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Parental vaccine hesitancy in Italy – Results from a national survey

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ABSTRACT

In Italy, in 2016, we conducted a cross-sectional survey to estimate vaccine hesitancy and investigate its determinants among parents of children aged 16–36 months.

Data on parental attitudes and beliefs about vaccinations were collected through a questionnaire administered online or self-administered at pediatricians' offices and nurseries. Parents were classified as pro-vaccine, vaccine-hesitant or anti-vaccine, according to self-reported tetanus and measles vaccination status of their child. Multivariable logistic regression was used to investigate factors associated with hesitancy.

A total of 3130 questionnaires were analysed: 83.7% of parents were pro-vaccine, 15.6% vaccine-hesitant and 0.7% anti-vaccine. Safety concerns are the main reported reason for refusing (38.1%) or interrupting (42.4%) vaccination. Anti-vaccine and hesitant parents are significantly more afraid than pro-vaccine parents of short-term (85.7 and 79.7% vs 60.4%) and long-term (95.2 and 72.3% vs 43.7%) vaccine adverse reactions. Most pro-vaccine and hesitant parents agree about the benefits of vaccinations. Family pediatricians are considered a reliable source of information by most pro-vaccine and hesitant parents (96.9 and 83.3% respectively), against 45% of anti-vaccine parents. The main factors associated with hesitancy were found to be: not having received from a paediatrician a recommendation to fully vaccinate their child [adjusted odds ratio (AOR): 3.21, 95% CI: 2.14–4.79], having received discordant opinions on vaccinations (AOR: 1.64, 95% CI: 1.11–2.43), having met parents of children who experienced serious adverse reactions (AOR: 1.49, 95% CI: 1.03–2.15), and mainly using non-traditional medical treatments (AOR: 2.05, 95% CI: 1.31–3.19).

Vaccine safety is perceived as a concern by all parents, although more so by hesitant and anti-vaccine parents. Similarly to pro-vaccine parents, hesitant parents consider vaccination an important prevention tool and trust their family pediatricians, suggesting that they could benefit from appropriate communication interventions. Training health professionals and providing homogenous information about vaccinations, in line with national recommendations, are crucial for responding to their concerns.

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1. Introduction

The World Health Organization (WHO) describes vaccine hesitancy as the "delay in acceptance or refusal of vaccination despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as complacency, convenience and confidence" (page 4163) [1]. This phenomenon is globally increasing in the general population [2–6].

Research has identified several factors associated with parental vaccine refusal and hesitancy [7–9]. In order to map these factors, the WHO SAGE Working Group classifies them under three categories: contextual (due to historical, socio-cultural, environmental, institutional, economic or political factors), individual and group (e.g. personal beliefs and attitudes about prevention or previous experiences with vaccinations), and vaccine/vaccination-specific (e.g. concerns about a new vaccine or formulation or about mode of administration or delivery) [1].

In 2013, staff from the WHO regional offices conducted interviews on reasons for vaccine hesitancy with immunization managers of thirteen countries, representing the six WHO Regions, confirming that causes of vaccine hesitancy varied in the different countries and also through-out the same country. This indicates a need to strengthen the capacity of countries to locally identify the relevant causal factors of vaccine hesitancy and to develop tailored strategies to address them [10].

In Italy, childhood vaccination coverage rates for various vaccine-preventable diseases have been decreasing since 2013. In 2016, the vaccination coverage rate for poliomyelitis in children at 24 months of age was below 95% [11]. This comes at a time when the WHO European Region is at risk for a poliomyelitis outbreak [12,13]. Moreover, in 2016, the vaccination coverage rate for measles in children at 24 months of age was only 87.3% [11] and a large measles epidemic occurred in Italy in 2017, with more than 4885 cases reported from January to December 2017 [14].

We carried out a cross-sectional survey to estimate the degree of parental vaccine hesitancy existing in Italy and investigate its determinants among parents of children aged 16–36 months.

2. Methods

2.1. Study population and data collection

The survey, coordinated by the Italian National Institute of Public Health (Istituto Superiore di Sanità), was conducted in the period December 2015 – June 2016, among parents of children aged 16–36 months. Data were collected: (i) through a Computer/Mobile Assisted Web Interviewing survey performed by an external research company that sampled participants from an online panel of Italian families, stratified to reflect the geographical distribution of the reference population by macro area (Northern, Central and Southern Italy); (ii) among parents attending pediatricians' offices and nurseries in five Italian Regions (Emilia-Romagna, Friuli Venezia Giulia, Marche, Piemonte, Puglia) who voluntarily completed a printed questionnaire.

The development of the questionnaire was informed by a literature review. It was tested within a group of 30 participants to evaluate clarity and appropriateness of questions, and modified accordingly. All participants were informed of the study aims and confidentiality of data. Online participants provided consent through an electronic form, whereas consent was considered implicit in parents who voluntarily and anonymously filled in a paper questionnaire.

2.2. Outcome and exposures

Self-reported vaccination status of children was assessed for tetanus, poliomyelitis, diphtheria, pertussis, *Haemophilus influenzae* type b (Hib), hepatitis B, measles, mumps, and rubella. To define vaccine hesitancy (outcome), measles and tetanus vaccinations were used as proxies of measles-mumps-rubella (MMR) and hexavalent vaccinations, respectively. Parents were classified as: (i) pro-vaccine if their child was vaccinated within the recommended age-intervals for both antigens, (ii) vaccine-hesitant if vaccination was delayed or interrupted for at least one of the two antigens, if their child was unvaccinated for one of the two antigens or if their child was not vaccinated at all but parents were still uncertain about the decision of vaccinating him/her, (iii) anti-vaccine if their child was unvaccinated for both antigens and parents were fully convinced of the decision not to vaccinate him/her. Parents were questioned about the main reason for refusal, delay or interruption. Parents reporting to have interrupted, delayed or refused vaccinations for the presence of one or more contraindications to vaccination were excluded.

The three groups were compared in terms of attitudes, beliefs and sources of information about vaccinations, and other variables (exposures). Attitudes and beliefs were explored through 26 questions on a 5-point agreement scale ranging from "Strongly agree" to "Strongly disagree" and including "I do not know", regarding parental perceptions, the usefulness and benefits of vaccinations, safety of vaccinations, acceptance of combined and co-administered vaccines, perceptions about the vaccination information received, confidence and opinion on family pediatricians and public immunization services. The use of different vaccination information sources was assessed together with perceived reliability. The latter was measured on a 5-point scale ranging from "Very reliable" to "Not reliable" and including "I do not know". Other aspects were evaluated: (i) whether parents had had any doubts about vaccinating their child; (ii) which advice on vaccinations was given to them by the family pediatrician, (iii) whether they had received discordant opinions on vaccinations from different health care professionals, (iv) whether they had met parents of children that had experienced serious reactions following vaccination, (v) which kind of treatments (traditional medicine/homeopathy/naturopathy or other types of non-traditional treatments) they principally used when their child was ill. Information on parental socio-demographic characteristics (nationality, geographical area of residence, educational level, employment status, employment in health care) were also collected. The complete questionnaire used for the survey is presented in supplementary file 1.

2.3. Statistical analysis

A sample size of at least 2646 individuals was determined necessary to detect as statistically significant at least a 1.5-fold increase in the proportion of hesitant parents in the exposed group compared to unexposed group, with a sufficient statistical power ($\geq$80%). The sample size calculation was based on the following assumptions: α-level equal to 0.05; expected percentage of hesitant parents (outcome) in the unexposed group $\geq$10%; and ratio of unexposed to exposed subjects $\leq$6.

We conducted a descriptive analysis of questionnaire responses using absolute frequencies with percentages (categorical variables) and means with standard deviation (SD) (continuous variables). The association between vaccine hesitancy and exposure variables was evaluated using the chi-square test. Exposure variables measured on a 5-point-scale were analysed excluding respondents who did not express an opinion and pooling them in two categories (e.g., "strongly agree or agree" and "disagree or strongly disagree").

Multivariable logistic regression comparing hesitant vs. pro-vaccine parents was used to evaluate the association between hesitancy and socio-demographic characteristics of parents. The main exposure variables significantly associated with vaccine hesitancy in bivariate analysis ($p < .05$) were also included in a multivariable logistic regression model while controlling for socio-demographic factors. The adjusted odds ratios (ORs) and their corresponding 95% confidence intervals (CIs) were used to describe the strength of the associations.

We analysed data using Stata/MP version 13 (StataCorp, Texas, USA).

3. Results

A total of 3230 questionnaires were collected: 1924 (59.6%) from pediatricians and nurseries and 1306 (40.4%) from the online survey. Most questionnaires (72.5%) were completed by the mothers. One hundred questionnaires were excluded because of incomplete/missing information about tetanus and/or measles vaccinations, leaving 3130 questionnaires available for the analysis. Socio-demographic characteristics of the sample are presented in Table 1.

3.1. Hesitancy

Vaccination coverage for tetanus (full series) was 94.6% at 16–24 months and 95.9% at 25–36 months; coverage for one dose of measles was 86.1% at 16–24 months and 88.8% at 25–36 months. The main reported reason for having delayed at least one of these vaccinations was the presence of contraindications (47.5%), whereas most of those who interrupted or refused vaccination took this decision because of doubts on vaccine safety (41.4 and 41.3%, respectively) (Table 2).

Table 1
Socio-demographic characteristics of the sample (n = 3130).

Number of children aged between 16 and 36 months (n, %)		
1	2743	89.6
2+	317	10.4
Geographical area (n, %)		
North	1627	52.0
Center	787	25.1
South and Islands	716	22.9
Age (n, %)		
Both parents < 35 years	788	25.2
One parent < 35 and the other ≥ 35 years	794	25.4
Both parents ≥ 35 years old	1548	49.5
Age (mean years ± SD)		
Mother's age	34.6	±5.4
Father's age	37.5	±6.1
The child's age	25.8	±6.4
Nationality (n, %)		
Both Italian parents	2811	89.8
One Italian and one foreign parent	169	5.4
Both foreign parents	150	4.8
Education (n, %)		
Both parents with a university degree	775	24.7
Only one parent with a university degree	944	30.2
No parent with a university degree	1411	45.1
Occupation (n, %)		
Both parents employed	2247	71.8
Only one parent employed	782	25.0
No parent employed	101	3.2
Occupation in health care (n, %)		
At least one parent employed in health care	413	13.2
No parent employed in health care	2717	86.8

SD, standard deviation.

After excluding 257 questionnaires reporting contraindications as the reason for having interrupted, delayed or not vaccinated their child against tetanus or measles, 2404 (83.7%) parents were classified as "pro-vaccine", 448 (15.6%) as "vaccine-hesitant" and 21 (0.7%) as "anti-vaccine", according to the definitions reported in Section 2.

We also asked parents if they had had any doubts about vaccinating their child and 39.5% of the whole sample answered positively; in particular 32.4% of pro-vaccine, 76.5% of hesitant and 52.4% of anti-vaccine parents declared to have had doubts ($p < .001$).

3.2. Parental beliefs about vaccinations

Hesitant parents were generally found to have an intermediate position between pro and anti-vaccine parents for most of the items related to vaccination beliefs (Table 3).

Regarding questionnaire statements on the usefulness and benefits of vaccinations, the position of hesitant parents was found to be closer to pro-vaccine than to anti-vaccine parents. In fact, over 90% of parents agreed or strongly agreed with the following statements: "if we stop vaccinating, very rare diseases could resurge" and "the whole community benefits from childhood vaccination". The proportions of parents who agree with these statements are significantly higher among pro-vaccine and hesitant parents than among anti-vaccine parents. Only 13% of parents believe that vaccination is not necessary if one conducts a healthy lifestyle and uses natural remedies; again, the percentage of parents who agree with this statement is significantly lower among pro-vaccine and hesitant parents (10.4% and 28.7%, respectively) than among anti-vaccine parents (84.2%) ($p < .001$).

Anti-vaccine and hesitant parents were found to be significantly ($p < .001$) more afraid than pro-vaccine parents of short-term (85.7 and 79.7% vs 60.4%) and long-term (95.2 and 72.3% vs 43.7%) vaccine adverse reactions. Also, a significantly higher proportion of anti-vaccine and hesitant parents believe that vaccinating children at three months of age is too early, with respect to pro-vaccine parents (95.0 and 71.7% vs. 26.7%). Finally, hesitant and anti-vaccine parents were found to be less in favor of combined and co-administered vaccines ($p < .001$).

Most hesitant (76.6%) and anti-vaccine (85.7%) parents think that healthcare professionals give information only about the benefits of vaccination but not about their risks, compared to 54.0% of pro-vaccine parents ($p < .001$).

Most pro-vaccine (88.4%) and hesitant parents (71.8%) consider their family pediatrician to be competent about vaccinations, against 47.4% of anti-vaccine parents ($p < .001$). Again, 71.8% of pro-vaccine and 64.2% of hesitant parents consider that their family pediatrician spends enough time discussing about vaccination, against 36.8% of anti-vaccine parents ($p < .001$). The proportion of parents who believe that public vaccination service staff spend enough time responding to vaccine-related doubts is low in all three groups but especially among anti-vaccine parents: 60.3% pro-vaccine, 42.9% hesitant and 19.1% anti-vaccine parents ($p < .001$).

Overall, 53.1% of parents believe that the number of state-offered vaccinations is influenced by economic interests of pharmaceutical companies (Table 3).

3.3. Sources of information about vaccinations

Family pediatricians are the most frequently consulted source of information for pro-vaccine (90.0%) and hesitant (74.3%) parents, but this is not so for anti-vaccine parents (38.1%). The latter reported that their main source of information are trusted physicians (other than the family pediatrician) and associations against vaccination (Table 4). A low proportion of parents mentioned

Table 2
Main reason for having delayed, interrupted or not having performed one or more vaccinations.

	Delay (N = 366)		Interruption (N = 29)		Refusal (N = 310)	
	n	%	n	%	n	%
Diseases/health conditions that have not allowed vaccination (contraindications)	174	47.5	12	41.4	82	26.5
Doubts related to the safety of vaccinations	81	22.1	12	41.4	128	41.3
I thought my child was too young	53	14.5	0	0	29	9.4
Doubts related to the usefulness of vaccinations	28	7.6	2	6.9	43	13.9
Forgetting/unable to comply with the appointment date for personal reasons	12	3.3	0	0	7	2.3
I received the invitation too late	11	3.0	0	0	4	1.3
Healthcare providers suggested me not join the vaccination program	1	0.3	2	6.9	6	1.9
Religious reasons	1	0.3	0	0	0	0
Other	5	1.4	1	3.4	11	3.5

public vaccination services (33.4%) among the three main consulted sources of information on vaccinations.

Overall, 60.2% of parents consult the web for information on vaccinations, mainly generic searches on Google or other search engines (43.7%) and institutional websites (eg. Ministry of Health, National Institute of Health, Italian Agency for Medicine) (43.1%). However, only 26.7% of parents ranked the web among the three main sources of information used (Table 4).

Over 90% of parents reported that their family pediatrician and trusted physicians other than the family pediatrician, are a very or sufficiently reliable source of information on vaccinations; 80.4% consider public immunization services staff as a very or sufficiently reliable source of information. These proportions are higher among pro-vaccine and hesitant parents than among anti-vaccine parents (Table 4). Instead, only 32.6% of the sample considers the web a reliable source of information and this proportion is higher among anti-vaccine than pro-vaccine and hesitant parents (Table 4).

Out of 1820 parents who consulted more than one healthcare professional, 22.9% received discordant opinions about vaccinations. This proportion is significantly lower among pro-vaccine (17.1%) than hesitant (49.8%) and anti-vaccine (71.4%) parents (Table 4).

Overall, 83.8% of parents reported to have been advised, by their family pediatrician, to fully vaccinate their children; 9.7% reported that their family pediatrician advised them to partially vaccinate or to not vaccinate him/her; 6.5% declared that their family pediatrician did not give any recommendations about vaccinations (Table 4).

3.4. Determinants of vaccine hesitancy

According to the multivariable analysis presented in Table 5, having two or more children aged 16–36 months, residing in central or southern Italy, and having Italian citizenship were all significantly associated with hesitancy (model 1). After adjustment for socio-demographic variables, the following factors were also found to be associated with hesitancy: not having received by the family pediatrician a recommendation to fully vaccinate their child, having received discordant opinions on vaccinations by various health professionals, having personally met parents of children who had experienced serious adverse reactions after vaccination, and mainly using complementary medicine for their children (model 2). A high degree of hesitancy was also observed among parents who reported not trusting pediatricians and public immunization services, and among those who consider associations against vaccinations as a reliable source of information.

4. Discussion

In our sample the proportion of vaccine-hesitant parents was 16%, whereas less than 1% of parents are fully opposed to vaccinations; 39% of all the parents had had some doubts about vaccinating their children. These results are in agreement with two surveys carried out in Canada in 2014 and Australia in 2012, respectively. According to these surveys, 19% and 8% of parents, respectively, reported that their children were unimmunized or partially immunized and 40% and 52%, respectively, declared having had concerns about vaccinating their child [15,16]. However, a variable proportion of hesitant parents across countries is expected, given that hesitancy has been shown to be country- and time-specific [1,10] and that the definition of hesitancy can vary across studies.

Pro-vaccine, hesitant and anti-vaccine parents were found to have very different beliefs about vaccinations. Hesitant and anti-vaccine parents have more doubts about the safety of vaccines compared with pro-vaccine parents and are less favorable to the use of combined and co-administered vaccines. They fear immediate reactions following vaccination more than pro-vaccine parents but the three groups differ especially regarding their fear of long-term reactions. This finding is in agreement with another study on vaccine hesitancy conducted in the Veneto region in northern Italy from 2009 to 2011, using a similar methodology [17].

Unsurprisingly, safety concerns were the main reported reason for refusing vaccination, confirming other findings reported in the literature [7,8,15]. Vaccine safety was found to be a concern for all parents. Despite the fact that many studies have refuted any increased risk of developing autism following vaccination [18,19], 21% of parents in our study still believe that vaccines can cause autism. Also, even though thimerosal is no longer used as a preservative for vaccines (except for multidose influenza vaccine), 44% of parents believe that many vaccines contain "mercury". Again, 32% of parents are also concerned that their child's immune system could be weakened by vaccination.

Health care professionals play a key role in informing parents about vaccinations. In fact, family pediatricians and other doctors were found to be the most consulted and trusted sources of information among pro-vaccine and hesitant parents. Having received a recommendation by their pediatrician to fully vaccinate their child appears to have significantly affected parental decision about vaccination. Consistently with findings from other studies, these results confirm the crucial role of family pediatricians in influencing parental choice about vaccination [8,15].

However, only 84% of parents reported having received a recommendation by their pediatrician to fully vaccinate their child, confirming that vaccine hesitancy is also a concern of health professionals, as reported in literature [2,8,20].

The proportion of parents who would consult public immunization services in case of doubts on vaccination is low in the overall sample (33%). This finding is in agreement with results from two knowledge-attitude-practice surveys on vaccination against human papillomavirus conducted in Italy [21,22]. Even though childhood vaccinations in Italy are offered and administered almost exclusively in the public sector, the general population does not consider immunization services providers as a reference point for information about vaccinations. Parents generally prefer to

Table 3
Beliefs regarding vaccinations: agreement degree on survey items of pro-vaccine, hesitant, and anti-vaccine parents.

Survey items	All parents n (%)*	Pro-vaccine n (%)*	Hesitant n (%)*	Anti-vaccine n (%)*	p-value
Usefulness and benefits of vaccinations					
If we stop vaccinating, very rare diseases could resurge	2562 (92.4)	2236 (96.3)	323 (75.1)	3 (14.3)	<.001
The whole community benefits childhood vaccination	2533 (91.3)	2214 (95.2)	318 (74.1)	1 (5.0)	<.001
Mandatory vaccines are more important than non-mandatory	1552 (57.6)	1288 (57.2)	262 (62.4)	2 (9.5)	<.001
Vaccination is not necessary if you follow healthy lifestyles or natural remedies	368 (13.8)	234 (10.4)	118 (28.7)	16 (84.2)	<.001
I do not think vaccinations are useful: the diseases they prevent are not so serious	412 (15.2)	281 (12.4)	122 (28.8)	9 (47.4)	<.001
Safety of vaccinations					
I am afraid of the adverse events that may occur immediately after vaccination	1798 (63.6)	1427 (60.4)	353 (79.7)	18 (85.7)	<.001
I am afraid of possible damage that can occur years after vaccination	1358 (48.6)	1019 (43.7)	319 (72.3)	20 (95.2)	<.001
Vaccines cause autism	453 (21.1)	288 (16.2)	149 (42.3)	16 (88.9)	<.001
Vaccines weaken or overload the immune system	805 (32.6)	529 (25.8)	261 (65.1)	15 (83.3)	<.001
Vaccinate at the third month of life is too early and it is better to wait for the baby to grow	884 (34.6)	564 (26.7)	301 (71.7)	19 (95.0)	<.001
Some vaccines are more dangerous than the infections they prevent	707 (28.1)	450 (21.5)	238 (58.3)	19 (95.0)	<.001
Many vaccines contain thiomersal	637 (43.9)	410 (36.8)	210 (65.4)	17 (100.0)	<.001
Combined and co-administered vaccines					
I would prefer not to give my child more vaccines in the same vaccine session	1252 (47.8)	920 (42.3)	316 (74.4)	16 (88.9)	<.001
Combined vaccines limit the freedom to choose which vaccinations to accept	1249 (47.9)	906 (42.0)	324 (75.9)	19 (90.5)	<.001
Combined vaccines overload the immune system	1090 (45.6)	767 (39.1)	304 (74.3)	19 (90.5)	<.001
Information received on vaccinations					
When I took a decision about my child vaccination I did not feel properly informed	1087 (39.8)	853 (37.4)	228 (53.2)	6 (30.0)	<.001
Healthcare professionals give information on the benefits of vaccination but not on the risks	1592 (57.8)	1241 (54.0)	333 (76.6)	18 (85.7)	<.001
Beliefs on family pediatrician					
A vaccination recommended by the family pediatrician is safe	1832 (67.4)	1657 (72.9)	175 (41.4)	0 (0)	<.001
My pediatrician spends enough time about vaccines topic	1920 (70.4)	1640 (71.8)	273 (64.2)	7 (36.8)	<.001
My pediatrician is competent on vaccination	2194 (85.5)	1903 (88.4)	282 (71.8)	9 (47.4)	<.001
The opinion of my pediatrician is crucial to make a decision about vaccinations	1853 (67.1)	1651 (71.4)	199 (46.4)	3 (15.0)	<.001
Beliefs on immunization services of local health units					
The offer of vaccines by local health units is influenced by the economic interests of pharmaceutical companies	1285 (53.1)	951 (47.9)	313 (76.0)	21 (100)	<.001
The free of charge vaccinations offered by local health units are too many	631 (24.4)	429 (19.8)	185 (46.8)	17 (89.5)	<.001
A vaccination recommended by local health units is safe	1796 (66.0)	1646 (72.3)	150 (35.6)	0 (0)	<.001
Public immunization service staff spend enough time to respond to any vaccine-related doubts	1531 (57.3)	1345 (60.3)	182 (42.9)	4 (19.1)	<.001
Public immunization service staff is competent on vaccinations	1929 (75.5)	1714 (80.3)	214 (53.5)	1 (5.3)	<.001

* Number and percentage of parents reporting to agree or strongly agree the survey items among those who expressed an opinion (column percentages do not add up to 100% because statements within each survey domain are not mutually exclusive).

consult their family pediatricians, who know their child's full clinical history, rather than the immunization services which are perceived only as a place for vaccine administration.These services could potentially play a central role in this regard, however, the lack of adequate human resources negatively affects the amount of time staff are available to talk with parents before and after administering vaccines. To build population trust toward public immunizations services, health care workers involved in administering vaccines should be adequately trained not only on technical aspects of vaccination but also to improve their counseling skills.

An extensive literature review [8] has recently highlighted that the credibility of institutions that deliver vaccination information seems to influence vaccination acceptance more than the information content itself. Some findings from our survey also highlight that various forms of mistrust exist: in particular, more than half of parents believe that the economic interests of pharmaceutical companies influence vaccination policy, and that health care professionals provide information only on vaccination benefits but do not discuss the risks.

Hesitant parents' perceptions of the usefulness and benefits of vaccination is similar to that of pro-vaccine parents. Most hesitant parents think that very rare diseases could resurge if we stop vaccinating and that the whole community benefits from vaccination, suggesting that hesitant parents still consider vaccinations a valid tool for prevention.

In order to increase vaccine confidence, health care providers should provide univocal messages and information to parents. On the contrary, our study showed that 23% of parents who consulted more than one physician reported to have received discordant opinions. Similar findings have been reported in a national survey focused on HPV vaccination [21].

Although 60% of interviewed parents search for information on the Internet, the web is not ranked among the three most consulted sources of information and is considered very/sufficiently reliable only by 33% of parents. This suggests that the population is aware that the quality of information found in the web can be highly variable and has to be carefully evaluated. Previous studies on vaccinations conducted in Italy [17,21] concluded that it might be useful to increase the activism of institutions and scientific societies to address misleading antivaccination contents appearing in web sites and in social media.

Table 4
Sources of information on vaccinations for pro-vaccine, hesitant, and anti-vaccine parents.

Survey items	All parents n (%)	Pro-vaccine n (%)	Hesitant n (%)	Anti-vaccine n (%)	p-value
If you have any doubts about the risks or the real benefits of a vaccine, which of the following sources would you consult for information?*					
Family pediatrician	2505 (87.2)	2164 (90.0)	333 (74.3)	8 (38.1)	<.001
Other doctors of trust	1176 (40.9)	967 (40.2)	199 (44.4)	10 (47.6)	.208
Public immunization services	960 (33.4)	847 (35.3)	110 (24.6)	3 (14.3)	<.001
Associations against vaccinations	264 (9.2)	165 (6.9)	89 (19.9)	10 (47.6)	<.001
Web	768 (26.7)	620 (25.8)	142 (31.7)	6 (28.6)	.034
Friends/family	359 (12.5)	293 (12.2)	63 (14.1)	3 (14.3)	.528
How reliable are the following sources of vaccine information?**					
Family pediatrician	2653 (94.4)	2281 (96.9)	363 (83.3)	9 (45.0)	<.001
Other doctors of trust	2490 (94.0)	2108 (95.4)	368 (87.4)	14 (73.7)	<.001
Public immunization services	2136 (80.4)	1894 (85.6)	237 (55.9)	5 (26.3)	<.001
Associations against vaccinations	701 (29.2)	479 (24.3)	207 (50.4)	15 (79.0)	<.001
Web	851 (32.6)	674 (31.1)	166 (39.3)	11 (61.1)	<.001
Friends/family	1004 (38.9)	833 (38.9)	164 (39.1)	7 (38.9)	.995
Did you receive information about pediatric vaccinations in the hospital where the birth took place?					
No/the staff just informed us to contact the immunization service or family pediatrician	2073 (80.5)	1723 (80.5)	333 (79.9)	17 (94.4)	.311
Yes	503 (19.5)	418 (19.5)	84 (20.1)	1 (5.6)	
Did you receive information about pediatric vaccinations during the prenatal course?***					
No/the staff just informed us to contact the immunization service or family pediatrician	1398 (70.3)	1157 (70.4)	232 (69.9)	9 (69.2)	.977
Yes	590 (29.7)	486 (29.6)	100 (30.1)	4 (30.8)	
Did you receive information about pediatric vaccinations by the gynecologist/obstetrician who followed the pregnancy?					
No/the staff just informed us to contact the immunization service or family pediatrician	2229 (84.2)	1875 (85.2)	338 (79.5)	16 (80.0)	.012
Yes	417 (15.8)	326 (14.8)	87 (20.5)	4 (20.0)	
With regard to vaccinations offered free of charge from public immunization services, which advice did your family pediatrician give to you?^					
Advised me to do all vaccinations	2235 (83.8)	1950 (87.9)	270 (63.1)	15 (75.0)	
Advised me to only do some vaccinations	246 (9.2)	127 (5.8)	116 (27.1)	3 (15.0)	
Advised me not to do any vaccination	13 (0.5)	3 (0.1)	9 (2.1)	1 (5.0)	<.001
Did not express an opinion about whether to do or not to do vaccination	172 (6.5)	138 (6.2)	33 (7.7)	1 (5.0)	
Did you receive discordant opinions on vaccinations by various health professionals?^^					
Yes	416 (22.9)	257 (17.1)	149 (49.8)	10 (71.4)	<.001
No	1404 (77.1)	1250 (82.9)	150 (50.2)	4 (28.6)	

* A maximum of the options was allowed (column percentages do not add up to 100% because the listed sources of information are not mutually exclusive).
** Number and proportion of parents reporting to consider very/sufficiently reliable each source among those who expressed an opinion (column percentages do not add up to 100% because the listed sources of information are not mutually exclusive).
*** Only among parents who reported to have participated in a prenatal course.
^ Only among parents who reported to have discussed vaccines with their family pediatrician.
^^ Only among parents who reported to have consulted one or none health professional.

Generally, data on the effectiveness of interventions to address parental vaccine hesitancy is limited [9,23]. Interventions with multiple components seem to be the most effective [24,25]. The Italian Ministry of Health has recently promoted several interventions to address the problem of vaccine hesitancy. For example, the present survey is part of a wider project aimed at developing national communication material for promoting vaccination [26,27] and a national toll free number for responding to vaccination concerns was successfully piloted [28]. Moreover, a law to introduce mandatory vaccinations (against poliomyelitis, diphtheria, tetanus, pertussis, hepatitis B, Hib, measles, mumps, rubella, varicella) for enrollment in nursery schools and kindergartens was approved in 2017 [29,30]. Further studies are therefore needed in the next years to evaluate the effectiveness of these interventions on either vaccination uptake and/or changes in hesitant parents' profile and attitudes.

The findings of our survey are in line with the results of a 2016 large-scale study on worldwide attitudes to immunization conducted in 67 countries [31]. According to this study, Italy is ranked among the WHO European Region countries with the highest levels of skepticism related to the importance of vaccinations (15.9%), effectiveness-related doubts (19.3%) and safety-based vaccine skepticism (22.7). This finding is consistent with immunization coverage data [32]: in 2015 Italian coverage rates for DTP and MMR (93.5% and 85% respectively) were among the lowest of all European countries.

Finally, in agreement with the results of the vaccine hesitancy survey conducted in Veneto Region and mentioned above [17], we found that hesitancy was significantly associated with having more than one child aged 16–36 months and being of Italian citizenship. In contrast with that study, we did not find any association with parental educational level and employment in health care [17].

Some limitations of this study must be addressed. The geographical distribution of our sample slightly differs from that of the reference study population [33]. Families residing in north-central Italy were over-sampled in some regions and this could have introduced a bias in our estimates because of the likely association between hesitancy and area of residence.

Hesitancy was defined according to the child's vaccination status that was reported by parents. Hesitancy rates could therefore be over or under-estimated because of recall and/or social desirability bias. However, it should be noted that estimates of vaccination coverage for tetanus and measles at 24 months of age (94.6 and 86.1% respectively) are consistent with official national figures (93.7% and 87.3% in 2016 respectively) [11], suggesting that self-reporting is not likely to have introduced a bias. Finally, the sample size did not allow us to make inferences at the regional level with an adequate statistical power.

Table 5
Determinants of vaccine hesitancy.

Characteristics		Hesitancy* n (%)	Bivariate analysis OR crude	95%CI	Multivariable analysis** OR*** adj	95%CI
Multivariable Model 1 (n = 2698) – association between vaccine hesitancy and socio-demographic characteristics						
Who took the decision about vaccinations	Mother	103 (15.8)	1		1	
	Father	11 (21.6)	1.47	0.73–2.95	1.23	0.59–2.53
	Both	331 (15.6)	0.98	0.77–1.25	0.91	0.69–1.19
Number of children aged 16–36 months	1	384 (15.3)	1		1	
	2+	60 (21.1	1.48	1.09–2.00	1.42	1.03–1.96
Geographical area	North	171 (11.3)	1		1	
	Center	149 (21.4)	2.15	1.69–2.73	2.12	1.66–2.72
	South	128 (20.1)	1.98	1.54–2.55	1.80	1.39–2.33
Nationality^	Italian	425 (16.6)	1		1	
	Not Italian	17 (6.7)	0.36	0.22–0.59	0.43	0.26–0.73
Parental age^	≤35 years	203 (16.1)	1		1	
	>35 years	239 (15.5)	0.95	0.78–1.17	0.92	0.74–1.15
Age of the child	≤24 months	216 (17.6)	1		1	
	>24 months	232 (14.3)	0.78	0.64–0.95	0.81	0.66–1.01
Education^	Secondary education or lower	183 (13.7)	1		1	
	University degree or higher	261 (17.7)	1.35	1.10–1.66	1.21	0.97–1.51
Employment^	Employed	419 (16.2)	1		1	
	Not employed	26 (11.2)	0.65	0.43–0.99	0.62	0.39–1.00
Employment in health care^	No	377 (15.5)	1		1	
	Yes	64 (17.7)	0.85	0.64–1.14	0.87	0.64–1.19
Multivariable Model 2 (n = 1259) – association between vaccine hesitancy and other variables						
Pediatrician advice on vaccinations offered free of charge from public immunization services	Advised to do all of them	270 (12.2)	1		1	
	Advised to do only some of them/not to do any vaccination/ no advice	158 (37.1)	4.26	3.37–5.38	3.21	2.14–4.79
Having received discordant opinions on vaccinations by various health professionals	No	150 (10.7)	1		1	
	Yes	149 (36.7)	4.83	3.71–6.29	1.64	1.11–2.43
Having personally met a parent of a child who experienced serious reactions after immunization	No	184 (9.7)	1		1	
	Yes	240 (28.8)	3.76	3.03–4.65	1.49	1.03–2.15
Kind of treatments principally used when children are ill	Traditional medicine	330 (13.4)	1		1	
	Non-traditional medical treatments	111 (31.3)	2.94	2.28–3.79	2.05	1.31–3.19
Reliability of the following source of information about vaccinations						
Family pediatrician	Yes	363 (13.7)	1		1	
	No	73 (49.7)	6.20	4.40–8.72	2.58	1.32–5.04
Trusted physicians, other than family pediatrician	Yes	368 (14.9)	1		1	
	No	53 (34.4)	3.01	2.12–4.27	0.94	0.49–1.80
Public immunization services	Yes	237 (11.1)	1		1	
	No	187 (37.0)	4.68	3.74–5.87	2.94	1.96–4.40
Associations against vaccinations	Yes	207 (30.2)	1		1	
	No	204 (12.1)	0.32	0.25–0.39	0.50	0.35–0.73
Web	Yes	166 (19.8)	1		1	
	No	256 (14.6)	0.69	0.56–0.86	1.00	0.69–1.46
Friends/Family	Yes	164 (16.4)	1		–	–
	No	255 (16.3)	0.99	0.80–1.23	–	–
Received information about pediatric vaccinations						
In the birth hospital	Yes	84 (16.7)	1		–	–
	No	333 (16.2)	1.04	0.80–1.35	–	–
During the prenatal course	Yes	100 (17.1)	1		–	–
	No	232 (16.7)	1.03	0.79–1.33	–	–
By the gynecologist/obstetrician who followed the pregnancy	Yes	338 (15.3)	1		1	
	No	87 (21.1)	1.48	1.14–1.93	1.02	0.68–1.55

OR, odds ratio; CI, confidence interval.
^ These variables are referred to the parent who took the decision about vaccinations.
* The analysis was conducted excluding the 21 anti-vaccine parents.
** Only variables significantly associated with vaccine hesitancy in bivariate analysis ($p < .05$) were included in the multivariable models.
*** OR adjusted for all variables included in the corresponding model (ORs from model-2 are also adjusted for variables included in model-1).

5. Conclusions

Vaccine safety is perceived as a problem by all parents, although hesitant and anti-vaccine parents appear more concerned than pro-vaccine parents, as well as less favorable to using combined vaccines and to vaccine co-administration. Like pro-vaccine parents, vaccine-hesitant parents still consider vaccination an important prevention tool and trust family pediatricians, suggesting that appropriate communication and information interventions aimed at increasing trust in vaccination may improve uptake.

The integration of multiple strategies and interventions, targeting both population and health professionals, is necessary to reduce parental hesitancy [8,34]. More efforts are required to strengthen training of different professional profiles. Providing

univocal information and advice about vaccinations to parents, in line with national official recommendations, is crucial for building relationships of trust with vaccine-hesitant parents and for supporting pro-vaccine parents.

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Competing interests

The authors declare that they have no competing interest.

Authors' contributions

CG designed the study, prepared the material, coordinated and monitored the study activities, analyzed the data, interpreted the results, drafted and edited the manuscript. MCR designed the study, prepared the material, interpreted the results and edited the manuscript. MF designed the study, analyzed the data, interpreted the results and edited the manuscript. AF designed the study, interpreted the results and edited the manuscript. AB, FD, MD and CR designed the study, interpreted the results and critically revised the manuscript. LF, DF, TG, DM, MGP and RP revised the material used for the study, coordinated the activities at regional level and critically revised the manuscript. All authors read and approved the final manuscript.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.vaccine.2017.12.074.

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