV-related diseases among men and women, ii) the French policy at that time targeting only girls, and iii) gender-neutral vaccination in other countries (**Figure 1**, original French-language version in **Supplementary material B**). Parents were then asked if they had previously been aware of the fact that HPV vaccination could apply to boys as well as girls. Lastly, parents with unvaccinated daughters or uncertain of their daughter's vaccination status were asked if they would intend to have their daughter vaccinated against HPV were it to be recommended for boys as well as girls in France.

3. Statistical analyses

Because one parent could reply with regard to more than one daughter, the units of observation in the analyses and results were individual girls, whereas exposure and co-factors referred to parental characteristics. We investigated the factors associated with three outcomes: 1) HPV vaccination status among the entire sample of 11-19-year-old girls (n=1726); 2) parental HPV vaccine intention regarding unvaccinated girls or with uncertain HPV vaccination status (n=1147) and; 3) positive change in parental HPV vaccine intention after provision of HPV information including a male perspective (n=804), (**Figure 2**). A positive change in parental vaccine intention was defined as a change from “No” or “Do not know” to “Yes” regarding unvaccinated girls or those with uncertain vaccination status.

Possible factors were parental knowledge, attitudes and sociodemographic variables, as described above.

For each outcome, we constructed multivariable Poisson regression models using girls as the unit of analysis and taking into account the cluster effect among parents (*-xtppoisson* command in Stata, with population average option). All variables associated with the outcome in bivariable models at a $p < 0.20$ significance level were tested for collinearity and added to a full multivariable model. Parsimonious models including variables at $p < 0.05$ were then constructed by backward stepwise regression. Poisson models yielded effect estimates in the form of adjusted relative risk (RR) with 95% confidence intervals.

Gender differences in parental attitudes and knowledge about HPV vaccination and vaccination in general were assessed using Pearson's Chi-square tests.

Results

1. Description of participants

The final database consisted of the answers provided by 1424 parents regarding 1726 girls aged 11-19 years. Responding parents were mainly female (67.5%), predominantly from two-parent families (82.2%), and half of them lived in high socioeconomic status households (49.7%). Most of the parents had only one daughter aged 11-19 years (80.5%), and 16.9% also had at least one son (**Table 1**). Cervical cancer as a target of HPV vaccination was known by 74.0% of parents and genital cancers by 27.7%. Genital warts and other cancer locations such as anal and oropharyngeal cancers were nearly unknown to most parents (fewer than 7% identified them). Breast cancer, AIDS and genital herpes were suspected of being related to HPV by fewer than 8% of parents. HPV vaccines were considered safe by 26.3% (52.2% not sure) and effective by 41.6% of parents (31.3% not sure). All in all, 46.1% of parents considered themselves poorly informed about HPV and 51.3% had heard about some kind of debate or controversy concerning HPV vaccination. The parental characteristics of the three subgroups of girls included in the following analyses differed mainly in terms of attitudes towards HPV vaccination and vaccination in general (**Supplementary material C**).

2. Factors associated with HPV vaccination status

According to parental declarations, 33.6% of the 1726 girls aged 11-19 years were vaccinated against HPV (n=579), 57.8% were not, and the status of 8.7% remained (**Supplementary material C**). Women declared more frequently than men that their daughter was vaccinated (36.7 vs 26.9%, $p<0.001$) (**Table 2**). Vaccine coverage was lower among girls aged 11-14 years vs. 15-19 years (26.8 vs 40.2 %, $p<0.001$), and higher among parents with positive attitudes about HPV vaccine safety, effectiveness and vaccination in general. By the same token, vaccine coverage was greater among girls whose parents evidenced higher knowledge scores, self-reported level of information and awareness of possible HPV vaccine for boys. Daughters' vaccination status was not significantly associated with the presence of a boy in the family (31.7% and 33.9%, respectively, for girls with and without a brother). In the parsimonious multivariable analysis, daughter's HPV vaccination status was positively associated with older age of the daughter (RR 1.48 [1.28,1.72]). and negatively associated with the parent thinking the HPV vaccine was unsafe (RR 0.31 [0.22,0.45]) or ineffective (RR 0.21 [0.06,0.75]), a self-reported low level of information on this vaccination (RR 0.58 [0.46,0.74]), and not being in favor of vaccination in general (RR 0.38 [0.20,0.70]) (**Table 2**).

3. Factors associated with HPV vaccine intention among parents of unvaccinated girls

Among the 1147 unvaccinated girls or with unknown status, parents of 343 (29.9%) of them declared that they would have them vaccinated if they had the opportunity today. With regard to 509 girls (44.4%), parents were unsure of their intentions, and concerning 295 (25.7%), their parents did not intend to have them vaccinated. Fathers expressed their intentions more frequently than mothers (34.6% vs 27.5%, $p<0.05$), as did parents in two-parent families, parents of younger girls, parents aware of the HPV vaccine for boys, as well as those declaring being well-informed on HPV and having positive attitudes about HPV vaccine safety, effectiveness and vaccination in general (**Table 3**). In the parsimonious multivariable analysis, intention to vaccinate their daughter was negatively associated with negative opinions or lack of certainty on vaccine safety and effectiveness ("vaccine is unsafe" RR: 0.21 [0.13,0.34], "lack of data on its effectiveness" RR: 0.39 [0.27,0.58]) and being against vaccination in general (RR: 0.39 [0.22,0.71]), but it was not associated with parental gender.

4. Gender differences in parental attitudes and knowledge about HPV vaccination

Among parents of unvaccinated daughters or with unknown status, and who had no intention to have them vaccinated before receiving the information (n=670), fewer fathers had formed an opinion about HPV vaccination compared to mothers (**Table 4**). Indeed, more frequently than mothers they responded "I do not know" to the statements on HPV vaccine safety (69.0% vs 51.4%) and effectiveness (52.6% vs 32.2%). They were also significantly less aware of "debates or controversies" regarding the HPV vaccine (64.8 vs 48.6%, $p\text{-value}<0.001$). Fathers had significantly less knowledge of which diseases were caused by HPV (lowest score: 39.9% vs 15.1%) and were significantly more likely not to know if their daughter was vaccinated (17.7 vs 4.5%). In this subsample, however, fathers and mothers attested at a similar rate to being ill-informed, unaware that HPV vaccination can be offered to boys, and having the same

opinion on vaccination in general. Mothers in this sub-group expressed more doubts about the HPV vaccine, with 42.7% declaring that it was not safe (vs 24.9% of men), and 39.6% that there is not enough data to draw a conclusion on HPV effectiveness (vs 18.8% of men).

5. Changes in HPV vaccine intention after receiving HPV information containing a male perspective

With regard to 16.7% (n=134) of the unvaccinated girls or those with unknown status for whom the participating parent had no prior HPV vaccine intention (n=804), parents changed their intentions after having acquainted themselves with HPV vaccination information including a male perspective. In this subsample, 26.4% of fathers and 11.9% of mothers (test for difference $p < 0.001$) changed their minds toward vaccine intention. In households with at least one boy, parents were less likely to change their minds (10.1%), as compared to households with exclusively girls (18%, test for difference $p < 0.05$). Parents with a positive attitude toward HPV vaccine safety and effectiveness, as well as vaccination in general, more frequently modified their intentions. Conversely, positive change was not significantly more frequent among parents with low self-assessed or score-based knowledge, or ignoring that HPV vaccine applied to boys as well as girls (**Table 5**). In the parsimonious multivariable analysis, male parental gender was positively associated with a change of mind regarding intention (RR: 1.74 [1.20,2.54], **Table 5**), while factors such as older age of the daughter (RR: 0.76 [0.58,0.99]), having a negative opinion on HPV vaccine safety (RR: 0.30 [0.15,0.61]), perceiving effectiveness data as insufficient (RR: 0.52 [0.29,0.91]) and being against vaccination in general (RR: 0.19 [0.07,0.52]) were negatively associated with change of mind. Inclusion of other knowledge-related variables in the model, the objective being to control for lower knowledge levels among fathers, did not substantially change the gender effect.

Discussion

In this study of parents of adolescent girls aged 11-19 years living in mainland France, we found that regarding 17% of unvaccinated girls, parents changed their intentions after receiving written HPV vaccine information including a male perspective. This information included a description of HPV-related diseases among men, references to HPV vaccine recommendations for boys in some countries, and the change in intention was measured with the post-information question: "if the HPV vaccine were recommended in France for boys as well as girls, would you intend to have your daughter vaccinated?"

Reception of at least one dose of HPV vaccine was reported by parents for 33.5% of girls, which is comparable to the estimated 34.9% ≥ 1 -dose coverage at age 15 years in France in 2019 [9]. As an extrapolation, if at least 17% of parents of the 65% unvaccinated girls opted for vaccination in the context of a GNP (neglecting the fact that our results are limited to parents without intention), this could translate into an expected 11% increase of vaccine uptake among girls and have a substantial impact on public health.

Change of mind was not associated with lower initial knowledge about HPV diseases and vaccination, suggesting that the effect of the HPV vaccination information was not simply

to improve previously lacking awareness and knowledge. We consequently interpreted our results as evidence pointing to a specific effect of adding the male perspective to HPV information, possibly by assigning higher value to a vaccine recommendation addressed to boys as well as girls. Parents could perceive a recommendation as more convincing, HPV-related diseases as more severe or a vaccine as more important if it targeted both sexes and not only girls. Another mechanism could work by avoiding the emphasis on young women's sexuality, which has been characterized as a source of prejudice against HPV vaccination [18,19].

Little is known about the effect of proposing a preventative measure for males as well as females. This can be explained by the fact that most sex-specific prevention programs are based on measures that do not apply to the other sex, two examples being breast cancer and prostate cancer screening. The closest "gender-neutral" situation may consist in rubella vaccination, initially recommended only for pre-adolescent girls in several countries, before being extended to young men and integrated into the infant immunization program [20]. However, no data on the impact of such measures on vaccine acceptance are available for this changes in strategy, which was mainly dictated by the need to avoid congenital rubella syndrome.

We found that male gender was associated with a positive change in vaccination intention subsequent to reception HPV information including a male perspective. This association was found to be independent of attitudes toward vaccination in general, HPV vaccination, and all of the knowledge items (self-reported, score-based and prior awareness of HPV vaccination for boys). Our results suggest that information on HPV disease and vaccination including the male perspective may be particularly relevant to fathers, when they are asked to decide on having their daughters vaccinated. In an Austrian study, researchers found that a father's high educational status was correlated with higher HPV vaccine uptake, especially for boys [21]. More studies are needed to investigate not only fathers' knowledge and attitudes towards HPV vaccine, but also their involvement in vaccine decision-making in France. However, the literature shows that mothers are generally more involved than fathers in decision-making concerning their children's health [22], including HPV vaccination [23].

The observed factors associated with daughters' vaccination status and parents' intentions to have them vaccinated are similar to those reported in the literature, including with regard to French parents: low levels of awareness and knowledge about HPV vaccination, lack of recommendations by general practitioners (GPs) [24], negative perceptions of the benefit-risk balance of HPV vaccination [25]; with the key factors for perception of HPV vaccination being hesitancy towards vaccines in general, fear of side effects, and negative perceptions regarding efficacy [25,26].

HPV vaccine coverage data from the USA following the change to a GNP do not suggest a substantial positive impact on vaccine uptake among girls [27]. However, specific causal evaluation studies are required to assess a hypothetical impact of GNP on social norms, and more specifically on parental vaccine attitudes, behaviors and vaccine uptake itself. In 2023, The Lancet Global Health has published, with substantial press coverage, updated global and regional estimates of genital HPV prevalence among men, which could further modify parental perceptions of the gender-neutral aspect of HPV vaccination and, potentially, their intentions to have boys as well as girls vaccinated [28]. In France, a GNP has been operational since

January 2021 (12.8% 1-dose uptake among boys in 2022 [9]). Moreover, in September 2023 France introduced a nationwide school vaccination campaign for HPV. Even though, due to the COVID-19 pandemic, the change to GNP was not accompanied by large-scale communication, the launch of school-based vaccination has been supported by considerable efforts to inform parents and adolescents on HPV vaccination, irrespective of gender. In light of these programmatic changes, It will be interesting to assess the evolution in terms of girls' vaccine coverage, parental knowledge of the male perspective, and more generally, their perceptions of HPV vaccination.

One specific observation from our results is that relatively few parents agreed that the vaccine was effective (26%, 52% not sure) or safe (42%, 31% not sure). Data from the 2016 nationwide Santé Publique France Health Barometer survey [26] had found substantially higher prevalences (69% and 46%, respectively, with 10% not being sure on each item). This sizable difference can be explained by the fact that in our study, the question was addressed to all parents, including those who were not aware of the vaccine recommendation, while the 2016 data referenced only parents who were already aware

Limitations

Our study has several limitations. First, although the original sample aspired to representativeness of French parents concerning essential sociodemographic variables, our study sample largely consisted of computer-literate participants, who were willing and able to participate in online surveys. By removing parents without daughters, the sample in this secondary analysis was no longer ensured of full representativeness. In addition, only parents from mainland France were included and generalization of results to other settings may be inappropriate.

We performed a pre-post intervention comparison of observational data which did not include a control group possibly having received HPV information with an exclusively female perspective. We therefore cannot be certain that inclusion of the male perspective caused the observed impact; indeed, some of the effect may be due to our having provided written information. While our questionnaire included simple items on perceived vaccine effectiveness and safety, a more comprehensive, validated tool, such as the 5C-vaccine hesitancy scale [29], would be interesting for further research.

Once again, the effect on vaccine intention found in our study might have been influenced by the specific context of receiving written information during survey participation; the same information given by a different source could have more or less influence, depending on the level of trust for the source. General practitioners are the most trusted source of information on this topic, while mistrust in pharmaceutical industries, governments or health institutions could negatively impact reception of the same information [23].

Conclusions

All in all, our study provides evidence that presentation of HPV vaccine information including a male perspective and mention of GNP may have a positive effect on parental HPV vaccine intention for their daughters. Albeit small-sized, this effect could be used as a lever for HPV vaccine promotion, possibly in a public information campaign, or by healthcare professionals.

Journal Pre-proofs

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Author contributions

SD, JG, LZ and CP designed the survey and implemented data collection. SC and JEM conceived the analytical plan, conducted the analyses and drafted the first manuscript under JEM's supervision. SD, AC and JG provided the database and reviewed the manuscript. All authors have read and approved the final version of the manuscript.

Highlights

- HPV information from a male perspective was provided to parents who did not intend to have their with no their daughters vaccinated.
- Following the information, 17% of parents were more inclined to have their daughters vaccinated.
- This effect was stronger among fathers compared to mothers.
- Gender-neutral policies may render parents more inclined to have their daughters vaccinated.

English translation of the HPV vaccine information presented to parents

Papillomaviruses, or HPV, are sexually transmitted viruses that can, if not monitored and treated, cause several diseases (genital warts, cervical cancer and, more rarely, head and neck cancers, anal, penile, vulvar or vaginal cancers).

There exists a vaccine against some forms of HPV infections, which is recommended for girls before they begin their sexual life.

Genital warts affect women and men equally. Papillomavirus-related cancers are less common in men (penile and anal cancer) than in women.

Today in France, vaccination is recommended for young girls between the ages of 11 and 14, before they begin their sexual life. Catch-up vaccination is possible until the age of 19 years.

In some countries, vaccination against HPV infections is offered to all adolescents (boys and girls), to directly protect them against these diseases and to reduce transmission of the virus.

Figure 1. HPV vaccine information including a male perspective presented to parents during the survey

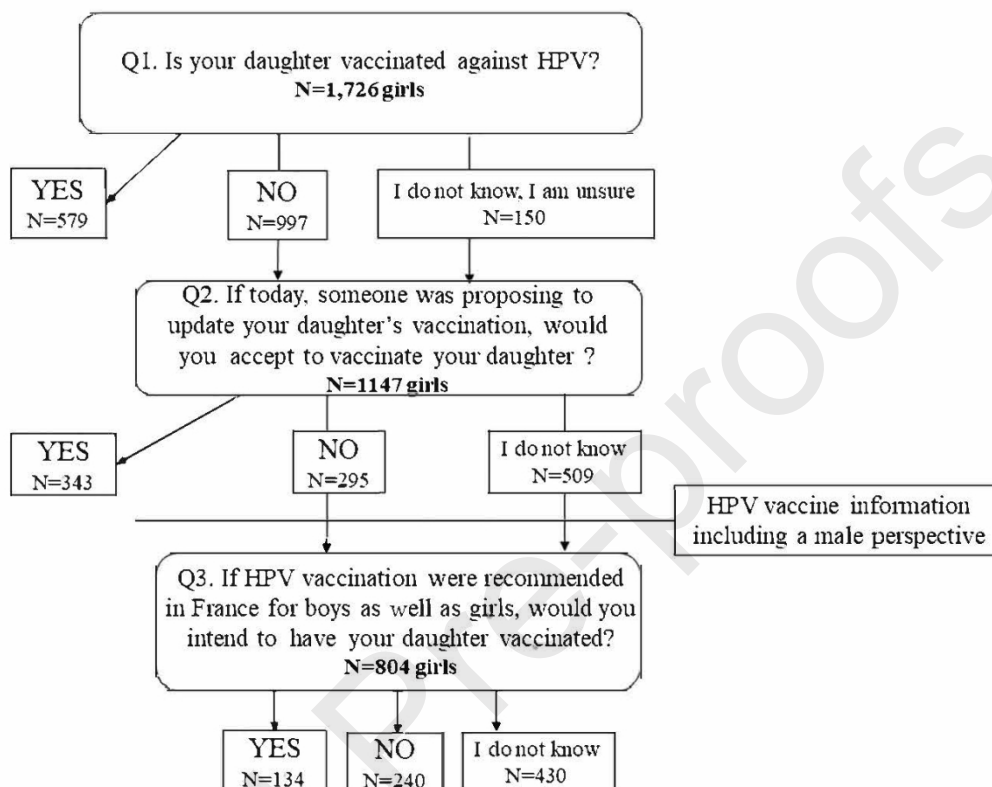


Figure 2. Flow chart for the pre-post comparison of parental HPV vaccine intentions for unvaccinated girls or with unknown status.

Table 1. Characteristics of daughters and responding parents with at least one daughter aged 11-19 years, residing in mainland France.

N (%)

Daughters' characteristics (N=1726)

Age category

11-14 years old	860 (49.8%)
15-19 years old	866 (50.2%)
HPV vaccine status	
vaccinated	579 (33.6%)
unvaccinated	997 (57.8%)
Parent is unsure	150 (8.7%)
Parents' characteristics (N=1424)	
Gender	
Male	463 (32.5%)
Female	961 (67.5%)
Age category	
≤34 years old	48 (3.4%)
35-44 years old	600 (42.1%)
45-49 years old	433 (30.4%)
≥50 years old	343 (24.1%)
Family type	
Two-parent family	1170 (82.2%)
Single-parent family	254 (17.8%)

Gender of children in the household

Only girl(s)	1184 (83.1%)
Girl(s) and boy(s)	240 (16.9%)

Number of children aged below 20 years old

One	401 (28.2%)
Two	679 (47.7%)
Three	263 (18.5%)
Four and more	81 (5.7%)

Number of girls aged 11 - 19 years old

Only one	1146 (80.5%)
At least two	278 (19.5%)

Socioeconomic status of the household's reference person

High	708 (49.7%)
Low	620 (43.5%)
Professionally inactive	96 (6.7%)

Geographical area

Paris area	265 (18.6%)
North-East France	317 (22.3%)

North-West France	341 (23.9%)
South-West France	149 (10.5%)
South-East France	352 (24.7%)
Size of urban area	
Rural areas and small cities	593 (41.6%)
Medium-sized and big cities	600 (42.1%)
Paris area	231 (16.2%)
Attitudes and knowledge of HPV vaccination by responding parent	
HPV vaccine is safe	
Yes	375 (26.3%)
No	306 (21.5%)
I do not know	743 (52.2%)
HPV vaccine is effective	
Yes	592 (41.6%)
No	60 (4.2%)
I do not know	445 (31.3%)
Not enough data to conclude	327 (23.0%)
Knowledge about debates on HPV	

Yes	693 (48.7%)
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No	731 (51.3%)
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Self-assessed level of knowledge on HPV

Well-informed	767 (53.9%)
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Ill-informed	657 (46.1%)
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Knowledge of targets of the HPV vaccination

Cervical cancers	1053 (73.9%)
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Genital cancers (vagina, penis)	394 (27.7%)
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Some anal cancers	90 (6.3%)
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Some mouth and throat cancers	74 (5.2%)
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Genital warts	97 (6.8%)
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Breast cancers	22 (1.5%)
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AIDS	23 (1.6%)
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Genital herpes	108 (7.6%)
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Knowledge score on diseases caused by HPV

Score 1 (very low knowledge)	274 (19.2%)
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Score 2 (average)	842 (59.1%)
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Score 3 (good)	277 (19.5%)
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Score 4 (very good knowledge)	31 (2.2%)
Knowledge of HPV vaccine for boys	
Yes	330 (23.2%)
No	1094 (76.8%)
Opinions on vaccination in general	
In favor of vaccination in general	
In favor	1261 (88.6%)
Not in favor	163 (11.4%)
Negative opinion of specific vaccines	
Influenza vaccine (for elderly)	712 (50.0%)
Human Papillomavirus vaccine	373 (26.2%)
Hepatitis B vaccine	308 (21.6%)
Pneumococcal vaccine	192 (13.5%)
Meningococcal serogroup C vaccine	178 (12.5%)
BCG (tuberculosis) vaccine	120 (8.4%)
Measles-mumps-rubella vaccine	88 (6.2%)
Tetanus-diphtheria-pertussis vaccine	56 (3.9%)

Table 2. Factors associated with HPV vaccination status (N=1726 girls).

	Vaccinated girl (N=579) Pearson's Chi-square test _a		Bivariable multilevel Poisson regressions for vaccinated girl		Multivariable multilevel Poisson regression for vaccinated girl (parsimonious model)	
	Row percentage	Frequency	Poisson RR	Poisson 95% CI	Poisson RR	Poisson 95% CI
Parental characteristics						
Gender of responding parent	***					
Female (ref)	36.7	430	1.00			
Male	26.9	149	0.78*	[0.64,0.95]		
Age category of responding parent						
≤34 years (ref)	32.7	18	1.00			
35-44 years	30.2	225	1.05	[0.61,1.82]		
45-49 years	37.5	198	1.32	[0.75,2.24]		
≥50 years	34.6	138	1.25	[0.71,2.17]		
Family type						

Two-parent family (ref)	33.2	472	1.00	
Single-parent family	35.3	107	1.08	[0.86,1.35]
Gender of children in the household				
Only girls (ref)	33.9	491	1.00	
Girls and boys	31.7	88	0.93	[0.73,1.19]
Number of children aged below 20				
One (ref)	34.4	138	1.00	
Two	34.1	283	0.96	[0.78,1.19]
Three	35.1	129	0.95	[0.73,1.24]
Four and more	22.8	29	0.71	[0.45,1.11]
Socioeconomic status of the household's reference person				
High (ref)	34.0	293	1.00	
Low	33.3	251	0.97	[0.81,1.17]

Inactive persons	31.5	35	0.96	[0.66,1.39]		
Geographical area						
Paris area (ref)	31.2	97	1.00			
Northeast	36.3	137	1.15	[0.87,1.53]		
Northwest	34.5	144	1.11	[0.84,1.46]		
Southwest	34.2	65	1.06	[0.75,1.50]		
Southeast	31.6	136	1.01	[0.76,1.34]		
Size of urban area						
Rural areas and small cities (ref)	31.8	233	1.00			
Medium-sized and big cities	36.1	262	1.09	[0.90,1.33]		
Paris area	31.2	84	0.97	[0.75,1.27]		
Age category of the girl						

11-14 years (ref)	26.9	231	1.00		1.00	
15-19 years	40.2	348	1.50***	[1.30,1.74]	1.48***	[1.28,1.71]

Parental attitudes and knowledge on (HPV) vaccination

HPV vaccine is safe	***					
Yes (ref)	68.0	313	1.00		1.00	
No	11.9	44	0.17***	[0.12,0.24]	0.31***	[0.22,0.45]
I do not know	24.8	222	0.37***	[0.30,0.44]	0.63***	[0.51,0.78]
HPV vaccine is effective	***					
Yes (ref)	55.2	396	1.00		1.00	
No	4.0	3	0.06***	[0.02,0.24]	0.21*	[0.06,0.75]
I do not know	16.6	90	0.30***	[0.24,0.39]	0.52***	[0.39,0.69]
Not enough data to conclude	23.1	90	0.41***	[0.32,0.53]	0.71*	[0.54,0.93]
Knowledge about debates on HPV vaccination	***					
Yes (ref)	39.1	330	1.00			
No	28.3	249	0.73***	[0.61,0.87]		

Declared level of knowledge on HPV	***					
Well-informed (ref)	47.8	446	1.00		1.00	
Ill-informed	16.8	133	0.34***	[0.28,0.42]	0.58***	[0.46,0.74]
Knowledge score on diseases caused by HPV	***					
Score 1 (very low) (ref)	18.5	60	1.00			
Score 2 (average)	37.0	383	1.96***	[1.46,2.63]		
Score 3 (good)	36.3	121	1.97***	[1.41,2.74]		
Score 4 (very good)	45.5	15	2.32**	[1.27,4.23]		
Knowledge of HPV vaccine for boys	***					
Yes (ref)	42.6	172	1.00			
No	30.8	407	0.73**	[0.60,0.89]		
In favor of vaccination in general	***					

In favor (ref)	36.9	565	1.00		1.00	
Not in favor	7.3	14	0.17***	[0.09,0.31]	0.38**	[0.20,0.70]

^a Of note: Regarding 26.9% of girls, the father declared having been vaccinated.

RR: Relative Risk; CI: Confidence interval. *: p-value<0.05; **: p-value<0.01; ***: p-value<0.001.

Table 3. Factors associated with parental HPV vaccine intention in unvaccinated girls or with unknown status (N=1,147 girls).

	Vaccination intention (N= 343)		Multivariable multilevel Poisson regression of vaccination intention (parsimonious model)			
	Pearson's Chi-square test		Bivariable multilevel Poisson regressions of vaccination intention			
	Row percentage	Frequency	Poisson RR	Poisson 95% CI	Poisson RR	Poisson 95% CI
Parental characteristics						
Gender of responding parent	*					
Female (ref)	27.4	203	1.00			
Male	34.6	140	1.31*	[1.04,1.65]		
Age category of responding parent	*					
≤34 years old (ref)	37.8	14	1.00			
old 35-44 years	32.8	170	0.93	[0.53,1.63]		
old 45-49 years	23.3	77	0.67	[0.37,1.21]		
old ≥50 years	31.4	82	0.87	[0.49,1.57]		
Family type	*					

Two-parent family (ref)	31.4	299	1.00	
Single-parent family	22.5	44	0.75	[0.54,1.04]
Gender of children in the household				
Only girls (ref)	30.4	291	1.00	
Girls and boys	27.4	52	0.91	[0.67,1.24]
Number of children aged below 20 years				
One (ref)	26.6	70	1.00	
Two	30.5	167	1.21	[0.91,1.60]
Three	32.2	77	1.23	[0.88,1.73]
Four and more	29.6	29	1.14	[0.70,1.85]
Socioeconomic status of the household's reference person				
High (ref)	31.7	180		
Low	27.4	138	0.86	[0.68,1.09]
Inactive persons	32.9	25	1.01	[0.65,1.57]
Geographical area				

Paris area (ref)	28.0	60	1.00			
Northeast	33.3	80	1.24	[0.88,1.76]		
Northwest	31.5	86	1.11	[0.79,1.58]		
Southwest	28.0	35	0.92	[0.59,1.45]		
Southeast	27.8	82	0.97	[0.68,1.38]		
Size of urban area						
Rural areas and small cities (ref)	27.7	138	1.00			
Medium-sized and big cities	33.5	155	1.21	[0.95,1.55]		
Paris area	27.0	50	0.98	[0.70,1.38]		
Age category of the girl						
11-14 year old (ref)	34.8	219	1.00			
15-19 year old	23.9	124	0.86	[0.72,1.02]		
Parental attitudes and knowledge on (HPV) vaccination						
HPV vaccine is safe						
Yes (ref)	68.0	100	1.00		1.00	
No	8.3	27	0.13***	[0.08,0.20]	0.21***	[0.13,0.34]

I do not know	32.0	216	0.46***	[0.36,0.59]	0.62***	[0.47,0.81]
HPV vaccine is effective	***					
Yes (ref)	50.6	163	1.00		1.00	
No	11.0	8	0.23***	[0.11,0.49]	0.57	[0.27,1.24]
I do not know	29.0	131	0.57***	[0.45,0.73]	0.67**	[0.51,0.88]
Not enough data to conclude	13.7	41	0.26***	[0.18,0.38]	0.39***	[0.27,0.58]
Knowledge of debates on HPV vaccination						
Yes (ref)	28.0	144	1.00			
No	31.5	199	1.09	[0.87,1.37]		
Declared level of knowledge on HPV	**					
Well-informed (ref)	35.3	172	1.00			
Ill-informed	26.0	171	0.72**	[0.57,0.90]		
Knowledge score on diseases caused by HPV						
Score 1 (very low) (ref)	31.7	84	1.00			
Score 2 (average)	29.9	195	1.00	[0.76,1.32]		

Score 3 (good)	28.3	60	0.93	[0.66,1.33]		
Score 4 (very good)	22.2	4	0.71	[0.26,1.95]		
Knowledge of HPV vaccine for boys	**					
Yes (ref)	37.5	87	1.00			
No	28.0	256	0.75*	[0.58,0.97]		
In favor of vaccination in general	***					
In favor (ref)	34.1	330	1.00		1.00	
Not in favor	7.3	13	0.22***	[0.12,0.39]	0.39**	[0.22,0.71]

RR: Relative Risk; CI: Confidence interval. *: p-value<0.05; **: p-value<0.01; ***: p-value<0.001.

Table 4. Gender differences in attitudes and knowledge about HPV and vaccination among parents in France (N=1424).

	Full sample of parents		Parents of unvaccinated girls or with unknown status		Parents of unvaccinated girls or with unknown status, and with no intention to have them vaccinated before receiving the information	
	Men (n=463)	Women (n=961)	Men (n=334)	Women (n=627)	Men (n=213)	Women (n=457)
Opinions and knowledge on HPV vaccination						
HPV vaccine is safe	***		***		***	
Yes	27.0	26.0	16.5	11.3	6.1	5.9
No	14.9	24.7	18.9	33.5	24.9	42.7
I do not know	58.1	49.3	64.7	55.2	69.0	51.4
HPV vaccine is effective	***		***		***	
Yes	40.0	42.4	30.8	27.8	23.5	19.3
No	3.7	4.5	5.1	6.7	5.2	9.0

I do not know	44.1	25.1	50.3	32.1	52.6	32.2
Not enough data to conclude	12.3	28.1	13.8	33.5	18.8	39.6
Knowledge of debates on HPV		***		***		***
Yes	41.3	52.2	36.5	49.4	35.2	51.4
No	58.8	47.8	63.5	50.6	64.8	48.6
Declared level of knowledge on HPV		**		ns		ns
Well-informed	47.5	56.9	39.2	44.7	38.0	40.3
Ill-informed	52.5	43.1	60.8	55.3	62.0	59.7
Knowledge score on diseases caused by HPV		***		***		***
Score 1 (very low)	33.3	12.5	38.9	15.0	39.9	15.1
Score 2 (average)	45.4	65.8	41.3	64.6	42.3	63.0

Score 3 (good)	19.7	19.4	18.3	18.3	16.4	19.5
Score 4 (very good)	1.7	2.4	1.5	2.1	1.4	2.4
Knowledg e of HPV vaccine for boys		ns		ns		ns
Yes	24.0	22.8	21.9	19.5	19.7	17.7
No	76.0	77.2	78.1	80.5	80.3	82.3
Opinion on vaccinatio n in general						
In favor of vaccinatio n in general		ns		ns		ns
In favor	89.0	88.4	86.2	82.9	80.3	78.3
Not in favor	11.0	11.7	13.8	17.1	19.7	21.7
For each girl	Girls n=1,727		Girls n=1,147		Girls n=804	
HPV vaccine status		***		***		***

She is vaccinated	26.9	36.7	0.0	0.0	0.0	0.0
She is not vaccinated	54.9	59.1	75.1	93.4	82.3	95.6
Unsure	18.2	4.2	24.9	6.6	17.7	4.5

Note: Gender differences in parental attitudes and knowledge about HPV vaccination and vaccination in general were assessed using Pearson's Chi-square tests: ns: not significant; *: p-value<0.05; **: p-value<0.01; ***: p-value<0.001.

Table 5. Factors associated with a parental change in HPV vaccine intention after having received HPV information including a male perspective, in a sample of unvaccinated girls or with unknown status (N=804 girls).

	Change to intention	Bivariable multilevel Poisson regressions of change to intention		Multivariable multilevel Poisson regression of change to intention (parsimonious model)	
	Row percentage	Poisson RR	Poisson 95% CI	Poisson RR	Poisson 95% CI
Individual characteristics					
Gender of responding parent					
Female (ref)	11.9	1		1	
Male	26.4	2.11***	[1.47,3.02]	1.74**	[1.20,2.54]
Age category of responding parent					
≤34 years old (ref)	13.0	1			
35-44 years old	16.6	1.34	[0.42,4.29]		
45-49 years old	17.0	1.27	[0.39,4.14]		
≥50 years old	16.8	1.26	[0.38,4.15]		
Family type					
Two-parent family (ref)	16.6	1			

Single-parent family	17.1	1.04	[0.66,1.65]
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Gender of children in the household

Only girls (ref)	18.0	1	
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Girls and boys	10.1	0.58	[0.33,1.03]
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Number of children aged below 20

One (ref)	15.0	1	
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Two	18.7	1.27	[0.81,1.97]
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Three	11.7	0.80	[0.44,1.48]
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Four and more	21.7	1.47	[0.73,2.96]
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Socioeconomic status of the household's reference person

High (ref)	19.1	1	
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Low	14.8	0.77	[0.53,1.13]
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Inactive persons	11.8	0.67	[0.29,1.55]
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Geographical area

Paris area (ref)	19.5	1	
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Northeast	13.8	0.66	[0.36,1.19]
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Northwest	17.1	0.84	[0.50,1.43]		
Southwest	21.1	1.07	[0.58,1.95]		
Southeast	14.6	0.74	[0.44,1.26]		
Size of urban area					
Rural areas and small cities (ref)	15.0	1			
Medium-sized and big cities	17.5	1.23	[0.82,1.85]		
Paris area	19.3	1.39	[0.85,2.28]		
Age category of the girl					
11-14 years old (ref)	19.8	1		1	
15-19 years old	13.5	0.74*	[0.56,0.98]	0.76*	[0.58,0.99]
Parental attitudes and knowledge on (HPV) vaccination					
HPV vaccine is safe					
Yes (ref)	36.2	1		1	
No	6.7	0.18***	[0.09,0.35]	0.30***	[0.15,0.61]
I do not know	21.1	0.55*	[0.32,0.94]	0.60	[0.34,1.06]
HPV vaccine is effective					

Yes (ref)	24.5	1		1	
No	6.2	0.23*	[0.07,0.74]	0.54	[0.16,1.80]
I do not know	20.9	0.84	[0.55,1.27]	0.84	[0.53,1.31]
Not enough data to conclude	9.3	0.36***	[0.21,0.62]	0.52*	[0.29,0.91]
Knowledge of debates on HPV vaccination					
Yes (ref)	12.9	1			
No	19.9	1.50*	[1.03,2.19]		
Declared level of knowledge on HPV					
Well-informed (ref)	15.2	1			
Ill-informed	17.6	1.03	[0.71,1.49]		
Knowledge score on diseases caused by HPV					
Score 1 (very low) (ref)	21.6	1			
Score 2 (average)	13.6	0.55**	[0.36,0.84]		
Score 3 (good)	19.7	0.79	[0.47,1.30]		
Score 4 (very good)	21.4	0.90	[0.28,2.91]		

Knowledge of HPV
vaccine for boys

Yes (ref)	18.6	1	
No	16.2	0.96	[0.60,1.52]

In favor of vaccination
in general

In favor (ref)	20.2	1		1	
Not in favor	3.0	0.14***	[0.05,0.37]	0.19**	[0.07,0.52]

RR: Relative Risk; CI: Confidence interval. *: p-value<0.05; **: p-value<0.01; ***: p-value<0.001.