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

3

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27

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

29 hesitancy.

Accepted Version

1 **Abstract**

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

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

12 **Results:** Vaccine refusers accounted for 26% of parents (95% CI=25%, 28%), delayers 7%
13 (95% CI=6%, 8%), and acceptors with doubts 13% (95% CI=12%, 14%). In bivariate
14 analyses, educational level was associated with VH but income was not, while commitment
15 and trust scores varied significantly with both VH and educational level ($p < 0.001$). In
16 multivariate analyses, highly educated parents were more prone to be delayers ($AOR_{\geq \text{Bac}+4}$
17 $\text{versus } < \text{Bac} = 1.73, 95\% \text{ CI} = 1.12, 2.69$) or refusers ($AOR_{\geq \text{Bac}+4} \text{ versus } < \text{Bac} = 1.56, 95\% \text{ CI} = 1.19, 2.04$)
18 than nonhesitant. These associations did not remain significant after inclusion of the
19 commitment and trust scores in the model.

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

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

Accepted Version

1 **1. Introduction**

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

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

26 have assessed the prevalence of different levels of VH through proportions of parents who can
27 be classified, either as unsure/hesitant acceptors, delayers, or refusers [11–14] or by other
28 specific scales [15,16]. In France, unfavorable attitudes towards vaccination in general have
29 increased substantially over the past decade [17], and a survey conducted in 67 countries in
30 2015 found the highest level of doubts about vaccine safety in France [18]. These results,
31 however, were based on only one question. More comprehensive data on VH, its different
32 degrees, and determinants in France are nonetheless not currently available.

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

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

45 **2. Methods**

46 *2.1. Sampling design and data collection*

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

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

59 *2.2. Measures*

60 Vaccine hesitancy

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

65 Commitment and trust

66 To measure parental levels of commitment to health-related decisions, the questionnaire of the
67 2016 *Baromètre santé* included two items adapted from previous questionnaires on VH
68 [15,16]; one item was based on the concept of locus of control [23], and another covered the
69 type and number of sources of information respondents consult about vaccination [10], as
70 active information-seeking is a key feature of healthism [24]. See Table 1 for a wording of
71 these 4 items.

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

73 Other perceptions about vaccination

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

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

78 Demographic and socioeconomic characteristics

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

86 *2.3. Statistical analyses*

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

90 Objective 1. Based on a methodology already published [13], we used answers to the 3 VH
91 items to build the variable "*VH level*," comprising four mutually exclusive categories (Figure
92 1). The two highest levels referred to ever having refused a vaccine for his/her child
93 ("*refuser*") and delayed but not refused a vaccine ("*delayer*"). The third category included
94 parents who had ever had his/her child vaccinated despite doubts, but never refused or
95 delayed ("*acceptors with doubts*"). The final category included parents responding "*no*" to
96 all 3 VH items ("*no VH*"). We estimated the prevalence of each level and of overall VH (i.e.,
97 the percentage of parents who were refusers or delayers or acceptors with doubts), and their
98 95% confidence intervals (CI).

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

101 multinomial logistic regression model (reference category: “no VH”), including both SES
102 variables (educational level and EHI) and adjusted for the other sociodemographic variables.
103 These factors have previously been associated with childhood vaccination compliance [25].
104 Objective 2. We built a commitment score by summing the answers to the 4 items used to
105 measure commitment (see paragraph “Measures”), coding as follows: first item, from
106 1=strongly disagree to 4=strongly agree; second and third items, from 1=strongly agree to
107 4=strongly disagree; item related to the sources of information, from 1=never look for
108 information/1 source to 4= at least 4 different sources. We also built a trust score, by
109 summing the answers to the 4 items measuring trust in different sources of information (see
110 paragraph “Measures”), coding as follows: from 1=strongly distrust to 4=strongly trust.
111 Following the Baron and Kenny causal-steps approach [26], we performed bivariate analyses
112 with ANOVA to verify whether the commitment and trust scores were associated with both
113 SES and VH. Then we reassessed the multiple multinomial logistic regression model
114 described above, adding these two scores, to verify whether they mediated the association
115 between SES and VH.
116 We performed supplementary analyses to explore the associations between VH levels and
117 parental perceptions of some specific vaccines (Appendix Table 1).
118 All analyses were based on two-sided p -values, with statistical significance defined by $p \leq$
119 0.05. They were performed with SAS 9.4 statistical software (SAS Institute, Cary, NC).

120 **3. Results**

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

124 *3.1. Characteristics of the study population and prevalence of different VH levels*

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

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

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

142 3.2. Associations between SES and levels of VH

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

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

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

152 *3.3. SES differences in VH: analysis of the mediating role of commitment and trust*

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

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

159 **4. Discussion**

160 *4.1. Main results*

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

166 *4.2. Prevalence of different VH levels: comparison with the literature*

167 Great heterogeneity across studies for VH definitions, measurement tools, and study
168 populations makes comparisons with published estimates of VH prevalence [11–15,27–29]
169 difficult: 16% in Italy (2016, parents of children aged 16-36 months) [29], 25% in the UK
170 (2014, parents of children under 5) [14], and 30% in the US (2014, parents of children under
171 7) [11]. Thus, our VH prevalence estimates appear somewhat higher than the preceding
172 estimates; but they are drawn from a sample of parents of children in broad age groups,
173 including adolescents: parents of preschool children were less likely to be refusers than
174 parents of older children (Appendix Table 1). Greater reluctance about the hepatitis B and

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

177 The high prevalence of parental VH found in our study is both a matter of concern and
178 consistent with the percentage of negative perceptions of vaccine safety in the French general
179 population (45%) previously published [18]. This latter result should nonetheless be
180 interpreted with caution, as it refers to only one five-point Likert scale question (“*Overall I*
181 *think vaccines are safe*”) that may be interpreted differently in different cultural contexts.

182 These results may be due in part to the multiple controversies in France about various
183 vaccines over the past two decades [17,30] and physicians’ own hesitations towards certain
184 vaccines [31,32]. Results from our supplementary analysis suggest that vaccines against
185 hepatitis B and HPV are the two vaccines most frequently associated with parental VH
186 (Appendix Table 1). Parents may have been particularly marked by the controversy during the
187 hepatitis B school vaccination campaign among French adolescents in the late 1990s, as they
188 were themselves adolescents at that time. This campaign was suspended by the French
189 government in 1998, after several lawsuits by individuals diagnosed with a demyelinating
190 event (especially multiple sclerosis) after hepatitis B vaccination [30]. More recently,
191 controversy has arisen concerning the usefulness and safety of the HPV vaccine, including
192 within the French medical community, as well as about the use of hexavalent vaccines in
193 infancy [32,33].

194 4.3. *Social differentiation of VH and the mediating role of commitment and trust*

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

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

219 *4.4. VH and demographic factors*

220 The literature about the association between parental gender, family status, and
221 beliefs/attitudes/behaviors towards childhood vaccination offers mixed evidence
222 [12,13,25,28,38–40]. We found, as did the authors of a US study [28], that mothers delayed or
223 refused vaccination for children more often than fathers (Table 2 and Appendix Table 1). This
224 may reflect their greater fear of potential side vaccine effects [39] and their more frequent

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

230 4.5. Limitations

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

250 **5. Conclusions**

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

266 In addition to this new law, appropriate information and educational interventions remain
267 critical to help restore trust in authorities and vaccines [42,47,48]. Helping healthcare
268 professionals to learn to communicate with vaccine-hesitant parents is essential. Use of
269 motivational interviewing approaches (based on a compassionate, collaborative, and
270 autonomy-supportive relationship) and techniques (e.g., open-ended questions, reflective
271 responses) appears especially promising in reducing parental concerns about vaccines and
272 increasing vaccine uptake [49,50]. However, further interventional research is needed to
273 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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300

301 **Competing interests**

302 The authors declare that they have no competing interest.

303

304

305

306 **Authors' contributions**

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

312 All authors attest they meet the ICMJE criteria for authorship.

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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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480 **Table 2**
 481 Study population's sociodemographic characteristics, levels of commitment and trust, and
 482 associations with level of vaccine hesitancy (results from bivariate analyses, parents of
 483 children aged 1-15 years, 2016 *Baromètre santé*)

	Total sample (column % or mean ± SD, n=3,927)	VH level (line % or mean ± SD)				p- value ^a
		No VH (n=2,011)	Acceptor with doubts (n=554)	Delayer (n=272)	Refuser (n=1,090)	
Demographic characteristics						
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, Equivalentized 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

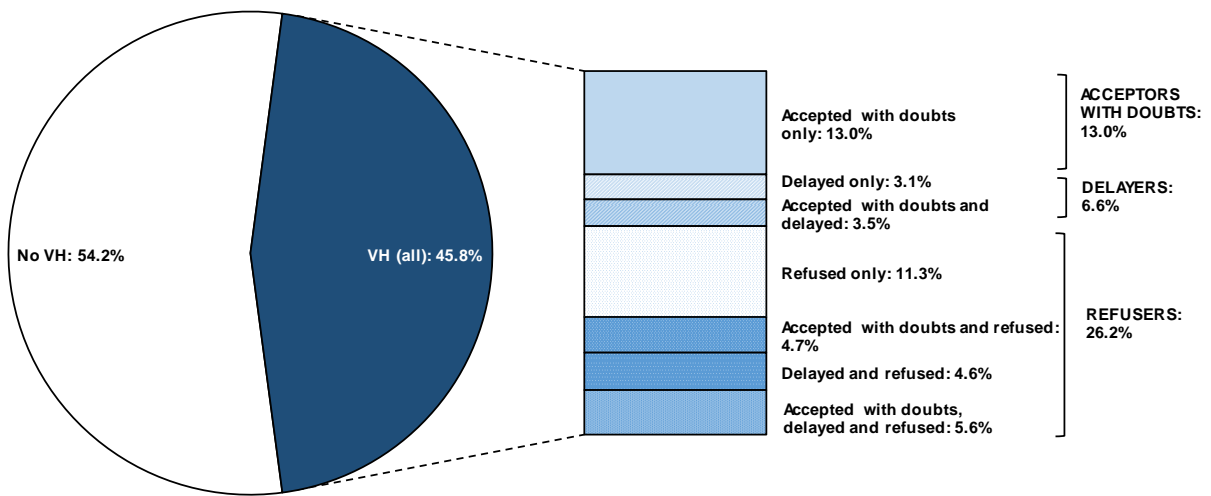
489 ^d To build the score, “*don't know/no response*” (<2% for all items) was coded at mid-point

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)

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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)				p-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

1 **Appendix Table 1**

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

	Total sample	VH level				p-value ^c
		No VH	Acceptor with doubts	Delayer	Refuser	
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	
<hr/>						
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

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

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

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

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

16 ^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

30 **Appendix Table 2**

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

	AOR [95%CI] (ref.: No VH)		
	<u>Acceptor with doubts</u>	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]

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

35 Vaccine hesitancy

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

37 ^a Bac: high school-leaving exam

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Appendix Box 1

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

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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.

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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].

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