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Social differentiation of vaccine hesitancy among French parents and the mediating role of trust and commitment to health: a nationwide cross-sectional study

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26 ** Members of the Baromètre santé 2016 group are listed in the Acknowledgement section.

27

28 Abbreviations: EHI, equivalized household income; SES, Socioeconomic status; VH, Vaccine

29 hesitancy.

Accepted Version

Abstract

Background: The relations between vaccine hesitancy (VH) and individual socioeconomic status (SES) vary with context and remain poorly understood. We examined associations between parental SES and VH levels and their potential mediation by two attitudinal factors: commitment to making "good" health-related decisions and trust in mainstream medicine.

Methods: Data come from the 2016 *Baromètre santé*, a random cross-sectional telephone survey of the French general population. We analyzed a sample comprising 3,927 parents of children aged 1-15 years, dividing them into 4 categories according to their VH level. We performed bivariate and then multiple multinomial logistic regression analyses to study associations between parental educational level, income, and VH. We then reassessed the logistic model with a causal steps approach, adding the commitment and trust scores.

Results: Vaccine refusers accounted for 26% of parents (95% CI=25%, 28%), delayers 7% (95% CI=6%, 8%), and acceptors with doubts 13% (95% CI=12%, 14%). In bivariate analyses, educational level was associated with VH but income was not, while commitment and trust scores varied significantly with both VH and educational level ($p<0.001$). In multivariate analyses, highly educated parents were more prone to be delayers ($\text{AOR}_{\geq \text{Bac}+4}$ versus $<\text{Bac}$ =1.73, 95% CI=1.12, 2.69) or refusers ($\text{AOR}_{\geq \text{Bac}+4}$ versus $<\text{Bac}$ =1.56, 95% CI=1.19, 2.04) than nonhesitant. These associations did not remain significant after inclusion of the commitment and trust scores in the model.

Conclusions: Vaccine refusal and delay are frequent among French parents, especially the more educated. Our results suggest that levels of commitment and trust play a key role in shaping VH. Suitable educational interventions are needed to restore trust in authorities and vaccines. Helping healthcare professionals to communicate better with vaccine-hesitant parents is also essential.

25 **Keywords:** Socioeconomic Factors; Attitude to Health; Vaccination Refusal; Parents; Cross-
26 Sectional Studies

Accepted Version

1. Introduction

Over the past decade, the public health literature has increasingly adopted the term *vaccine hesitancy* (VH) to describe the spreading reluctance concerning vaccines [1,2]. According to the Strategic Advisory Group of Experts (SAGE) Working Group on VH, “*VH refers to delay in acceptance or refusal of vaccines despite availability of vaccination services. [...] It includes factors such as complacency, convenience and confidence (“3Cs”)*”[3]. Some authors have discussed the ambiguities of this definition, which includes access issues that, although contributing to undervaccination, are not strictly speaking relevant to hesitancy (i.e., a psychological state associated with doubts) [4]. They and others have also questioned the underlying nature of VH, which has been described as a set of beliefs (e.g., about vaccine safety and efficacy), attitudes, and behaviors or some combination of these [4,5]. Peretti-Watel *et al.* previously suggested that VH be considered to be a kind of decision-making process rather than beliefs, attitudes, or behaviors [5]. Based on sociological theories developed in the field of the sociology of risk, they theorized that this process depends on two major structural features of contemporary societies: healthism, a cultural and societal trend encouraging individuals to exercise control over their own behaviors and use information disseminated by health authorities to maximize their life expectancy [6]; and disenchantment with science, defined as the turning of scientific skepticism against science itself [7]. These two societal features may shape individual beliefs and attitudes towards health and translate respectively into commitment to making "good" health-related decisions and the diminution of trust in health authorities and mainstream medicine (scientists and experts) [5]. This article refers to these attitudes as commitment and trust (hypothesized respectively to be increasing and decreasing today).

An essential prerequisite for addressing VH is the evaluation of its prevalence, sociodemographic correlates, and underlying determinants [4,8–10]. Some foreign studies

have assessed the prevalence of different levels of VH through proportions of parents who can be classified, either as unsure/hesitant acceptors, delayers, or refusers [11–14] or by other specific scales [15,16]. In France, unfavorable attitudes towards vaccination in general have increased substantially over the past decade [17], and a survey conducted in 67 countries in 2015 found the highest level of doubts about vaccine safety in France [18]. These results, however, were based on only one question. More comprehensive data on VH, its different degrees, and determinants in France are nonetheless not currently available.

VH is known to depend on socioeconomic characteristics, but the direction of these relations may differ by country and vaccine [1,19]. To open the black box of the social differentiation of VH, it would be useful to explore its underlying determinants. Evidence from research about vaccination [20] and other health behaviors [21,22] suggests that beliefs/attitudinal factors may play a role in mediating SES differences in health behaviors.

Based on the Peretti-Watel *et al.* framework [5], we hypothesized that VH is influenced by two principal attitudes (commitment and trust) and examined whether SES differences in these attitudes explain some part of SES differences in VH. We used data from a nationally representative sample of French parents of children aged 1-15 years (the 2016 *Baromètre santé* survey) to: 1) estimate the prevalence of different levels of VH and their associations with parental SES; 2) examine whether levels of commitment and trust mediate the association between SES and VH.

2. Methods

2.1. Sampling design and data collection

Data were from the 2016 *Baromètre santé*, the eighth in a series of national cross-sectional telephone surveys addressing health issues in representative population samples, designed and conducted by the French Public Health Agency (Santé publique France). This survey assessed health knowledge, attitudes, and behaviors of the French population and included a section on

vaccination issues. It used an overlapping dual-frame design of landline and mobile telephone numbers, generated randomly from the prefixes allocated by the electronic communications regulatory authority. All households with at least one French-speaking individual aged 15-75 years were eligible. In each household, one respondent was selected at random from eligible household members for landline phones or from eligible regular mobile users for mobile phones. Data were collected with a computer-assisted telephone interview (CATI) procedure between January and July 2016 in mainland France. The French national commission for computer data and individual freedom (CNIL) approved the survey.

2.2. Measures

Vaccine hesitancy

The questionnaire of the 2016 *Baromètre santé* included for the first time 3 items adapted from the SAGE group's definition of VH [3]. We designed these items (Table 1) to ensure that reasons for delay/refusal other than hesitancy (e.g., access barriers) were excluded, that is, could not be interpreted as VH [4].

Commitment and trust

To measure parental levels of commitment to health-related decisions, the questionnaire of the 2016 *Baromètre santé* included two items adapted from previous questionnaires on VH [15,16]; one item was based on the concept of locus of control [23], and another covered the type and number of sources of information respondents consult about vaccination [10], as active information-seeking is a key feature of healthism [24]. See Table 1 for a wording of these 4 items.

We measured parental level of trust with 4 items also described in Table 1 [10].

Other perceptions about vaccination

Other questions included in the 2016 *Baromètre santé* assessed parents' perceptions of the effectiveness and potential side effects associated with vaccines against measles, hepatitis B,

and human papillomavirus (HPV) as well as whether parents had unfavorable opinions about some specific vaccines, and if so, which (Appendix Table 1).

Demographic and socioeconomic characteristics

Respondents' characteristics included age, gender, partnership status (living together or not), number of children, at least one child aged 3 or under in the household, region of residence, educational level (did not pass Bac -- high school-leaving exam--, Bac, Bac +2-3 years, or Bac+4, or higher), and equivalized household income per month (EHI), which takes into account household size and composition. The EHI was calculated with a scale developed by the Organization for Economic Cooperation and Development (OECD) (See Appendix Box 1 for more details).

2.3. Statistical analyses

Data were weighted to match the sample to the national census for age, gender, educational level, household size, population of town of residence, and region of residence. All analyses were performed with weighted data.

Objective 1. Based on a methodology already published [13], we used answers to the 3 VH items to build the variable "*VH level*," comprising four mutually exclusive categories (Figure 1). The two highest levels referred to ever having refused a vaccine for his/her child ("*refuser*") and delayed but not refused a vaccine ("*delayer*"). The third category included parents who had ever had his/her child vaccinated despite doubts, but never refused or delayed ("*acceptors with doubts*"). The final category included parents responding "*no*" to all 3 VH items ("*no VH*"). We estimated the prevalence of each level and of overall VH (i.e., the percentage of parents who were refusers or delayers or acceptors with doubts), and their 95% confidence intervals (CI).

Bivariate analyses used Chi-square tests to study the associations between VH levels and respondents' demographic and socioeconomic characteristics. Then we constructed a multiple

multinomial logistic regression model (reference category: “no VH”), including both SES variables (educational level and EHI) and adjusted for the other sociodemographic variables. These factors have previously been associated with childhood vaccination compliance [25].

Objective 2. We built a commitment score by summing the answers to the 4 items used to measure commitment (see paragraph “Measures”), coding as follows: first item, from 1=strongly disagree to 4=strongly agree; second and third items, from 1=strongly agree to 4=strongly disagree; item related to the sources of information, from 1=never look for information/1 source to 4= at least 4 different sources. We also built a trust score, by summing the answers to the 4 items measuring trust in different sources of information (see paragraph “Measures”), coding as follows: from 1=strongly distrust to 4=strongly trust.

Following the Baron and Kenny causal-steps approach [26], we performed bivariate analyses with ANOVA to verify whether the commitment and trust scores were associated with both SES and VH. Then we reassessed the multiple multinomial logistic regression model described above, adding these two scores, to verify whether they mediated the association between SES and VH.

We performed supplementary analyses to explore the associations between VH levels and parental perceptions of some specific vaccines (Appendix Table 1).

All analyses were based on two-sided p -values, with statistical significance defined by $p \leq 0.05$. They were performed with SAS 9.4 statistical software (SAS Institute, Cary, NC).

3. Results

The sample included 15,216 respondents with full interviews (participation rate: 50%), including 3,938 parents of children aged 1-15 years. This study includes the 3,927 (99.7%) of these parents for whom we had complete data about VH.

3.1. Characteristics of the study population and prevalence of different VH levels

Of the 3,927 parents with complete data, 57% were mothers, 49% were younger than 40 years old, 91% lived with a partner, 68% had 1 or 2 children, and 32% had a child aged 3 or younger. In all, 57% had at least passed the "Bac" examination at the end of high school (Table 2).

Among them, 26% (95% CI=25%, 28%) had ever refused a vaccine for their child, 17% (95% CI=15%, 18%) had delayed a vaccine, and 27% (95% CI=25%, 28%) had their child vaccinated despite doubts. After combining these 3 items into the "VH level" variable, the prevalence of refusers was 26% (95% CI=25%, 28%), of delayers 7% (95% CI= 6%, 8%), and of acceptors with doubts 13% (95% CI=12%, 14%) (Figure 1). The overall prevalence of VH was 46% (95% CI=44%, 48%).

Supplementary analyses (Appendix Table 1) showed that vaccine-hesitant parents were more concerned about both vaccine effectiveness and vaccine safety than nonhesitant parents for all three of the vaccines we specifically asked about (measles, hepatitis B, and HPV). Concerns about safety remained more prevalent than those about effectiveness among all categories of vaccine-hesitant parents. Fewer than 2% of vaccine-hesitant parents reported an unfavorable opinion about *all* vaccines. Unfavorable opinions about hepatitis B and HPV vaccines increased with VH level.

3.2. Associations between SES and levels of VH

In bivariate analyses, the prevalence of different VH levels varied significantly with parental education: the prevalence of refusers was highest among parents who had at least passed the "bac" ($\geq 28\%$ versus 23% among less educated parents). We found no association with EHI, however (Table 2). VH was also higher among mothers than among fathers and among parents living with a partner (Table 2).

Multinomial multiple regression analyses confirmed these results (Table 3, model 1). Parents who had at least passed the "bac" were more prone to be refusers. Those with at least 2 or 3

years of college had a higher probability of all levels of VH. See Appendix Table 1 for results including the demographic adjustment factors.

3.3. SES differences in VH: analysis of the mediating role of commitment and trust

The commitment score was highest among delayers and refusers, and the trust score lowest (Table 2). At the same time, the commitment score increased with educational level, while the trust score was highest among less educated parents (Table 4).

After inclusion of both scores into the multiple regression analyses (Table 3, model 2), higher education was no longer associated with delay or refusal, but parents with at least 2 or 3 years of college were acceptors with doubts more often than the others (Table 3, model 2).

4. Discussion

4.1. Main results

This national study found that significant percentages of parents of children aged 1-15 years in France have at least once refused a vaccine for their child (26%), or delayed it (7%), or accepted it despite doubts (13%). More highly educated parents were delayers or refusers more often than those with less education, an association explained by the former's higher commitment to making "good" health-related decisions and lower trust.

4.2. Prevalence of different VH levels: comparison with the literature

Great heterogeneity across studies for VH definitions, measurement tools, and study populations makes comparisons with published estimates of VH prevalence [11–15,27–29] difficult: 16% in Italy (2016, parents of children aged 16-36 months) [29], 25% in the UK (2014, parents of children under 5) [14], and 30% in the US (2014, parents of children under 7) [11]. Thus, our VH prevalence estimates appear somewhat higher than the preceding estimates; but they are drawn from a sample of parents of children in broad age groups, including adolescents: parents of preschool children were less likely to be refusers than parents of older children (Appendix Table 1). Greater reluctance about the hepatitis B and

HPV vaccines we found among parents of older children (results not shown) may partly explain this difference.

The high prevalence of parental VH found in our study is both a matter of concern and consistent with the percentage of negative perceptions of vaccine safety in the French general population (45%) previously published [18]. This latter result should nonetheless be interpreted with caution, as it refers to only one five-point Likert scale question (“*Overall I think vaccines are safe*”) that may be interpreted differently in different cultural contexts. These results may be due in part to the multiple controversies in France about various vaccines over the past two decades [17,30] and physicians’ own hesitations towards certain vaccines [31,32]. Results from our supplementary analysis suggest that vaccines against hepatitis B and HPV are the two vaccines most frequently associated with parental VH (Appendix Table 1). Parents may have been particularly marked by the controversy during the hepatitis B school vaccination campaign among French adolescents in the late 1990s, as they were themselves adolescents at that time. This campaign was suspended by the French government in 1998, after several lawsuits by individuals diagnosed with a demyelinating event (especially multiple sclerosis) after hepatitis B vaccination [30]. More recently, controversy has arisen concerning the usefulness and safety of the HPV vaccine, including within the French medical community, as well as about the use of hexavalent vaccines in infancy [32,33].

4.3. Social differentiation of VH and the mediating role of commitment and trust

The positive association between parents' VH and their educational level and the lack of association between their VH and their income are consistent with previous results in the US and the UK [28,34]. Sociocognitive factors may thus play a more important role than material ones in the social differentiation of VH [35], at least when convenience is removed from its definition, as usefully proposed by Bedford *et al.* [4].

Among these sociocognitive factors, our results suggest that commitment and trust might be key determinants of VH, as several authors have emphasized [5,10,16]. The higher level of commitment to health-related decisions and the lower level of trust in authorities and mainstream medicine among educated parents echo features seen in contemporary societies: healthism and disenchantment with science [36]. In “risk societies”, more educated people have a stronger perception of “manufactured risks” (e.g., risks produced by science and industry) and may develop a sense of distrust towards science, especially “official” science and experts [7]. Distrust towards science and medicine, and commitment to “healthism” have also been described as typical of the educated middle classes, who are more likely than others to try alternative medicines and to seek information about health and illness online [24]. Our results support the mediating role of commitment and trust in the association between educational level and vaccine delay or refusal; they also support the hypothesis of Peretti-Watel *et al.* of “rationalized VH” among more educated people [5]. According to this hypothesis, their decision to delay or refuse some vaccines may result from a thoughtful and time-consuming process requiring an in-depth search for and analysis of information, time for discussion with physicians, and making a balanced decision. Only the trust score explains the social differentiation of acceptors with doubts — and then only in part. The absence of a role for the commitment score in the social differentiation of acceptors with doubts suggests that other factors may play a role, including for example social networks and social pressure [37].

4.4. VH and demographic factors

The literature about the association between parental gender, family status, and beliefs/attitudes/behaviors towards childhood vaccination offers mixed evidence [12,13,25,28,38–40]. We found, as did the authors of a US study [28], that mothers delayed or refused vaccination for children more often than fathers (Table 2 and Appendix Table 1). This may reflect their greater fear of potential side vaccine effects [39] and their more frequent

decision-making about children's vaccinations. Spouses and partners nonetheless play a key role in these decisions [37]; this may explain why those living with a partner were more prone to all levels of VH in our study (Table 2 and Appendix Table 1). Compared with single parents, those living with a partner may also have more opportunities and resources (e.g., time) to obtain information and advice about childhood vaccination.

4.5. Limitations

The results of this study should be interpreted with the following limitations in mind. First, the cross-sectional design of the *Baromètre santé* survey prevents drawing definitive conclusions about the directions of relations between VH and its determinants or about causality. Second, this study shares the usual shortcomings of quantitative telephone surveys, including a moderate participation rate (50%). As is frequently the case in epidemiologic studies [41], nonparticipants were probably less educated than participants; given the positive association between VH and education, this may have led to an overestimation of VH prevalence. Data weighting by several sociodemographic variables including educational level should have limited such bias. Moreover, there is no reason to suspect that respondents' answers regarding VH and its determinants were correlated with nonparticipation, as the survey announcement letter provided no details about the investigation topics. Finally, we must acknowledge several limitations of our measures of VH and of its determinants. The VH items did not allow us to assess the reasons why parents decided to refuse or delay a vaccine for their child, nor how many and which specific vaccine (or vaccines). Moreover, we found no appropriate scale in the existing literature to use to assess parents' commitment to health-related decisions. We thus used four items but they might not be sufficient to measure this variable as described in the literature [24]. Including additional items related to other aspects of parents' lifestyles (e.g., use of complementary and alternative medicine, organic food consumption, or breastfeeding practices) might be relevant in future research [24].

5. Conclusions

This study contributes to the small body of quantitative literature about social differentiation of parental VH and its determinants. This literature, although sparse, suggests the existence of different patterns of social differentiation, varying with context and vaccine [19]. From a public health perspective, our results shed some light on the extension of compulsory vaccination in France from 3 vaccines to 11 in children younger than 2 years and born after December 31, 2017. The reasons underlying the Health Ministry's decision undoubtedly include the inconsistency of the pre-2018 coexistence of compulsory and recommended childhood vaccines as well as some evidence that compulsory-vaccination laws have been effective in achieving higher immunization rates in other countries and contexts [42–44]. The high level of parental VH, however, together with its association with both commitment and distrust, raises concerns that these new obligations might reinforce resistance to some vaccines, especially to those which remain recommended but not compulsory, such as HPV vaccines [45,46]. In this context, it remains essential to monitor the course of vaccine coverage for both mandatory and recommended vaccines [44] as well as any changes in parental trust.

In addition to this new law, appropriate information and educational interventions remain critical to help restore trust in authorities and vaccines [42,47,48]. Helping healthcare professionals to learn to communicate with vaccine-hesitant parents is essential. Use of motivational interviewing approaches (based on a compassionate, collaborative, and autonomy-supportive relationship) and techniques (e.g., open-ended questions, reflective responses) appears especially promising in reducing parental concerns about vaccines and increasing vaccine uptake [49,50]. However, further interventional research is needed to determine which communication styles (e.g., presumptive or open approaches, motivational

274 interviewing) [51] best suit parents' needs, based on their characteristics (e.g., vaccine
275 hesitancy, educational level).

276 Finally we should stress, as others have [4], that, apart from VH, financial and logistical
277 barriers to vaccination may persist in developed countries with publicly funded national
278 vaccination programs, especially for children from low-SES background. Such inequalities
279 have been found in several settings [19], including France [52], and must be addressed.

280

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Competing interests

The authors declare that they have no competing interest.

Authors' contributions

AB designed the study, interpreted the results, drafted and edited the manuscript. LF and AZ analyzed the data, interpreted the results and edited the manuscript. JW and AG designed the study, interpreted the results and critically revised the manuscript. PPW and PV designed the study, interpreted the results and edited the manuscript. All authors read and approved the final manuscript.

All authors attest they meet the ICMJE criteria for authorship.

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doi:10.1016/j.arcped.2014.03.012.

468 **Table 1**

469 Measures of vaccine hesitancy, level of commitment and trust (2016 *Baromètre santé*)

Measures

Vaccine hesitancy (3 items^a)

1. Have you ever refused a vaccine recommended for your child by your physician, because you considered this vaccination dangerous or useless?
 2. Have you ever delayed a vaccine recommended by your physician for your child because you hesitated over it?
 3. Have you ever had a vaccine for your child despite doubts about its efficacy?
-

Commitment (4 items)

1. As the parent, it's my job to ask questions about the vaccines recommended by my child's physician^b
 2. For my child to stay healthy, I just have to follow the doctor's advice^b (R)
 3. When my child is sick, it's often because of bad luck or by accident^b (R)
 4. When you have questions about a vaccine for your child, where do you look for information?^c
-

Trust (4 items^d)

Do you trust the information regarding vaccinations provided by:

1. The child's physician?
 2. Pharmacists?
 3. The ministry of health?
 4. The pharmaceutical industry?
-

470 (R) indicates items that were reverse coded to build the commitment score.

471 ^a Yes/no, including a *don't know/no response* choice.

472 ^b 5-point Likert scale from *strongly disagree* to *strongly agree*, including *don't know/no*
473 *response*.

474 ^c Multiple answers allowed: *From your physician or a physician/From a pharmacist/On the*
475 *Internet/From friends or family/Other, including not relevant, never look for information*
476 *about vaccination*.

477 ^d 5-point Likert scale from *strongly distrust* to *strongly trust*, including *don't know/no*
478 *response*.

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Table 2

Study population's sociodemographic characteristics, levels of commitment and trust, and associations with level of vaccine hesitancy (results from bivariate analyses, parents of children aged 1-15 years, 2016 *Baromètre santé*)

	Total sample (column % or mean ± SD, n=3,927)	VH level (line % or mean ± SD)				<i>p</i> - value ^a
		No VH (n=2,011)	Acceptor	Delayer	Refuser	
			with	(n=272)	(n=1,090)	
			doubts (n=554)			
<i>Demographic characteristics</i>						
Age (years)						0.19
15-34	26.8	55.8	14.3	6.2	23.7	
35-39	22.3	56.2	11.2	6.1	26.6	
40-44	25.6	51.3	13.5	6.7	28.5	
45-75	25.3	53.8	12.7	7.2	26.3	
Gender						<0.001
Mother	56.5	50.6	12.4	7.0	30.0	
Father	43.5	59.0	13.8	6.0	21.3	
Family status						0.001
Single-parent	9.4	64.0	10.0	3.9	22.2	
Parent living with a partner	90.6	53.2	13.3	6.8	26.6	
Number of children						<0.001
1	24.1	59.0	14.9	5.2	20.9	

2	43.6	50.1	13.8	7.7	28.5	
3	21.3	56.2	10.2	6.9	26.7	
4 or more	11.0	56.4	11.3	4.4	27.9	
≥ 1 child aged 3 or under						<0.001
Yes	32.3	56.9	14.5	7.4	21.3	
No	67.7	53.0	12.3	6.2	28.6	
<i>Socioeconomic characteristics</i>						
Educational level^b						<0.001
Did not pass Bac	43.6	60.5	11.3	5.4	22.9	
Bac	19.4	52.0	12.6	7.1	28.3	
Bac +2-3 years	22.4	47.4	15.6	7.3	29.7	
Bac+4 or higher	14.7	49.2	14.3	8.2	28.2	
EHI (€ / month)^c						0.40
≤ 1100	42.4	55.8	11.7	6.3	26.3	
1101-1799	37.0	52.9	14.1	6.9	26.1	
≥ 1800	20.6	52.5	13.8	7.1	26.6	
<i>Commitment and trust</i>						
Commitment score^d						
(mean ± SD)	9.2±2.0	8.9±2.0	9.2±1.7	10.0±1.8	9.8±1.9	<0.001
Trust score^d (mean ± SD)						
	11.9±2.6	12.7±2.4	11.6±2.4	11.0±2.5	10.8±2.6	<0.001

484 EHI, Equivalized household income; SD, Standard deviation; VH, Vaccine hesitancy

485 Boldface indicates statistical significance ($p \leq 0.05$)

486 ^a Results from Chi-square tests or ANOVA

487 ^b 3 missing values. Bac: high school-leaving exam.

488 ^c 43 missing values

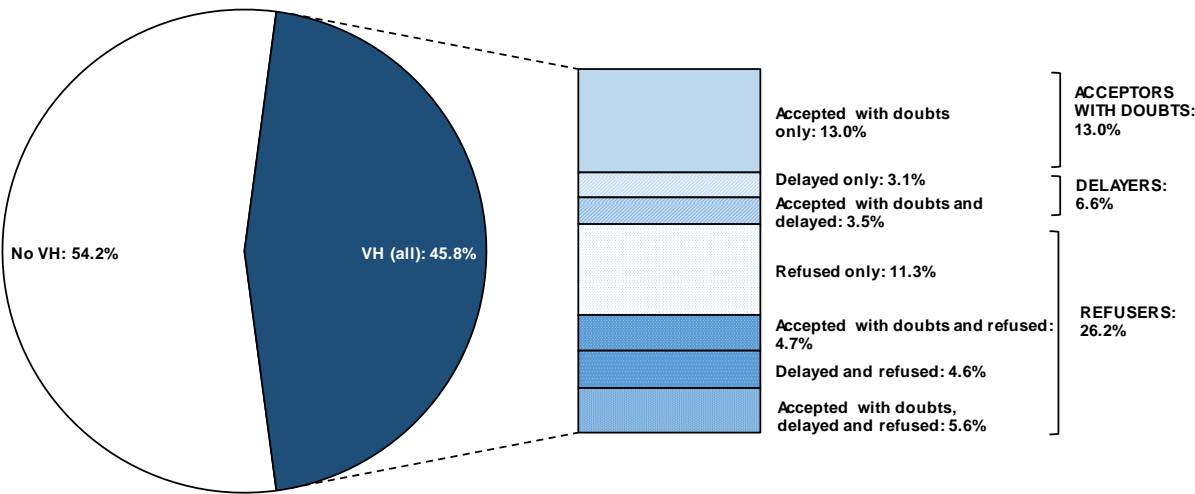
489 ^d To build the score, “*don’t know/no response*” (<2% for all items) was coded at mid-point

490 (2.5). The score ranged from 4 to 16.

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494 **Figure 1**

495 Prevalence of different levels of vaccine hesitancy (VH) among French parents of children
496 aged 1-15 years (2016 *Baromètre santé*, n=3,927)

497

Table 3

Analyses of the mediating role of commitment and trust score in the social differentiation of vaccine hesitancy: results from multiple multinomial logistic regressions (parents of children aged 1-15 years, 2016 *Baromètre santé*, Model 1^a n=3,881, Model 2^b n=3,880)

	AOR [95%CI] (Ref.: No VH)					
	Acceptor with doubts		Delayer		Refuser	
	Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b
Educational level (ref.: Did not pass Bac ^c)						
Bac	1.22 [0.92;1.62]	1.13 [0.85;1.51]	1.44 [1.00;2.09]	1.20 [0.82;1.75]	1.45 [1.17;1.80]	1.18 [0.94;1.48]
Bac +2-3 years	1.67 [1.27;2.20]	1.51 [1.14;2.00]	1.52 [1.04;2.22]	1.22 [0.83;1.79]	1.59 [1.28;1.98]	1.26 [1.00;1.59]
Bac+4 or higher	1.56 [1.12;2.18]	1.45 [1.03;2.04]	1.73 [1.12;2.69]	1.42 [0.91;2.23]	1.56 [1.19;2.04]	1.26 [0.95;1.68]
EHI (ref.: ≤ 1100)						
]1100-1800[1.01 [0.79;1.29]	1.00 [0.78;1.29]	0.86 [0.62;1.19]	0.88 [0.63;1.23]	0.89 [0.73;1.08]	0.92 [0.75;1.14]
≥ 1800	0.87 [0.63;1.20]	0.87 [0.63;1.20]	0.83 [0.55;1.27]	0.83 [0.54;1.27]	0.94 [0.73;1.21]	0.96 [0.73;1.25]
Commitment score	/	1.03 [0.98;1.09]	/	1.29 [1.20;1.39]	/	1.22 [1.17;1.28]
Trust score	/	0.83 [0.80;0.87]	/	0.77 [0.73;0.81]	/	0.74 [0.71;0.77]

AOR, Adjusted odds ratio; CI: Confidence interval; EHI, Equivalized household income; VH, Vaccine hesitancy

Boldface indicates statistical significance ($p \leq 0.05$)

^a Model 1 was adjusted for parent's age, gender, living with a partner, number of children, having a child aged 3 or under, region of residence, EHI, and educational level

^b Model 2 = Model 1 further adjusted for commitment and trust scores

^c Bac: high school-leaving exam

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Table 4

Associations between commitment and trust scores and parent's educational level (results from bivariate analyses, parents of children aged 1-15 years, 2016 *Baromètre santé*, n=3,927)

	Total sample (mean ± SD)	Educational level ^b (mean ± SD)				<i>p</i> -value ^a
		Did not pass Bac	Bac	Bac +2-3 years	Bac+4 or higher	
Commitment score	9.2 ± 2.0	8.9 ± 2.6	9.4 ± 1.8	9.5 ± 1.6	9.6 ± 1.5	<0.0001
Trust score	11.9 ± 2.6	12.2 ± 3.5	11.7 ± 2.6	11.6 ± 2.0	11.8 ± 1.8	<0.0001

Boldface indicates statistical significance ($p \leq 0.05$)

^a Results from ANOVA

^b Bac: high school-leaving exam

Appendix Table 1

Parental perceptions of the effectiveness and the safety^a of and unfavorable opinions^b towards some specific vaccines, and associations with level of vaccine hesitancy (column %, results from bivariate analyses, parents of children aged 1-15 years, 2016 *Baromètre santé*, n=3,927)

Total sample		VH level				
		No VH	Acceptor with doubts	Delayer	Refuser	p- value ^c
Measles						
<i>Vaccine is effective^d</i>						<.0001
Absolutely/Somewhat	85.2	87.7	83.9	80.7	81.8	
Not really/Not at all	14.8	12.4	16.1	19.3	18.2	
<i>Vaccine may cause severe side effects^e</i>						<.0001
Absolutely/Somewhat	40.1	34.7	43.6	53.0	48.5	
Not really/Not at all	59.4	65.3	56.4	47.0	51.5	
Hepatitis B						
<i>Vaccine is effective^f</i>						<.0001
Absolutely/Somewhat	82.3	88.0	84.0	80.6	70.2	
Not really/Not at all	17.7	12.0	16.0	19.5	29.8	
<i>Vaccine may cause severe side effects^g</i>						<.0001
Absolutely/Somewhat	58.8	48.0	60.2	65.7	78.6	
Not really/Not at all	41.2	52.0	39.8	34.3	21.4	
HPV^h						
<i>Vaccine is effectiveⁱ</i>						<.0001
Absolutely/Somewhat	74.9	84.1	79.9	83.4	57.3	
Not really/Not at all	25.1	15.9	20.1	16.6	42.7	

<i>Vaccine may cause severe side effects^j</i>		<.0001				
Absolutely/Somewhat	56.0	47.7	54.7	55.9	68.9	
Not really/Not at all	44.0	52.3	45.3	44.1	31.1	
Unfavorable opinion towards some specific vaccines^k						
No	53.4	68.3	56.3	41.7	24.4	
Yes	45.7	31.4	42.2	57.0	74.0	
Yes to all vaccines	0.9	0.3	1.6	1.3	1.7	
<i>If “Yes”^l: most frequently cited vaccines^b</i>						
Hepatitis B vaccine	29.7	17.0	24.5	30.5	42.1	<.0001
HPV vaccine	15.6	11.3	11.0	15.3	20.8	<.0001
MMR vaccines	4.1	1.5	5.1	8.3	5.3	<.0001

HPV, Human papillomavirus; MMR, measles, mumps, rubella; VH, Vaccine hesitancy

Boldface indicates statistical significance ($p \leq 0.05$)

^a The wording of the questions was: "Do you think that the vaccine against [specific disease] is effective for preventing this disease?" and "Do you think that the vaccine against [specific disease] can induce severe adverse effects?" (5-point Likert scale from *absolutely* to *not at all*, including a *don't know/no response* choice). *Don't know/no response* answers were excluded from these analyses.

^b This question was worded: "Are you unfavorable towards some specific vaccinations in particular?" (*Yes, no, yes to all vaccinations in general*, including a *don't know/no response* choice) -- If yes: which ones? (open question). *Don't know/no response* answers were excluded from these analyses.

^c Results from Chi-square tests

17 ^d 111 missing values

18 ^e 185 missing values

19 ^f 113 missing values

20 ^g 114 missing values

21 ^h Questions about effectiveness and safety of HPV vaccine were asked only of parents of girls
22 aged 11-15 years who were aware of this vaccine (*i.e.*, 823/957 parents of girls in this age
23 group).

24 ⁱ 35 missing values

25 ^j 43 missing values

26 ^k 18 missing values

27 ^l n=1,821

28

29

Appendix Table 2

Sociodemographic correlated of parent's level of vaccine hesitancy: results from multiple multinomial logistic regression (parents of children aged 1-15 years, 2016 *Baromètre santé*, n=3,881)

	AOR [95%CI] (ref.: No VH)		
	Acceptor with doubts	Delayer	Refuser
Age (ref.: 15-34 years)			
35-39	0.82 [0.61;1.11]	1.00 [0.67;1.52]	1.00 [0.78;1.28]
40-44	1.21 [0.88;1.66]	1.43 [0.92;2.22]	1.10 [0.84;1.43]
45-75	1.17 [0.83;1.66]	1.70 [1.06;2.71]	1.00 [0.75;1.33]
Women (ref.: men)	1.24 [1.00;1.53]	1.85 [1.39;2.46]	2.06 [1.73;2.46]
Living with a partner (ref.: no)	1.57 [1.07;2.31]	2.48 [1.39;4.43]	1.94 [1.43;2.62]
Number of children (ref.: 1)			
2	1.13 [0.88;1.45]	1.84 [1.28;2.64]	1.77 [1.43;2.21]
3	0.76 [0.56;1.04]	1.42 [0.93;2.18]	1.46 [1.12;1.89]
4 or more	0.87 [0.58;1.30]	1.02 [0.56;1.86]	1.85 [1.34;2.56]
≥1 child aged 3 or under (ref.: no)	1.19 [0.93;1.53]	1.41 [1.00;2.00]	0.71 [0.58;0.88]
Region of residence (ref.: Paris region)			
Northwest	0.97 [0.71;1.32]	0.98 [0.63;1.52]	0.98 [0.75;1.28]
Northeast	1.15 [0.86;1.56]	1.16 [0.76;1.78]	1.26 [0.97;1.63]
Southeast	0.82 [0.60;1.12]	1.54 [1.03;2.29]	1.52 [1.18;1.95]
Southwest	1.12 [0.80;1.57]	1.16 [0.72;1.88]	1.20 [0.90;1.61]

Educational level (ref.: Did

not pass Bac^a)

Bac	1.13 [0.85;1.51]	1.20 [0.82;1.75]	1.18 [0.94;1.48]
Bac +2-3 years	1.51 [1.14;2.00]	1.22 [0.83;1.79]	1.26 [1.00;1.59]
Bac+4 or higher	1.45 [1.03;2.04]	1.42 [0.91;2.23]	1.26 [0.95;1.68]
EHI (ref.: ≤ 1100)			
]1100-1800[1.00 [0.78;1.29]	0.88 [0.63;1.23]	0.92 [0.75;1.14]
≥ 1800	0.87 [0.63;1.20]	0.83 [0.54;1.27]	0.96 [0.73;1.25]
Commitment score	1.03 [0.98;1.09]	1.29 [1.20;1.39]	1.22 [1.17;1.28]
Trust score	0.83 [0.80;0.87]	0.77 [0.73;0.81]	0.74 [0.71;0.77]

AOR, Adjusted odds ratio; CI: Confidence interval; EHI, Equivalized household income; VH,

Vaccine hesitancy

Boldface indicates statistical significance ($p \leq 0.05$)

^a Bac: high school-leaving exam

Appendix Box 1

Description of Organization for Economic Cooperation and Development's scale used to calculate the Equivalized Household Income

The standard of living of households cannot be compared satisfactorily by assessing consumption per person, as the needs of the household do not increase proportionally to its size. Therefore, a weighting system assigning a coefficient to each member of the household is used to compare standards of living between households of different sizes and compositions. With this weighting, the number of people is converted into a number of consumption units (CU) using an equivalence scale [1].

The most widely used scale (known as the Organization for Economic Cooperation and Development's scale –OECD – scale) uses the following weighting [1]:

- 1 CU for the first adult in the household;
- 0.5 CU for the other persons aged 14 years or older;
- 0.3 CU for the children under 14 years.

Reference

[1] National Institute of Statistics and Economic Studies. Definitions and methods-Definitions-Consumption unit. <http://www.insee.fr/en/methodes/default.asp?page=definitions/unite-consommation.htm>; 2016 [accessed 24 July 2018].