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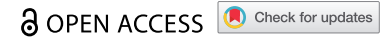
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RESEARCH ARTICLE



## Sociodemographic determinants of HPV vaccine awareness, uptake, and intention among parents of adolescents in France 2021-22

Alexia F. Rivera<sup>a</sup>, Josée M. Dussault<sup>b</sup>, Damien Oudin Doglioni<sup>b,c</sup>, Sandra Chyderiotis<sup>b</sup>, Jonathan Sicsic<sup>d</sup>, Anne-Sophie Barret<sup>e</sup>, Jocelyn Raude<sup>a,f</sup>, Aurélie Gauchet<sup>g</sup>, Amandine Gagneux-Brunon<sup>h,i,j</sup>, Sébastien Bruel<sup>k,l</sup>, Morgane Michel<sup>m,n</sup>, Anne-Sophie Le Duc-Banaszuk<sup>o</sup>, Nathalie Thilly<sup>p,q</sup>, and Judith E. Mueller<sup>a,b,f</sup>

<sup>a</sup>EHESP French School of Public Health, Paris, France; <sup>b</sup>Emerging Disease Epidemiology Unit, Institut Pasteur, Université Paris Cité, Paris, France; <sup>c</sup>Univ. Grenoble Alpes, Univ. Savoie Mont-Blanc, Grenoble, France; <sup>d</sup>Université Paris Cité, Paris, France; <sup>e</sup>Santé Publique France, Saint Maurice, France; <sup>f</sup>CNRS, EHESP, Univ. Rennes, Rennes, France; <sup>g</sup>Univ. Savoie Mont Blanc, Univ. Grenoble Alpes, Grenoble, France; <sup>h</sup>CHU de Saint-Etienne – Service d'infectiologie, Saint-Etienne, France; <sup>i</sup>Centre International de Recherche en Infectiologie, Team GIMAP, Université de Lyon, Lyon, France; <sup>j</sup>CNRS, Université Jean Monnet, Université Claude Bernard Lyon 1, Lyon, France; <sup>k</sup>Department of General Practice, Faculté de Médecine Jacques Lisfranc, Université Jean Monnet, Université de Lyon, Saint-Etienne, France; <sup>l</sup>CIC-INSERM 1408, CHU de Saint-Etienne, Saint-Etienne, France; <sup>m</sup>ECEVE, Université Paris Cité, Paris, France; <sup>n</sup>Publique-Hôpitaux de Paris, Hôpital Robert Debré, Unité d'épidémiologie clinique, Paris, France; <sup>o</sup>Centre Régional de Coordination des Dépistages des cancers-Pays de la Loire, Angers, France; <sup>p</sup>Université de Lorraine, Nancy, France; <sup>q</sup>CHRU-Nancy, Département Méthodologie, Promotion, Investigation, Université de Lorraine, Nancy, France

### ABSTRACT

Human Papillomavirus (HPV) vaccine coverage was <50% in France in 2022 and even lower among socially disadvantaged populations. We aimed to evaluate socio-demographic determinants of HPV vaccine awareness, uptake, and intention among parents of adolescents, and related attitudes and knowledge items. Parents of adolescents attending middle schools across France, who participated in a randomized trial responded to an anonymous baseline survey, conducted between November 2021 and February 2022. We used logistic regression models adjusting for a child's age and sex to explore sociodemographic determinants (including at-home multilingualism, occupational categories, local deprivation index and urbanity) of HPV vaccine awareness, uptake, and intention. Among the 1889 participants from 61 schools, parents working as factory workers/farmers had significantly lower odds of vaccine awareness compared to executives/professionals, both if they reported (OR = 0.07; 0.03–0.15) or not (OR = 0.20; 0.11–0.36) speaking also another language than French at home. Parents in lower occupational categories with multilingual families were less likely to have the intention to vaccinate their child (OR = 0.19; 0.07–0.56). Recent physician visit or vaccine offer was strong positive determinants of awareness, uptake and intention. A substantial gradient across occupational categories was observed for attitudes and knowledge around HPV vaccine usefulness, safety, and accessibility. This study confirms the disparities on HPV vaccine uptake in France and provides insight into mechanisms of social disparities in HPV vaccine awareness, access and intention.

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HPV; human papillomavirus vaccine; awareness; uptake; intention; social determinants; parents; adolescent vaccination

## Introduction

History of Human Papillomavirus (HPV) infection, including those with oncogenic genotypes, is quasi systematic among adults of both sexes worldwide.<sup>1</sup> Persistent infection can lead to HPV-related cancers of the ano-genital and the head and neck spheres. Vaccination is highly effective in preventing HPV infection and related cancers,<sup>1-3</sup> and modeling studies suggest that a vaccine coverage of at least 60% among female and male adolescents could ultimately eliminate cervical cancer.<sup>4</sup> Since the first approved HPV vaccine in 2006,<sup>2</sup> most high-income countries have implemented HPV vaccination in their vaccination schedules for adolescents.<sup>5,6</sup> Despite national and international health authorities' efforts to improve HPV vaccine uptake,<sup>5,7,8</sup> complete HPV vaccination coverage remains suboptimal in many European countries,<sup>5,6</sup> especially in France.<sup>6,9-13</sup>

Since 2007, HPV vaccination has been a part of the French vaccination calendar for girls aged 11–14 years with a catch-up possible up to age 19, and 65% of its cost is covered by the French national health insurance.<sup>13,14</sup> Since 2021, the French vaccine schedule has also included HPV vaccination for boys.<sup>14</sup> Nevertheless, by the end of 2021, coverage of the first dose among 15-year-old girls was 45.8%, and 6.6% among 15-year-old boys,<sup>15</sup> well below the national objective of 80%.<sup>16</sup> In addition, studies have shown social inequalities in HPV vaccination at both ecological and individual level, related to parental education, income levels and local deprivation.<sup>9-11</sup> Also, lack of standard or complementary health insurance was associated with lower HPV vaccination rates among girls and lower uptake of cervical screening among French women.<sup>10</sup>

Such multiple inequalities regarding HPV immunization among young girls and their parents have been documented

**CONTACT** Judith E. Mueller ✉ [Judith.mueller@ehesp.fr](mailto:Judith.mueller@ehesp.fr) Emerging Disease Epidemiology Unit, Institut Pasteur, 25-28 rue du Dr Roux, Paris Cedex 75724, France.  
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in many countries. These inequalities arise from several factors including age, household income, parents' educational level, cultural beliefs, vaccination status for other vaccines, access to healthcare, health insurance coverage, as well as the engagement of mothers in gynecological consultations and screening.<sup>17–20</sup> Parents play a significant role in their child's vaccination, and differences in parental awareness and intention likely contribute to social disparities in vaccine uptake.<sup>11,17,21,22</sup> Consequently, young girls and women from underprivileged backgrounds have an increased risk of not benefiting from either of the two cervical cancer prevention measures throughout their lifetime.

However, it is not established whether social inequalities in HPV vaccination occur through social gradients in access to information and offer, access to vaccination or acceptability. We therefore aimed to evaluate, among parents of adolescents enrolled in middle school in France, sociodemographic determinants of awareness of HPV vaccine, uptake given awareness and intention for future vaccination. We also evaluated the contribution of general practitioner contact to hypothetical inequalities; and described the sociodemographic gradients of HPV-vaccine-related knowledge and attitude. This data collection occurred approximately two years before the announcement of a national policy for school-based HPV vaccination campaigns for 11-year-old children.

## Methodology

### Study design and data collection

The present study is a cross-sectional analysis of baseline data (T0) from the PrevHPV project, a cluster-randomized controlled trial that aimed to evaluate the impact of a multicomponent intervention on HPV vaccine uptake among French adolescents. The unit of randomization was the municipality. The intervention components consisted of school-based information and education, school-based vaccine campaigns, and training of general practitioners in the municipality. The primary outcome consisted of vaccination coverage as assessed through administrative and trial data. Questionnaires were distributed to adolescents and their parents before and after the intervention to assess the effect of the intervention on HPV vaccine knowledge, attitudes and behaviors, including self-declared vaccine status and intentions (secondary outcomes). Details of the trial protocol have been published elsewhere.<sup>23</sup> The French Ethics Committee “CPP Sud-Est VI” approved the PrevHPV trial protocol on December 22, 2020 (ID-RCB: 2020-A02031-38), which is registered in ClinicalTrials.gov (NCT04945655).

Middle-schools located in randomized municipalities sent invitations via the electronic school platform to all parents of attending pupils (typically aged 10–14 years). Of the 91 middle schools, 61 effectively sent out invitations for baseline data collection. The groups of participating and not participating schools in randomized municipalities showed comparable proportions of private institutions and mean local deprivation indices.

The invitation contained study information and a link to the online questionnaire published on the REDcap platform

from November 22, 2021 to February 8, 2022. The questionnaire was anonymous and self-administered. The study notice informed parents of their right to choose not to participate and indicated that starting the questionnaire corresponded to consent to participate. Participants had to enter an anonymized identifier, obtained via the liaison notebook of their child, which allowed us in the present analysis to link the observations to school level variables.

Parents were invited to answer the questions regarding their oldest child attending middle school. The questionnaire (Supplementary Table S1) gathered information on sociodemographic characteristics of participants, HPV vaccine awareness, child vaccine status and intention to vaccinate against HPV, along with information on attitudes to vaccination in general, recent general practitioner (GP) visits and HPV vaccine offer by the GP. Additionally, on a 5-point Likert scale, we collected information on parents' HPV vaccine-related attitudes and knowledge in relation to the 7C-psychological antecedents of vaccination, as previously reported.<sup>24</sup> Knowledge about diseases related to HPV infections was evaluated by a multiple-choice question.

The questionnaire was developed in early 2020 to capture intervention effects on 1) vaccine awareness, uptake and intention, 2) and knowledge, attitudes and practice (KAP); and 3) to explore hypothesized interactions for effectiveness. For 1 and 3, we used items that are commonly used in evaluation of vaccine programs. For 2), we crossed the principal of KAP surveys with the 7C model, to capture a large panel of aspects that could be impacted by PrevHPV interventions. No validated instrument exists for this approach, but the present baseline data were used to validate the principal of the extension from a 5C to a 7C model to explain variations of vaccine readiness.<sup>24</sup>

### Sociodemographic determinants of vaccine awareness, uptake and intention

We defined three outcomes: parental vaccine awareness, child's vaccine uptake among parents who were aware, and parental vaccine intention among aware parents with unvaccinated children. HPV vaccine awareness was defined as declaring having heard about HPV vaccine (binary aware/not aware). Among parents who were aware of the HPV vaccine (or who were not sure whether they had heard about it), vaccine uptake of the child was defined as a binary variable: vaccinated, irrespective of the number of doses, or unvaccinated. The latter group included parents who were not sure about their child's HPV vaccine status. Among this unvaccinated group, intention to vaccinate was categorized as a three-level variable: vaccine refusal, indecision, and intention.

Explanatory variables included sociodemographic characteristics of the responding parents such as their gender, age, language, occupation, living environment, the school area's deprivation level, and their child's sex and age. The parent's age was classified as an ordinal categorical variable which was defined by specific age ranges: less than 35 years, between 35 and 44 years, more than 45 years old. If the parent reported also speaking a language other than French fluently with their child at home, they were identified as

multilingual (vs. monolingual). Parental occupation was categorized into five distinct groups for analysis purposes; 1) farmers/small business owners, 2) executives/professionals, 3) technicians and service workers, 4) factory workers, and 5) inactive, which included unemployed persons, students, apprentices, and others not falling into the previous categories (Supplementary Tables S2-S4). As categories 1, 4 and 5 showed generally comparable effect sizes, they were combined into one group in multivariable models to increase the group sample size. We also combined occupation and multilingualism in multivariable models, based on the hypothesis that at-home multilingualism and occupation (which is a proxy for educational attainment and economic situation) have a joint effect on vaccine awareness, uptake and intention.

Local deprivation index was derived from the French Deprivation Index (FDep) for the given municipality where the parent's child attended school.<sup>25</sup> This deprivation index is based on the median household income, the percentage of high-school graduates in the population aged 15 and older, the percentage of blue-collar workers in the working population, and the unemployment rate. The municipalities of the schools participating at baseline had an index spanning from -2.2 to 2.2. In France, municipality FDep can exceed values of -3 and 3, while the first and fifth quintiles are delimited by values of -1.22 and 1.36, respectively. Using the approach used in the previous analysis on adolescent data,<sup>26</sup> we categorized the index into four groups of comparable ranges: low (FDep  $\leq$  -1); moderate low (-1 < FDep  $\leq$  0); moderate high (0 < FDep  $\leq$  1); and high (FDep > 1). Compared to national quintiles, these cutoffs increased the sample size in the four classes and in particular in the extreme categories. The child's current grade level in the French nomenclature ranged from 6<sup>th</sup> (typically 10–11 years) to 3<sup>rd</sup> (typically 13–14 years).

We built logistic regression models for each outcome. Explanatory variables associated with the outcome in bivariable models at  $p < .20$  were subsequently included in a full multivariable model, but forced parental age and gender into the model. Given that vaccine intention was a three-level categorical variable, this outcome was regressed using multinomial logistic regression, with vaccine refusal as the reference category. We also explored whether GP visits during the last 12 months (visit, unsure or no visit) or having ever received an HPV vaccine offer for the child by the GP (offer, unsure or no offer) mediated associations between sociodemographic determinants and the three outcomes of interest, by adding GP variables to the model and observing the change in the main effect. For this, we included these variables in the full multivariable models of sociodemographic determinants, if they had been associated with outcomes at  $p < .20$  in bivariate models.

In additional analyses, we explored interactions between child's sex and socio-demographic determinants by adding interaction terms in the models. Given the limited sample size, we could not conduct interaction analyses to explore mitigation of sociodemographic inequalities by GP visits, as previously done for adolescent data.<sup>27</sup> Given the limited sample size and the large number of participating schools, analyses did not account for design effect clustering around schools. We conducted a sensitivity analysis accounting for the fact that

parents were recruited in clusters around schools (STATA *svy* command).

All analyses were performed using the Stata software, version 17.<sup>28</sup> A P-value  $< .05$  was considered statistically significant.

### **Description of sociodemographic gradients in attitudes and knowledge**

To offer an additional lens into the sociodemographic gradient of HPV vaccine accessibility and acceptability in France, we represented parents' attitudes and knowledge around HPV vaccination by categories of sociodemographic characteristics. We reduced the attitude items that were evaluated by the 7C questionnaire on a 5-point Likert scale to three categories (unfavorable, undecided and favorable attitude). Data were presented as the proportion of parents in each category who provided a correct/favorable, incorrect/unfavorable, and unsure/undecided answer. We tested differences between specific population groups using Chi-square tests.

## **Results**

### **Participant characteristics and outcomes**

A total of 2,008 connections with questionnaire completion were observed. After excluding 46 and 27 questionnaires with invalid or duplicate anonymized identifier, respectively, and 46 with missing data on individual characteristics or vaccine awareness, the final study sample included 1,889 parents (Supplementary Figure S1). Of these, 1,675 (89%) had heard about the HPV vaccine and 47 (3% were not sure) (Figure 1). Among 1703 parents aware of the HPV vaccine or not sure, 641 (38%) had vaccinated their child against HPV, while 1,050 (61%) had not and 12 (1%) were not sure. Of 1,049 parents who had an unvaccinated child or were not sure, 582 (56%) had the intention to vaccinate the child.

Participants were mostly mothers (91%), French monolingual (90%), and between 35 and 44 years old (61%) (Table 1). Most respondents worked as technicians/service workers (54%) or executives/professionals (22%). Sixty-six percent of respondents lived in urban zones, 12% had their child enrolled in a school located in a low-deprivation area and 15% in a high deprivation area. Responding parents were slightly more likely to have daughters (54%), with fairly balanced distribution across the four grade levels. Most participants (89%) declared having a favorable opinion on vaccination in general. One third (33.6%) of participants declared having an unfavorable opinion against at least one vaccine and 30 (1.5%) against all vaccines (data not shown). The vaccines against which unfavorable opinions were most often reported were those against COVID-19 (in particular for children), hepatitis B and rotavirus.

Eighty-eight percent of parents declared a recent consultation with the child's physician, but only 54% that they already had received an HPV vaccine offer from a physician (55% of mothers and 43% of father). Parents declared that their child was vaccinated against HPV for 47% of the daughters and 20% of the sons.



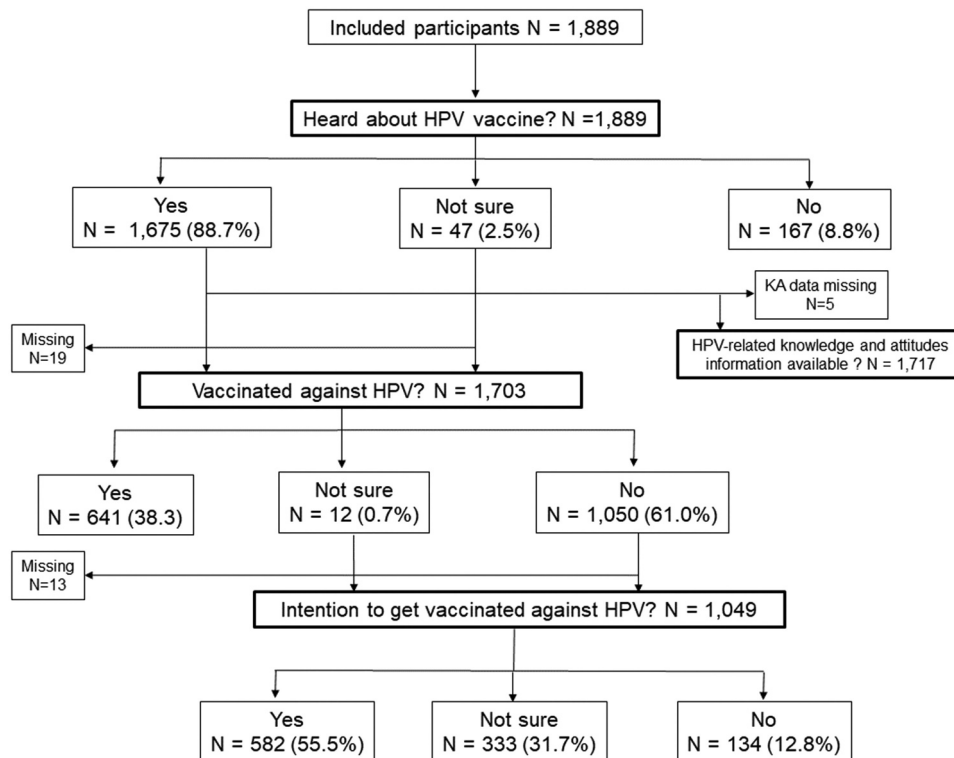


Figure 1. HPV-related outcomes among included parents of adolescents in France, 2021–2022 ( $N = 1,889$ ).

### Sociodemographic determinants of vaccine awareness, uptake and intention

We found several sociodemographic determinants of HPV vaccine awareness, uptake and intention. The results of bivariate analyses are shown in the tables Supplementary Table S2–S4.

#### Vaccine awareness

In multivariable analyses, HPV vaccine awareness was strongly associated with occupational category, in particular in combination with multilingualism (Table 2, Supplementary Figure S2). For example, relative to French monolingual executives/professionals, French monolingual parents in occupations like farmers and small business owners, factory workers, and inactive persons were five times less likely to have heard of the vaccine (OR 0.20 [95%CI 0.11–0.36]), while multilingual participants in these occupations were 10 times less likely (OR 0.07 [0.03–0.15]) to have heard of the vaccine. Mothers, older parents and parents of girls tended to be more likely to have heard about the HPV vaccine (e.g., father vs mother, OR 0.28 [0.19–0.43]).

A visit with the child's GP during the last 12 months did not mediate any association of sociodemographic factors with awareness, but was itself associated with HPV vaccine awareness (no visit vs. visit, OR 0.33 [0.22–0.49]) (Supplementary Table S5).

#### Vaccine uptake

In multivariable analyses among parents who were aware of the HPV vaccine, reporting that the child's vaccination was associated with the child's sex (female vs male, OR 4.19 [3.33–

5.25]) and the grade level (3rd vs 6th, OR 3.90 [2.82–5.41]). A general trend to lower vaccine uptake was visible for parents reporting lower occupational categories and for higher local deprivation, while significant effects appeared only for French monolingual factory workers/inactive parents (vs. executives/professionals, OR 0.66 [0.49–0.94]) and moderate-low local deprivation index (vs low, OR 0.54 [0.38–0.77]) (Table 2, Supplementary Figure S3). GP visit and HPV vaccine offer explained only some of the difference by child's sex, but were strongly associated with HPV vaccine uptake (e.g., no offer vs offer, OR 0.06 [0.04–0.08]) (Supplementary Table S6).

#### Vaccine intention

In multinomial analysis among parents of unvaccinated children who had heard about the HPV vaccine, relative to French monolingual executives/professionals, French monolingual parents reporting occupations as farmers, small business owners, factory workers, or no activity were half as likely to intend vaccination (OR 0.49 [0.26–0.93]), while multilingual members of this occupational category were five times less likely (OR 0.19 [0.07–0.56]) (Table 2, Supplementary Figure S4). Occupational category was not associated with indecision to vaccinate vs refusal. In addition, both indecision and intention to vaccinate (vs. refusing vaccination) were associated with female sex and older age of the child (odds ratios around 2).

Neither recent GP visit nor HPV vaccine offer mediated associations between occupation, multilingualism or child characteristics, and vaccine intention. However, lack of vaccine offer was strongly negatively associated with intention or

**Table 1.** Participant characteristics, overall and stratified by gender, among included parents of adolescents in France, 2021–2022 ( $N = 1,889$ ).

Characteristics	Total ( $N = 1,889$ )	Mothers ( $N = 1,713$ )	Fathers ( $N = 176$ )
	N (%)	N (%)	N (%)
<b>Age</b>			
Less than 35 years	100 (5.3)	88 (5.1)	12 (6.8)
Between 35 and 44 years	1,154 (61.1)	1,075 (62.8)	79 (44.9)
More than 45 years	635 (33.6)	550 (32.1)	85 (48.3)
<b>Occupation</b>			
Farmers/small business owners	88 (4.7)	81 (4.7)	7 (4.0)
Executives and professionals	413 (21.9)	345 (20.1)	68 (38.6)
Technicians/service workers	1,022 (54.1)	963 (56.2)	59 (33.5)
Factory workers	68 (3.6)	49 (2.9)	19 (10.8)
Inactive/others	298 (15.8)	275 (16.1)	23 (13.1)
<b>Language</b>			
Multilingual	182 (9.6)	152 (8.9)	30 (17.1)
French monolingual	1,707 (90.4)	1,561 (91.1)	146 (82.9)
<b>Living Environment</b>			
Urban	1,248 (66.1)	1,117 (65.2)	131 (74.4)
Peri-urban	215 (11.4)	199 (11.6)	16 (9.1)
Rural	426 (22.5)	397 (23.2)	29 (16.5)
<b>Local deprivation index</b>			
Low	237 (12.0)	207 (12.1)	30 (17.1)
Moderate low	680 (36.0)	608 (35.5)	72 (40.9)
Moderate high	699 (37.0)	646 (37.7)	53 (30.1)
High	273 (14.5)	252 (14.7)	21 (11.9)
<b>Child's sex</b>			
Female	1,010 (53.5)	925 (54.0)	85 (48.3)
Male	879 (46.5)	788 (46.0)	91 (51.7)
<b>Child's grade level (typical age)</b>			
6 <sup>th</sup> (10–11 years)	444 (23.5)	395 (23.1)	49 (27.8)
5 <sup>th</sup> (11–12 years)	426 (22.6)	398 (23.2)	28 (15.9)
4 <sup>th</sup> (12–13 years)	569 (30.1)	524 (30.6)	45 (25.6)
3 <sup>rd</sup> (13–14 years)	450 (23.8)	396 (23.1)	54 (30.7)
<b>Attitude toward vaccination in general</b>			
Favorable	1679 (88.9)	1520 (88.7)	159 (90.3)
Undecided	138 (7.3)	129 (7.5)	9 (5.1)
Unfavorable	72 (3.8)	64 (3.7)	8 (4.5)
<b>Recent physician visit*</b>			
Yes	1,638 (87.6)	1,488 (87.6)	150 (87.7)
Unsure	35 (1.9)	33 (1.9)	2 (1.2)
No	197 (10.5)	178 (10.5)	19 (11.1)
<b>HPV vaccine offer by a physician (among all participants*, **)</b>			
Yes	1,002 (53.6)	929 (54.7)	73 (42.7)
Unsure	33 (1.8)	19 (1.1)	14 (8.2)
<b>Declared child vaccinated against HPV (at least one dose, among all participant**)</b>			
Female child	473/1,010 (46.8)	434/925 (47.0)	39/85 (45.9)
Male child	171/879 (19.5)	160/788 (20.3)	11/91 (12.1)

\*The number of participants responding to this last section of the questionnaire is  $N = 1870$  (1699 mothers, 171 fathers), of whom  $N = 1862$  participants were aware of HPV vaccination).

\*\*This percentage is calculated with regard to all participants who participated in the section of the questionnaire, ie, including in the denominator those who declared not having heard of HPV vaccination.

indecision to vaccinate (intention vs no intention, OR 0.13 [0.07–0.23]) (Supplementary Tables S7 and S8).

Interaction analyses did not show any significant interaction between child's sex and socio-demographic determinants. Sensitivity analyses accounting for design effect by clustering around schools showed minimally wider confidence intervals, however, within impact on statistical conclusions (Supplementary Table S9).

### Sociodemographic gradients in attitudes and knowledge

Attitude and knowledge items among the 1735 parents who were aware of the HPV vaccine or not sure and who had answered these questions varied across the gender and age of the parent, child's sex, and local deprivation index (Supplementary Figures S5–S9 a-b). The strongest gradients

were observed for both attitudes and knowledge across parents' occupational categories (Figure 2a,b), and the weakest between mono- and multilingual parents (Supplementary Figure S6 a-b). In general, the gradient occurred through the increasing frequency of the “undecided” category from executives/professionals to technicians/service workers and farmers/small business owners, to inactive persons and factory workers. For attitude items, parents who worked as factory workers had the lowest and executives/professionals the highest proportion of favorable attitudes toward HPV vaccine safety (59% and 82%, respectively; Chi-square  $p < .001$ ), while unfavorable attitudes spanned from 40% to 15%, respectively. Similar variations were observed for perceptions around the ease of getting the child vaccinated against HPV, usefulness and benefit-risk balance of HPV vaccination (all:  $p < .001$ ) (Figure 2a).

**Table 2.** Sociodemographic determinants of HPV vaccine awareness, uptake, and intention among parents of adolescents in France, 2021–22. (N = 1,889).

	HPV vaccine awareness N = 1,889		Vaccine uptake (among aware parents) N = 1,703		Intention (among unvaccinated) N = 1,049			
	Heard vs Not heard		Vaccinated vs Unvaccinated		Indecision vs Refusal		Intention vs Refusal	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<b>Gender</b>								
Mothers	1		1		1		1	
Fathers	<b>0.28</b>	(0.19–0.43)	0.90	(0.60–1.36)	0.72	(0.33–1.56)	1.19	(0.59–2.40)
<b>Age</b>								
Less than 35 years	1		1		1		1	
Between 35 and 44 years	<b>2.01</b>	(1.18–3.42)	1.37	(0.79–2.40)	0.92	(0.35–2.38)	0.88	(0.36–2.14)
45 years or older	<b>2.14</b>	(1.22–3.77)	1.64	(0.92–2.91)	0.94	(0.35–2.52)	0.68	(0.27–1.72)
<b>Language/Occupation</b>								
French monolingual, Executives, and professionals	1		1		1		1	
French monolingual, Technicians, and service workers	<b>0.44</b>	(0.25–0.79)	0.83	(0.62–1.09)	1.07	(0.59–1.97)	0.75	(0.42–1.31)
French monolingual, Farmers and small business owners, Factory workers, and Inactive	<b>0.20</b>	(0.11–0.36)	<b>0.66</b>	(0.49–0.94)	0.66	(0.33–1.32)	<b>0.49</b>	(0.26–0.93)
Multilingual, Executives and professionals	0.45	(0.16–1.26)	0.90	(0.45–1.78)	1.70	(0.32–8.92)	1.34	(0.28–6.51)
Multilingual, Technicians and service workers	<b>0.19</b>	(0.09–0.42)	0.78	(0.42–1.45)	2.18	(0.56–8.44)	1.23	(0.33–4.56)
Multilingual, Farmers and small business owners, Factory workers, and Inactive (others)	<b>0.07</b>	(0.03–0.15)	0.52	(0.23–1.15)	0.38	(0.13–1.14)	<b>0.19</b>	(0.07–0.56)
<b>Local deprivation index</b>								
Low	1		1		1		1	
Moderate-low	0.89	(0.52–1.54)	<b>0.54</b>	(0.38–0.77)	1.15	(0.53–2.51)	0.64	(0.32–1.30)
Moderate-high	0.85	(0.49–1.46)	0.71	(0.50–1.00)	1.47	(0.65–3.3)	1.27	(0.61–2.66)
High	0.61	(0.33–1.11)	0.67	(0.44–1.02)	1.37	(0.57–3.25)	0.47	(0.21–1.06)
<b>Child's sex</b>								
Female	<b>2.16</b>	(1.58–2.93)	<b>4.19</b>	(3.33–5.25)	<b>1.64</b>	(1.05–2.58)	<b>2.80</b>	(1.83–4.29)
Male	1		1		1		1	
<b>Child's grade level and typical age</b>								
6th (10–11 yrs)	1		1		1		1	
5th (11–12 yrs)	1.39	(0.90–2.15)	1.33	(0.96–1.85)	1.28	(0.74–2.24)	<b>1.93</b>	(1.16–3.21)
4th (12–13 yrs)	1.50	(0.99–2.28)	<b>2.06</b>	(1.52–2.80)	<b>3.21</b>	(1.82–5.66)	<b>2.56</b>	(1.48–4.42)
3rd (13–14 yrs)	1.13	(0.74–1.72)	<b>3.90</b>	(2.82–5.41)	<b>2.15</b>	(1.16–4.00)	<b>1.94</b>	(1.07–3.52)

Results obtained from multivariable logistic regression models. OR (95%–CI), odds ratio and 95% confidence interval.

Distribution of attitude (a) and knowledge (b) items regarding HPV vaccination among parents who have heard about HPV vaccination or are not sure, by occupation. France, 2021–22 (N = 1,717). \* = p-value <0.05; \*\* = p-value <0.01; Chi-square test on prevalences across the categories

We also found substantial differences in parents' knowledge by occupational group (Figures 2b and 3). For knowledge, correct answers about HPV vaccine recommendation targeting both sexes were given by 61% of factory workers compared to 87% of executives/professionals (p-value <.001). We observed particularly strong gradients for knowledge about HPV vaccine having more benefits than risks for persons of both sexes, varying between 34% correct responses among factory workers and 75% among executives/professionals (p-value <.001); and the potential of elimination of HPV-related cancers given high vaccine coverage (12% vs 52%, p-value <.001). Knowledge about vaccine coverage > 80% in neighboring countries was rare (<20%) in all occupational categories. Most (90%) parents could correctly identify at least one HPV-related disease (Figures 2b and 3). Inactive persons and factory workers were overrepresented among persons attributing HIV/AIDS to HPV infection, or who said they did not know which disease was related to HPV.

## Discussion

In this cross-sectional study among parents of middle school pupils in France, we found social inequalities in HPV vaccine awareness, uptake and intention, with particularly poor outcomes among multilingual parents belonging to occupational categories with lower educational attainment or lower income. Increasing local deprivation was associated with decreasing vaccine awareness, while vaccine uptake was particularly high in the lowest deprivation group. Differences in GP consultation and HPV vaccine offer were important determinants of the evaluated outcomes, but did not contribute to the observed inequalities. Among parents aware of the vaccine, those belonging to occupational categories with lower educational levels and whose child's school was in higher deprivation areas reported substantially less frequently favorable and more frequently undecided attitudes toward the HPV vaccine's safety, usefulness and accessibility.

An examination of the social determinants of health is essential to understand HPV vaccine acceptance and uptake among parents of adolescents. A previous research has emphasized the crucial role of parents in HPV vaccination decision-making in France,<sup>29</sup> which is influenced by their knowledge and beliefs. Our study reveals that most parents had some basic knowledge about HPV-related diseases and vaccination.

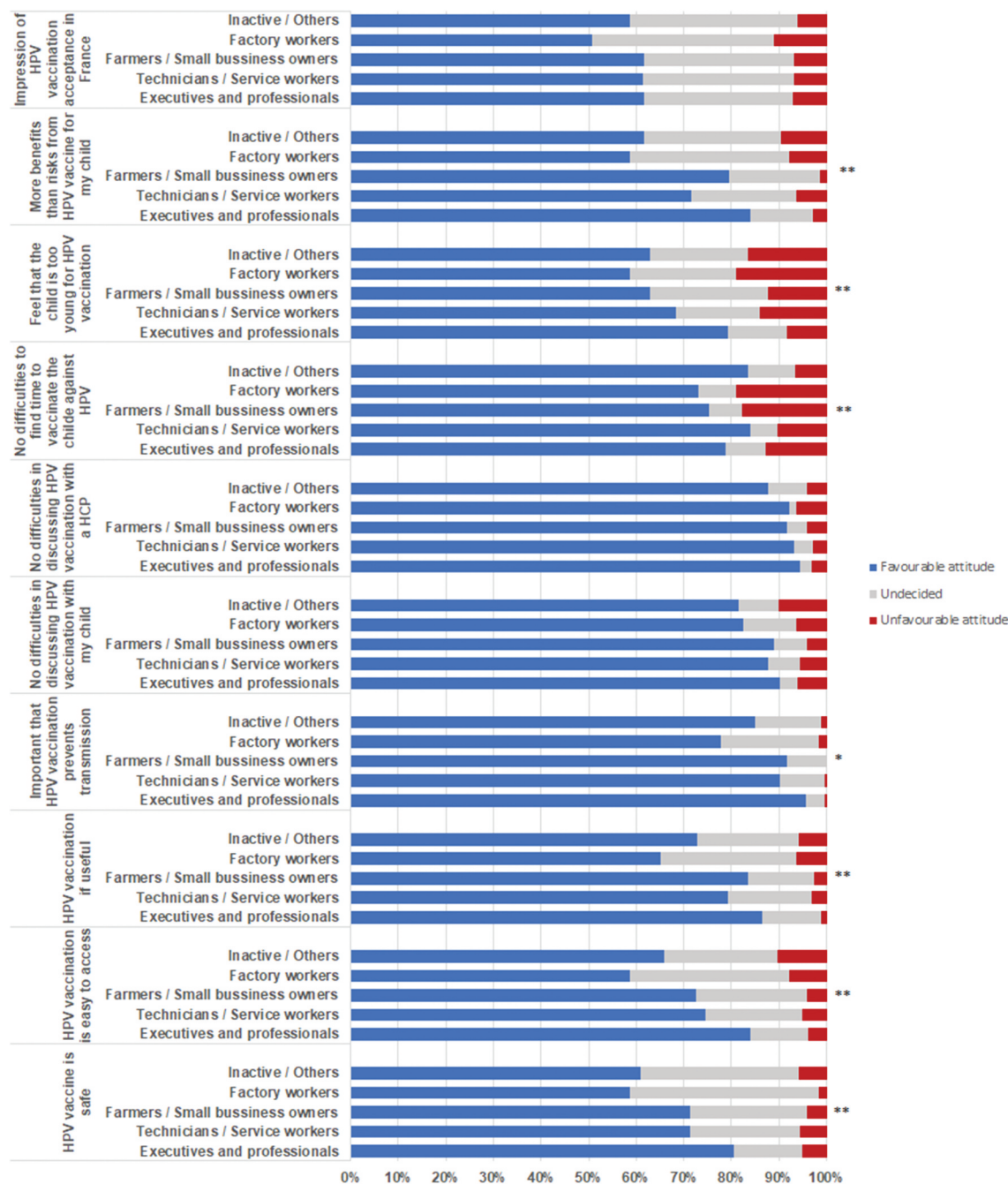
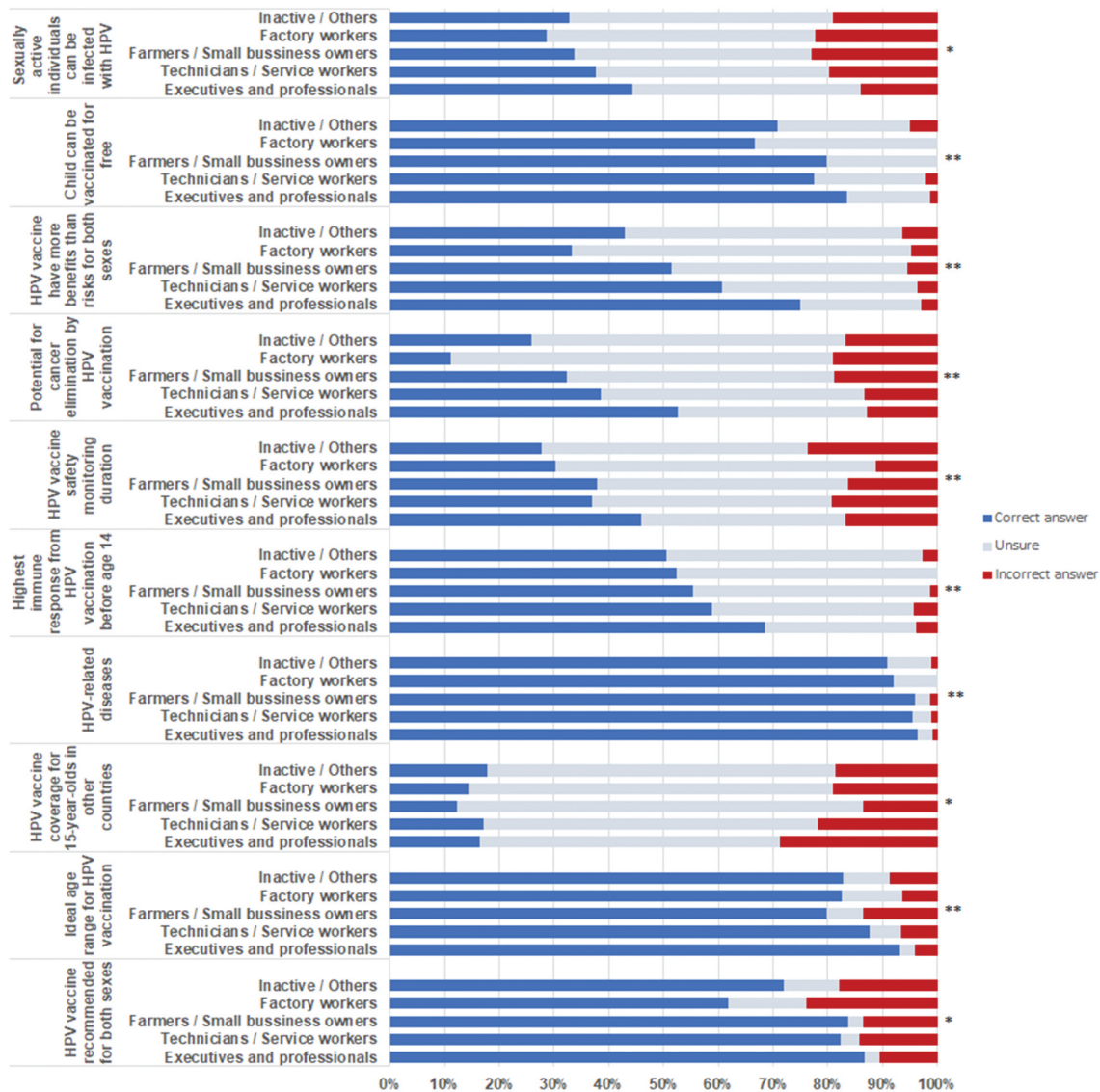


Figure 2a.

Similar results were found in a previous study conducted in France among parents of girls aged 15 to 18 years.<sup>9</sup> Within subgroups, we found that fathers were less likely to have HPV vaccine awareness, as were both French monolingual and multilingual parents in occupational groups such as technicians, service workers, farmers, small business owners, factory workers, and inactive individuals. These findings also mirror the social gradient found among middle school pupils in the PrevHPV project, where lower parental educational attainment and a multilingual family environment were associated with reduced awareness and intention to receive the HPV vaccine.<sup>29</sup>

In line with prior research conducted within the French population,<sup>26,30,31</sup> we found notable knowledge differences and some misconceptions about HPV vaccination among specific socioeconomic subgroups, particularly those living in moderate-high and high deprivation areas. These included knowledge about the role of HPV vaccination in cancer elimination, with more than half of our sample of parents reporting uncertainty or providing an incorrect answer. Furthermore, an important finding is that less than half of the parent population, regardless of their occupation, were aware that all sexually active individuals are at risk of HPV infection.





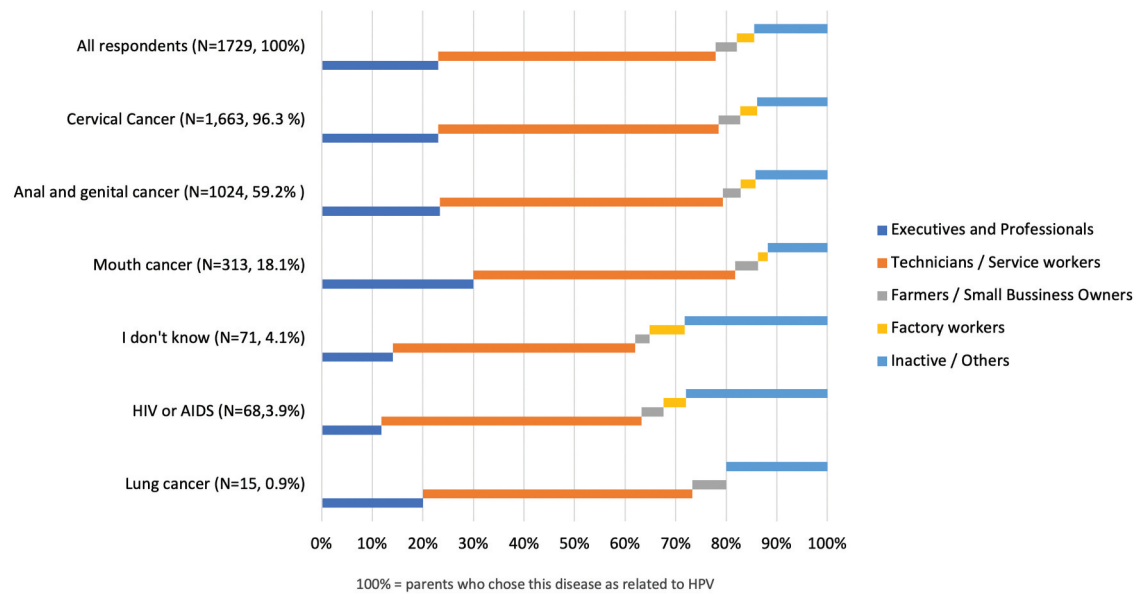
**Figure 2b.** Distribution of attitude (a) and knowledge (b) items regarding HPV vaccination among parents who have heard about HPV vaccination or are not sure, by occupation. France, 2021–22 (N=1,717). \* = p-value <0.05; \*\* = p-value <0.01; Chi-square test on prevalences across the categories.

Overall, we observed favorable attitudes toward HPV vaccination among parents across all sociodemographic groups. However, factory workers, inactive individuals, and parents in high-deprivation school areas exhibited more unfavorable attitudes and were more undecided, particularly regarding the perceptions of the safety, usefulness, and benefits vs risks of the HPV vaccine. Approximately 30 to 40% of factory workers and inactive parents expressed doubts about the safety of HPV vaccine, which aligns with the previously reported prevalence of such attitudes on vaccines in general (38%) in France.<sup>30</sup>

Our findings among parents differ from the attitudes and perceptions that we observed in the companion study among adolescents in the PrevHPV project, where just a minority expressed concerns about the vaccine safety, and where positive attitudes toward its utility and accessibility were prominent in both boys and girls.<sup>27</sup> Furthermore, compared to adolescents, parents' attitudes were less favorable about the

child being too young for vaccination and difficulties to access or discuss HPV vaccination with the child. The passive recruitment of our parent sample (based on volunteering to participate) resulted in a selection of persons with favorable attitudes toward vaccination in general (89%), while the completion of the questionnaire by adolescents was mandatory as filled out in classes and yielded a more representative sample. The observed differences in adolescent and parental attitudes may thus even be underestimated. In a related analysis of parent-child dyads, psychometric models suggested that adolescent attitudes can favorably influence parental intention to vaccinate (Oudin-Doglioni et al., *Health Psychology*, in press). Such information encourages school-based vaccine promotion, but careful construction of interventions is needed to reduce and not exacerbate social inequalities.

In this study, we found that more than half (55%) of parents with an unvaccinated child had the intention to immunize them. This estimate is consistent with findings from other



**Figure 3.** Distribution of occupational categories across all respondents and respondents who link (correctly or falsely) various diseases to HPV infection. Parents who have heard about HPV vaccination or are not sure, France, 2021–22 ( $N = 1,717$ ). Reading example: Among the  $N$  participants linking lung cancer to HPV infections (0.9% of the total sample), 7% were farmers/small business owners and 0% were factory workers, while these categories represent 4% and 3%, respectively, of the overall sample.

studies conducted in various countries investigating HPV vaccination intention and subsequent vaccination rates, which revealed that only 38% to 57% of the parents follow through with their intention to vaccinate their child.<sup>32,33</sup> Similar to previous studies that highlighted the significant influence of socioeconomic determinants on HPV vaccination intention,<sup>34–36</sup> we identified an association between family multilingualism, parental occupation, and vaccine intention. Given our data, the relationship between occupational category and vaccine intention is likely attributable to misconceptions/misinformation that lead to unfavorable attitudes regarding the usefulness, safety and accessibility of the vaccine, but could also reflect limited social trust. By contrast, differences by multilingualism may pertain in particular to lack of awareness. The fact that attitudes and knowledge did not substantially vary by lingualism suggests that other mechanisms are at play to create lower intention in multilingual groups.

Despite the general parental awareness and favorable attitudes regarding HPV vaccination, the actual reported uptake rates were low in our study, with half of parents of girls and four fifth of boys not reporting HPV vaccination. While some of this lack of vaccination could be explained by the child's young age (one quarter of participants had a 10- to 11-year-old child), our findings reveal that a significant proportion of parents of unvaccinated children (45%) are either indecisive about or refuse to vaccinate their children. Previous studies in France have shown that girls from low-income families were less likely to receive the HPV vaccine, with lower coverage rates observed in rural areas and areas with high poverty levels.<sup>9,10</sup> Research in other European countries and the US has also shown a relationship between socioeconomic status, including income and educational level, and HPV vaccine uptake.<sup>19,37</sup> Our observations allow disentangling the effects

that demographic and socioeconomic factors have on vaccination coverage, by separating awareness, uptake and intention. Our results suggest that the observed social disparities in vaccine coverage are related to a complex combination of lack of awareness and mitigated opinion about the vaccine.

### Strengths and limitations

The study findings should be interpreted while considering several limitations. Firstly, the participants included in the study are not a representative sample of parents in France, as their inclusion depended on the agreement of school directors from 61 municipalities and the individual parents' willingness to participate. While schools declining participation after randomization were not different from those participating, those refusing randomization could have had specific characteristics, which are not known. Similarly, we do not have information on parents in participating schools who did not participate. The sample tended to be more favorable to vaccination in general than the general population (89% vs 79%, national statistics Ministry of Health, [https://sante.gouv.fr/IMG/pdf/bilan\\_obligations\\_vaccinales\\_-\\_2021.pdf](https://sante.gouv.fr/IMG/pdf/bilan_obligations_vaccinales_-_2021.pdf)), comprised fewer blue-collar workers (4% vs 19%, national statistics INSEE [https://www.insee.fr/fr/statistiques/2489546#figure1\\_radio2](https://www.insee.fr/fr/statistiques/2489546#figure1_radio2)), and consisted primarily of mothers. In addition, the proportion of parents with an HPV-vaccinated child aged 11–15 years tended to be higher than the national estimates for age 15 years in 2021 (47% vs 46% for girls, 20% vs 6% for boys).<sup>15</sup> Prevalence estimates should therefore be considered with great caution. Nevertheless, the sample included parents from a wide range of geographical, sociodemographic, and economic backgrounds, which allowed a broad analysis of determinants. As socio-demographic-economic groups and attitudes around vaccination were included in the models,

their underrepresentation is unlikely to have created bias. Nevertheless, extrapolation of our results to the entire French population requires careful consideration of the represented groups.

In this study, information on vaccine status, GP visit and vaccine offer was self-reported and thus prone to misclassification, if parents answered the question without consulting the vaccination documents. However, we included a « do not know category » to allow the expression of uncertainty. The other outcomes awareness and intention are individual judgments that are not prone to recall bias, as are socio-demographic variables. We reduced the risk of social desirability bias by the use of a self-administered online questionnaire.

Although the study had a relatively large sample size, the small number of participants in specific subgroups limited the statistical power of some analyses and prohibited stratified analyses, eg by parental gender. Another limitation is that the data were collected during late 2021 and early 2022, period which was preceded by national school-based activities to promote COVID-19 vaccination of adolescents. We cannot exclude that the attitudes of participants had transiently been impacted by this context. Also, the ecological data derived from the school code pertain to the municipality of the school, which may in some instances not be the municipality of family residence. Finally, as in any observational study, no causal link can be established between determinants and outcomes.

### Implications for public health and research

Our results have implications for public policy to reduce disparities around HPV vaccination. To increase informed decision-making in all population groups, vaccine promotion needs to take into account specific barriers, and include steps of tailoring and evaluation of interventions. Such interventions should target all three aspects of information, access and motivation for vaccination. While our results identify effects of lower occupational status, local deprivation, migration history in the family and access to family physician consultations, in a given territory, these proxies may relate to various specific factors (such as low health literacy, community spread of misinformation, low social trust, limited language proficiency, medical desertification and insufficient health care coverage), which require specific solutions.<sup>38</sup> As information appears not to reach all parent groups, these initiatives should create linguistically and culturally appropriate campaigns that emphasize the benefits and justification of HPV vaccination at a young age for both girls and boys, emphasizing cancer prevention and elimination, the quasi-systematic nature of HPV infection among sexually active individuals and vaccine safety.<sup>29,39,40</sup> School-based information and vaccination campaigns have demonstrated promising results in increasing coverage and reducing socioeconomic and geographic inequalities, as observed in other countries.<sup>6–41–43</sup> In France since autumn 2023, annual nation-wide school-based vaccination campaigns should offer HPV vaccination to all adolescents aged 11–12 years (5<sup>th</sup> grade level),<sup>44</sup> and coverage results for 2023 have increased to 55% and 26%, respectively, among 15-year-old girls and boys.<sup>45</sup> Reinforcing systematic HPV vaccine

offer by GPs is also important, as they are the most trusted source of information for parents in France. In addition, specifically tailored interventions using motivational interviewing<sup>46</sup> may be effective to increase awareness and vaccine intention among parents in low-skilled occupational categories with multilingual background.

The PrevHPV trial, during which these baseline data were collected, will evaluate the effectiveness of school-based vaccine promotion with and without vaccination campaigns and GP training about HPV in France. Special attention will be paid to the evaluation of the impact that interventions have on social inequalities in vaccine awareness, uptake, intention, knowledge and attitudes. In addition, the present data can serve as a comparator for evaluations of the recent policy changes in France, including gender-neutral HPV vaccine recommendation and HPV vaccine campaigns in schools.

### Conclusion

The present study extends beyond the current body of evidence on the social determinants of HPV vaccine coverage, and illustrates the sociodemographic and -economic gradients in awareness, intention, attitudes and knowledge/attitude among parents of adolescents in France. The findings emphasize the importance of increasing HPV vaccine awareness and tailoring both vaccine promotion and access to the specific needs and expectations of population groups that differ by occupational and socio-cultural context.

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### Disclosure statement

AGB declares receiving speaker honoraria from MSD. The other authors declare no competing interests.

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## ORCID

Judith E. Mueller  <http://orcid.org/0000-0003-0797-9971>

## Author contributions statement

JS, ASB, JR, AG, AGB, SB, MM, ASM, ASB, SB, NT, JEM designed the study. DOD, SC, AG, AGB, SBA, SB, NT implemented data collection. ART, JMD, JEM conducted data analysis and interpretation and drafted the manuscript. All authors revised the manuscript critically for intellectual content, approved the final version; and agreed to be accountable for all aspects of the work.

## Ethical statement

This protocol was approved by the French Ethics Committee 'CPP Sud-Est VI' on 22 December 2020 (ID-RCB:2020-A02031-38) and registered on ClinicalTrials.gov (NCT04945565).

## Clinical trial registration number

NCT04945565

## Data availability statement

The data that support the findings of this study are not publicly available. They are, however, available upon restrictions from the authors upon reasonable request and with permission of the French National Institute for Health and Medical Research (Inserm). The reuse of data is subject to compliance with the General Data Protection Regulation (GDPR) and French regulations.

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