Knowledge and beliefs on vaccines among a sample of Italian pregnant women: results from the NAVIDAD study

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ABSTRACT

Background

Vaccine hesitancy is an emerging phenomenon in European countries and leads to decreasing trends in infant vaccine coverage. The aim of this study was to analyse the level of confidence and correct awareness about immunizations, which are crucial for the success of vaccination programmes.

Methods

As part of the NAVIDAD multicentre study, we examined vaccination confidence and complacency among a sample of 1820 pregnant women from 14 Italian cities. The questionnaire assessed the interviewee's knowledge, beliefs and misconceptions, as well as their socioeconomic status, information sources about vaccines and confidence in the Italian National Healthcare Service.

Results

Only 9% of women completely believed to the efficacy, necessity and safety of vaccinations. Almost 20% of them had misconceptions on most of the themes. There was a significant difference in the level of knowledge considering educational level: women with a high educational level have less probability of obtaining a low knowledge score (OR 0.43[95%CI 0.34-0.54]). The level of knowledge was also influenced by the sources of information: women who received information from their general practitioner and from institutional websites had a significantly lower chance of having misconceptions (OR 0.74[95%CI 0.58-0.96]; OR 0.59[95%CI 0.46-0.74]). Finally, the results underlined the influence of trust in healthcare professional information on the likelihood of having misconceptions (OR 0.49[95%CI 0.27-0.89]).

Conclusions

The data suggest the efficacy of general practitioners and institutional websites as a source of information to contrast misconceptions and underline the importance of confidence in the healthcare system to increase complacency and confidence in vaccines.

Keywords

Knowledge, beliefs, misconceptions, vaccines, vaccine hesitancy

INTRODUCTION

Immunization programmes are the most powerful tools to reduce the burden of preventable infectious diseases and to decrease related morbidity, mortality and healthcare costs[1–5]. From this perspective, the World Health Organization European Region Vaccine Action Plan 2015-2020 (WHO EVAP) emphasizes the importance of implementing effective immunization policies[6]. In Italy, with the purpose of conforming the regional strategies, the Ministry of Health has conceived the National Immunization Prevention Plan (PNPV). The PNPV is a guiding document for immunization policies that have set out, inter alia, national target coverage rates[7,8]. Polio, hepatitis B, tetanus and diphtheria coverage rates have shown a negative trend since 2013, with coverage below 95%, while vaccine coverage for measles, mumps and rubella has never reached the 95% coverage target[9]. Therefore, PNPV immunization targets have been only partially met. Furthermore, in Italy and in some other European settings, vaccination hesitancy is emerging, which is likely to reduce trends in infant vaccine coverage[10].

In 2012, the Strategic Advisory Group of Experts (SAGE) Working Group defined the term "vaccine hesitancy" as the "delay in acceptance or refusal of vaccination despite the availability of vaccination services"[11]. Vaccine hesitancy is complex and context specific and varies across time, place and vaccines. Moreover, vaccine hesitancy includes factors such as convenience, complacency and confidence[12].

Vaccination convenience results from physical availability, affordability, structure accessibility and ability to understand (language and health literacy). Vaccination complacency occurs when the perceived risks of vaccine-preventable diseases are low, and vaccination is not considered a needed preventive action. Confidence refers to trust in the effectiveness and safety of vaccines, in the immunization system, and in the motivations of policy-makers who decide on the necessary vaccines[13].

In Italy, vaccination is actively offered to target population groups and administered free of charge by public immunization services, which are located all over the country. Despite this, the phenomenon of vaccine hesitancy is present and widespread. In this context, an important role is played by the confidence in vaccines and in health services and by the perception of the risk of vaccine-preventable diseases.

Pregnant women are of great interest in the field of public health since they will soon make vaccine-related decisions and represent a population particularly at risk of vaccines hesitancy[14]. As part of the NAVIDAD multicentre study[15], we examined the level of knowledge about vaccinations and the diffusion of anti-vaccine beliefs among a sample of Italian pregnant women. We then investigated possible factors associated with a low level of knowledge and the presence of misconceptions, that could affect confidence and complacency and, therefore, underpin the growing phenomenon of vaccine hesitancy in Italy.

METHODS

A cross-sectional multicentre study was conducted interviewing 1820 pregnant women from 14 Italian cities (from north, centre and south of Italy), through a non-self-compiling paper questionnaire. Convenience sampling was used to recruit participants: they were enrolled from September 2016 to May 2017 among patients waiting for a gynaecological, ultrasound or haematological examination in the reference hospitals of the cities involved in the study. The Ethics Committee of the centre leader of the research, the Hospital ‘‘A.O.U. Città della Salute e della Scienza di Torino”, approved the execution of this study. The full methodology has been described and published[15].

The questionnaire consisted of seven sections. Each section investigated:

1. the socio-economic framing (patient age, qualification, occupation, ...);
2. whether she intended to vaccinate her child and for which pathologies;
3. the sources through which the woman had sought and obtained information about vaccinations;
4. the degree of confidence of the woman in healthcare workers;
5. the perception of the frequency and severity of the major preventable pathologies with vaccinations;
6. an assessment of her vaccine knowledge, beliefs and misconceptions;
7. the interviewee's opinion on the restoration of mandatory vaccines.

This paper focuses on section 6, “interviewee’s vaccines knowledge, beliefs and misconceptions”, and evaluates their association with different factors: socio-economic framing, information sources and trust in the health care system (sections 1, 3 and 4).

Population and sample size

The sample was defined based on demographic data of the resident population, taking into account the number of new-borns in the cities included[16]. Considering the MPR vaccine coverage is 86.7%[17], it was possible to provide an estimation of the number of interviews necessary to obtain valid data[18,19]. We considered a −10% MPR vaccine coverage as "worst acceptable" for results to find a very conservative value. The confidence level was set at 95%, the power of the study was 80%. The sample size was then calculated using the statistical software EpiInfo 7.0. To be statistically representative, the final sample was expected to be in the range of 1764 and 2296 subjects.

Statistical analyses

A total of 1,820 questionnaires were processed by using SPSS 24 Statistical software for Windows.

First, a descriptive analysis of vaccine knowledge, beliefs and misconceptions was conducted, describing the sample as agree/disagree/don't know to the items.

Univariate and multivariate analyses were conducted to estimate the impact of the socio-demographic frame, trust in the health care system and information sources on the level of each woman's vaccine knowledge. Based on data collected from section, 6 "interviewee's vaccine knowledge, beliefs and misconceptions", in univariate analysis, the dependent variable was described as "high knowledge level" or "low knowledge level". If the number of "agree" and "don't know" on false myths was at least 4 out of 13, the interviewee was considered to have a "low knowledge level". In contrast, if the number of "agree" and "don't know" on false myths was at most 3 out of 13, the interviewee was considered to have "high knowledge level".

The covariates included in the final model were selected using a stepwise forward selection process, with the criterion of a p-value at univariate <0.25[20]. The results are expressed as odds

ratios (OR) with 95% confidence intervals (CIs) and the p-value ≤0.05 was considered significant for all analyses.

RESULTS

A total of 1820 pregnant women were interviewed.

The median age of the sample was 32.5 years (IQR 29-36). Most women declared themselves to be Italian (90.8%), married or living with a partner (91.9%) and primiparous (63.4%). Approximately half of the sample affirmed having obtained at least a university degree (46.8%). The whole sample has already been described in a previous study[15].

Knowledge, beliefs and misconceptions

We investigated knowledge and beliefs about the vaccination of 1820 pregnant women. The results are shown in Table 1.

Approximately 20% of the sample did not believe that vaccines prevent potentially deadly diseases and that if we stop using vaccines many diseases could return. Moreover, approximately 30% of interviewed women did not think that some vaccine-preventable diseases are still common due to low vaccination coverage. They also did not agree that, by immunizing their child, they protect other children who are too young or too sick to be vaccinated.

Furthermore, almost 30% of them did not believe that vaccination benefits outweigh the risks and 13.5% of the sample thought that the diseases we want to prevent are less dangerous than the vaccination itself. The same percentage affirmed that a healthy lifestyle may be sufficient to prevent diseases and 16% did not know how to answer the question.

Of the sample, more than 20% did not agree that most vaccine side effects are mild and tolerable and 30% did not think that vaccines are sufficiently tested. Furthermore, approximately 70% of the women did not believe that scientific studies demonstrate that there is no connection between autism and vaccination.

Finally, 30% of the future mothers interviewed did not think that the vaccination schedule was designed to protect children at an early stage. Moreover, approximately 20% of them believed that vaccination is performed on babies that are too young and that their immune system has difficulties dealing with multiple vaccinations.

We then grouped the sample according to their beliefs and misconceptions. In the overall sample, 9% of women completely believed the efficacy, necessity and safety of vaccinations. Almost 20% of them had misconceptions on most of the themes or did not provide an answer to them. We created two groups: women with a low level of knowledge (who did not dissent from four or more anti-vaccine beliefs) (55.8%, N 1016) and women with a higher level of knowledge about vaccinations (44.2%, N 804).

Univariate analysis and multivariate analysis

In Table 2, the main socio-demographic features of the sample are described, together with the information sources and trust in the health care system, stratified by the level of knowledge about vaccinations.

Table 3 describes the likelihood of obtaining a low level of knowledge.

After adjusting for confounding factors, women from the centre of Italy had a lower likelihood of having misconceptions towards vaccinations compared with women from the north (OR 0.72, [95%CI 0.55-0.94]). Moreover, foreign women have statistically less knowledge about vaccinations than Italian women (OR 0.57 [95%CI 0.36-0.88]). There was a significant difference in the level of knowledge also considering educational level: women with a college degree were likely to obtain a higher score than women with a lower educational level (OR 0.43 [95%CI 0.34-0.54]). Additionally, pregnant women younger than 33 years had a statistically lower level of knowledge compared to older women (OR 0.79

[95%CI 0.63-0.99]). Finally, a primiparous woman has a higher likelihood of having misconceptions, than a multiparous woman (OR 2.01 [95%CI 1.57-2.55]).

The level of knowledge and the number of misconceptions were also associated with the information sources. Women who received information from their general practitioner (GP) and institutional websites had a significantly lower risk of having misconceptions than women who did not use these sources (OR 0.74 [95%CI 0.58-0.96]; OR 0.59 [95%CI 0.46-0.74]). Furthermore, the results underlined the association between the level of knowledge about vaccinations and pregnant women's trust in the healthcare system. Women who declared to have confidence in information from healthcare professionals are at lower risk of having misconceptions about vaccinations (OR 0.49 [95%CI 0.27-0.89]). By contrast, women who trusted more private healthcare professionals than those engaged by the Italian National Health Service have a significantly greater chance to believe in false myths (OR 1.37 [95%CI 1.02-1.83]). Finally, women who believed that healthcare professionals have economic interest and women who thought that the healthcare system gives information only on vaccination benefits and not on risks, were more prone to misconceptions about vaccinations (OR 2.04 [95%CI 1.57-2.65]; OR 2.00 [95%CI 1.56-2.57]).

DISCUSSION

This multicentre study aimed to investigate the level of knowledge and the presence of anti-vaccine beliefs and misconceptions regarding vaccinations in a sample of pregnant women in 14 Italian cities. Our main purpose was then to explore the potential factors related to anti-vaccine beliefs and misinformation among the sample. To our knowledge, this is the first study investigating this issue in the Italian context.

Our results showed a general lack of knowledge and the presence of misconceptions related to vaccinations among future mothers. Indeed, only 9% of women completely believed in the efficacy, necessity and safety of vaccinations and almost 20% of them had misconceptions or lack of knowledge on most of the themes.

According to our results, among Italian pregnant women, there are many concerns regarding the usefulness and benefits of vaccinations. Despite the majority of the women believing that vaccines can prevent potentially deadly diseases, 20% of them did not believe it, and even a higher percentage of women did not agree that some vaccine-preventable diseases are common due to low adherence to a vaccination schedule and that, if we stop vaccinating, very rare diseases could resurge.

Moreover, 14% of the sample believed that vaccination is not necessary if one maintains a healthy lifestyle. This is an emerging aspect already mentioned in other studies[21,22], indicating that the general lifestyle of the parents might also play a role in vaccine hesitancy[21].

These results showed a problem of trust in the efficacy and usefulness of vaccination in our country, confirming other findings reported in the literature[22,23].

However, according to our data, trust in vaccination safety is even more undermined by misconceptions than its efficacy, as reported also in other studies[22–26].

The doubts that vaccinations are performed too early and that the immune system has difficulties dealing with multiple vaccinations were present in half of the sample. These

concerns about the vaccination schedule and immunization overload are important factors influencing vaccine hesitancy in Italy and several other countries[22,27,28]. Our results seemed to confirm a change in direction regarding perceptions of multiple vaccinations compared to less recent studies, which reported that parents did not vaccinate their child because of the large number of injections[29,30].

Nevertheless, one of the main concerns about vaccination safety is the correlation with autism: only approximately 30% of women believed that there is no connection between vaccination and autism. Our results were worse than studies that have been performed in other countries[24,25] as well as a recent Italian study[18]. This could be due to how the question was posed[33]. We asked, "if scientific studies demonstrate that there is no connection between autism and vaccination", and this could have led to a higher number of people who were not able to answer the question since they do not have knowledge about scientific studies related to this topic.

The multivariable models, performed to identify the possible predictors of low levels of knowledge and high levels of misconceptions on vaccination, showed how Italian women have a higher knowledge level regarding vaccinations compared to foreign women. Moreover, the level of education and age seemed to be associated with the knowledge of future mothers about vaccines. Indeed, women without a high school diploma were more likely to have misconceptions about vaccinations than those with a higher educational level; a similar finding was observed for younger women having less knowledge about vaccinations compared to older women. These results are in line with a recent Italian study by Napolitano et al.[23] on the factors associated with vaccine hesitancy but are not in line with a study by Giambi et al.[22]. These discordances reflect the results of a review by Larson et al. and confirm that individual factors cannot be considered in isolation as multiple influences are at play[34].

Moreover, we investigated the association between misconceptions regarding vaccinations and sources of information. In our sample, women who received information from their GPs and institutional websites had a significantly lower chance of believing false myths compared to women who did not consult with these kinds of sources. In contrast, there were no sources of information associated with the increase of misconceptions. These results reflected the importance of providing information about vaccination. Indeed, several studies showed that one of the factors associated with vaccine hesitancy is the unfulfilled wish to have more information about childhood vaccinations, as highlighted in a review of Brown et al.[27].

Finally, our results showed the association of trust in the healthcare system and level of knowledge on vaccinations. Communication of information is not sufficient to increase knowledge about vaccination, if not followed by the reliability of the healthcare system. Moreover, poor communication and negative relationships with health workers could impact on vaccination decisions[35] and a lower vaccine uptake was typically linked, according to other studies, with lower trust in the healthcare system and/or the government[21,27].

These results make it clear that there is a need to inform future mothers on vaccinations. Correct information can increase confidence and decrease complacency, but appropriate communication and interventions aimed at increasing trust in vaccination are needed[22]. Healthcare providers are in an excellent position to address the concerns perceived by parents and, therefore, to influence them in their decisions regarding vaccination[23]. Parents see healthcare workers as an important source of information, and they have specific expectations of their interactions with them[35]. In this context, it can be useful for health professionals to know the main concerns and misconceptions about vaccination: only with a better understanding of their motivation of hesitancy can effective tailored communication be delivered among hesitant parents.

This study had some strengths and limitations that should be acknowledged. One of the main strengths is represented by the sample size of women interviewed (1820 participants). Convenience sampling was chosen to recruit participants, which may lead to selection bias. Nevertheless, the interviews were conducted in different cities in the north, centre and south of Italy, allowing us to obtain a representative sample of the different Italian contexts. Another strength is that face-to-face interviews were carried out. Indeed, this is considered the gold standard method of survey administration[36].

A possible limitation of the study is the fact that resident doctors who performed the interviews were recognizable as physicians and women involved in the study might have been more hesitant to communicate their true opinions about vaccines to healthcare providers. It must be considered that the interviewers were not part of the study participants' care teams. Moreover, using trained professionals in administering the questionnaires enabled us to gain good compliance and completeness of the questionnaire, compared to the self-administered questionnaires[37]. Finally, the multicentre nature of this study could lead to a certain variability between interviewers. However, this problem was also partially solved by involving trained researchers in the interviews.

In conclusion, this study demonstrates that Italian pregnant women have several misconceptions about vaccinations, affecting both complacency and confidence in vaccines. These factors have a huge influence on vaccine hesitancy in Italian parents, as the study of Giambi et al. has revealed[22]. Therefore, we investigated possible elements influencing knowledge about vaccinations. Our data show the importance of GPs and institutional websites as a source of information. Moreover, our results underline the influence of confidence in the healthcare system and health professionals on vaccination concerns. These data show the need to implement information interventions, tailored according to the target population and to their reasons for hesitancy, aimed at increasing complacency and

confidence on vaccines and on health services[15,36]. Public health professionals should organize interventions focused on children vaccinations even during childbirth preparation courses, with the help of gynaecologists and obstetricians who have a close relationship with future mothers. Communication should be a two-way process: a good communication strategy involves understanding people and establishing a respectful partnership[38].

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CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

KEY POINTS

- There is a general lack of knowledge about vaccinations among future mothers.
- Italian pregnant women have many concerns regarding the benefits of vaccination.
- Despite this, most misconceptions regarding vaccinations are related to the safety of vaccinations.
- A lack of knowledge about vaccination is associated with a lack of trust in the healthcare system.
- Our data show the importance of general practitioner and institutional websites as source of information.

REFERENCES

1. Orenstein WA, Ahmed R. Simply put: Vaccination saves lives. Proc Natl Acad Sci U S A. 2017;114(16):4031-4033.

2. Signorelli C. Vaccines: building on scientific excellence and dispelling false myths. Epidemiol Prev. 2015;3:198-201.

3. Hinman AR, Orenstein WA, Schuchat A, Centers for Disease Control and Prevention (CDC). Vaccine-preventable diseases, immunizations, and MMWR--1961-2011. MMWR Suppl. 2011;60(4):49-57.

4. Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. 13th ed. Washington D.C.: Public Health Foundation, 2015.

5. Roush SW, Murphy T V., Group and the V-PDTW. Historical Comparisons of Morbidity and Mortality for Vaccine-Preventable Diseases in the United States. JAMA. 2007;298(18):2155.

6. The Regional Office for Europe of the World Health Organization. European Vaccine Action Plan 2015-2020. WHO Reg Off Eur Publ. 2014;(September 2014):15-18.

7. Ferré F, Giulio De Belvis A, Valerio L, et al. Health Systems in Transition. Vol 16.; 2014.

8. Signorelli C, Guerra R, Siliquini R, Ricciardi W. Italy's response to vaccine hesitancy: An innovative and cost effective National Immunization Plan based on scientific evidence. Vaccine. 2017.

9. Signorelli C, Odone A, Cella P, Iannazzo S, D 'ancona F, Guerra R. Infant immunization coverage in Italy (2000-2016). Ann Ist Super Sanità. 2017;53(3):231-

237.

10. Glanz JM, Newcomer SR, Narwaney KJ, et al. A population-based cohort study of undervaccination in 8 managed care organizations across the United States. JAMA Pediatr. 2013;167(3):274-281.

11. World Health Organization. Summary WHO SAGE conclusions and recommendations on Vaccine Hesitancy. 2015;(January):1-5.

12. SAGE Working Group on Vaccine Hesitancy. Report of the SAGE Working Group on Vaccine Hesitancy 12 November 2014.; 2014.

13. Nowak GJ, Gellin BG, MacDonald NE, et al. Addressing vaccine hesitancy: The potential value of commercial and social marketing principles and practices. Vaccine. 2015;33(34):4204-4211.

14. Weiner JL, Fisher AM, Basket MM, Gellin BG. Childhood Immunizations: First-Time Expectant Mothers' Knowledge, Beliefs, Intentions, and Behaviors. Am J Prev Med. 2015;49(6):S426-S434.

15. Gualano MR, Bert F, Voglino G, et al. Attitudes towards compulsory vaccination in Italy: Results from the NAVIDAD multicentre study. Vaccine. 2018;36(23):3368-3374.

16. ISTAT. Popolazione per classi di Età Scolastica 2016 - Italia. https://www.tuttitalia.it/statistiche/popolazione-eta-scolastica-2016/. Accessed March 17, 2019.

17. Istituto Superiore di Sanità. Copertura vaccinale in Italia. https://www.epicentro.iss.it/vaccini/dati_Ita. Accessed August 8, 2019.

18. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med. 2013;35(2):121.

19. Habib A, johargy A, Mahmood K. Design And Determination Of The Sample Size In Medical Research. Vol 13.; 2014.

20. Hosmer DW, Lemeshow S. Applied Logistic Regression. New York: Wiley; 1989.

21. Harmsen IA, Mollema L, Ruiter RAC, Paulussen TGW, de Melker HE, Kok G. Why parents refuse childhood vaccination: a qualitative study using online focus groups. BMC Public Health. 2013;13:1183.

22. Giambi C, Fabiani M, D'ancona F, et al. Parental vaccine hesitancy in Italy - Results from a national survey. Vaccine. 2018;36:779-787.

23. Napolitano F, D' A, Italo A&, Angelillo F, Alessandro AD', Angelillo IF. Investigating Italian parents' vaccine hesitancy: A cross-sectional survey. Hum Vaccines Immunother. 2018; 14(7):1558-1565.

24. Dubé E, Gagnon D, Nickels E, Jeram S, Schuster M. Mapping vaccine hesitancy—Country-specific characteristics of a global phenomenon. Vaccine. 2014;32(49):6649-6654.

25. Yaqub O, Castle-Clarke S, Sevdalis N, Chataway J. Attitudes to vaccination: A critical review. Soc Sci Med. 2014;112:1-11.

26. Marti M, de Cola M, MacDonald NE, Dumolard L, Duclos P. Assessments of global drivers of vaccine hesitancy in 2014—Looking beyond safety concerns. Borrow R, ed. PLoS One. 2017;12(3):e0172310.

27. Brown KF, Kroll JS, Hudson MJ, et al. Factors underlying parental decisions about

combination childhood vaccinations including MMR: A systematic review. Vaccine. 2010;28(26):4235-4248.

28. Smith LE, Amlôt R, Weinman J, Yiend J, Rubin GJ. A systematic review of factors affecting vaccine uptake in young children. 2017.

29. Bardenheier B, Yusuf H, Schwartz B, Gust D, Barker L, Rodewald L. Are Parental Vaccine Safety Concerns Associated With Receipt of Measles-Mumps-Rubella, Diphtheria and Tetanus Toxoids With Acellular Pertussis, or Hepatitis B Vaccines by Children? Arch Pediatr Adolesc Med. 2004;158(6):569.

30. Gust DA, Strine TW, Maurice E, et al. Underimmunization Among Children: Effects of Vaccine Safety Concerns on Immunization Status. 2004; 114(1):e16-22.

31. Freed GL, Clark SJ, Butchart AT, Singer DC, Davis MM. Parental Vaccine Safety Concerns in 2009. Pediatrics. 2010;125:654-659.

32. My C, Danchin M, Willaby HW, Pemberton S, Leask J. Parental attitudes, beliefs, behaviours and concerns towards childhood vaccinations in Australia: A national online survey. Aust Fam Physician. 2017;46(3):145-151.

33. Gesser-Edelsburg A, Walter N, Shir-Raz Y, Green MS. Voluntary or Mandatory? The Valence Framing Effect of Attitudes Regarding HPV Vaccination. J Health Commun. 2015;20(11):1287-1293.

34. Larson HJ, Jarrett C, Eckersberger E, Smith DMD, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: A systematic review of published literature, 2007-2012. Vaccine. 2014;32:2150-2159.

35. Ames HM, Glenton C, Lewin S. Parents' and informal caregivers' views and

experiences of communication about routine childhood vaccination: a synthesis of qualitative evidence. Cochrane Database Syst Rev. 2017;2:CD011787.

36. Leeuw ED de., Hox JJ, Dillman DA, European Association of Methodology. International Handbook of Survey Methodology. Lawrence Erlbaum Associates; 2008.

37. Bowling A. Mode of questionnaire administration can have serious effects on data quality. J Public Health (Bangkok). 2005;27(3):281-291.

38. Goldstein S, MacDonald NE, Guirguis S, SAGE Working Group on Vaccine Hesitancy. Health communication and vaccine hesitancy. Vaccine. 2015;33(34):4212-4214.

Table 1. Percentages of agreement to anti-vaccine beliefs (in italic) and to scientific information.

	Sentences	**Agree**		**Disagree**		**Don't know**	
		%	**N**	**%**	**N**	**%**	**N**
1	Vaccines prevent potentially deadly disease.	80.2%	1433	7.2%	129	12.6%	225
2	Vaccination benefits outweigh the risks.	73.0%	1295	5.7%	102	21.3%	377
3	Most vaccine side effects are tolerable like low-grade fever, asthenia and local pain.	78.3%	1388	5.1%	90	16.6%	295
4	Vaccines are sufficiently tested before they may enter the market.	69.1%	1225	5.8%	102	25.1%	445
5	*Vaccination is performed on babies that are too young. It would be better to wait until they become older.*	17.6%	309	51.9%	910	30.5%	535
6	*Immune system has difficulties to deal with multiple vaccinations, especially in young babies.*	21.9%	382	32.3%	564	45.9%	802
7	Vaccination schedule is designed to protect children, immunizing them at an early stage, before they could be exposed to dangerous disease.	70.6%	1244	4.7%	82	24.7%	435
8	*With a healthy lifestyle disease can be prevented with no need of vaccination.*	13.8%	239	70.1%	1212	16.1%	278
9	Immunize my child protect other children that are too young or too sick to be vaccinated.	73.1%	1265	11.8%	205	15.0%	260
10	Some vaccine-preventable diseases are common due to low adherence to vaccination schedule.	72.0%	1257	8.0%	140	20.0%	349
11	If we stop using vaccination, many diseases that nowadays are disappeared could return.	83.0%	1451	4.8%	84	12.2%	213
12	Scientific studies demonstrate that there is no connection between autism and vaccination.	31.8%	558	15.0%	263	53.2%	932
13	*The diseases we want to prevent are often less dangerous than the vaccination itself.*	13.5%	234	56.6%	983	29.9%	520

Table 2. Factors influencing level of knowledge

			Level of knowledge				
			High level (N=804)		Low level (N=1016)		P*
			%	N	%	N	
	Region	North (n=715)	49.8	356	50.2	359	**<0.001**
		Centre (n=462)	42.9	198	57.1	264	
		South (n=643)	38.9	250	61.1	393	
	Age (years)	<33 (n=894)	37.5	335	62.5	559	**<0.001**
		≥33 (n=921)	50.8	468	49.2	453	
	Nationality	Italian (n=1653)	45.4	750	54.6	903	**0.001**
		Foreign (n=150)	31.3	47	68.7	103	
	Marital status	Cohabiting/married (n=1673)	45.1	754	54.9	919	**0.02**
		Single/divorced (n=139)	34.5	48	65.5	91	
	Educational level	High School or inferior (n=967)	32.9	318	67.1	649	**<0.001**
		College degree (n=851)	57.0	485	43.0	366	
	Previous deliveries	One or more (n=665)	52.9	352	47.1	313	**<0.001**
		None (n=1154)	39.2	452	60.8	702	
Information sources	General practitioner	Yes (n=504)	49.6	250	50.4	254	**0.002**
		No (n=1291)	41.5	536	58.5	755	
	Gynaecologist	Yes (n=292)	50.3	147	49.7	145	**0.01**
		No (n=1503)	42.5	693	57.5	864	
	Paediatrician	Yes (n=679)	53.6	364	46.4	315	**<0.001**
		No (n=1113)	37.9	422	62.1	691	
	Institutional information leaflets	Yes (n=501)	55.3	277	44.7	224	**<0.001**
		No (n=1294)	39.3	509	60.7	785	
	Vaccination clinics	Yes (n=375)	56.5	212	43.5	163	**<0.001**
		No (n=1420)	40.4	574	59.6	846	
	Institutional web sites	Yes (n=593)	54.8	325	45.2	268	**<0.001**
		No (n=1201)	38.4	461	61.6	741	
	Non-	Yes (n=602)	49.3	297	50.7	305	**0.001**

	institutional web sites	No (n=1192)	41.0	489	59.0	703	
	Smartphone and tablet applications	Yes (n=71)	40.8	29	59.2	42	0.61
		No (n=1722)	43.9	756	56.1	966	
	Freelance healthcare professional	Yes (n=217)	52.1	113	47.9	104	0.09
		No (n=1578)	42.6	673	57.4	905	
	Prenatal course	Yes (n=345)	51.3	177	48.7	168	**0.002**
		No (n=1450)	42.0	609	58.0	841	
	Word of mouth	Yes (n=896)	46.1	401	53.9	468	0.05
		No (n=925)	41.6	385	58.4	540	
	Mass media	Yes (n=650)	49.2	320	50.8	330	**<0.001**
		No (n=1145)	40.7	466	59.3	679	
	Antivaccination movements	Yes (n=135)	45.2	61	54.8	74	0.72
		No (n=1656)	43.6	722	56.4	934	
Trust in health care system	Confidence in healthcare professional information	Agree/Strongly agree (n=1675)	15.7	20	84.3	107	**<0.001**
		Disagree/Strongly disagree (n=127)	46.2	774	53.8	901	
	Experienced and knowledgeable healthcare professional	Agree/Strongly agree (n=1574)	47.0	739	53.0	835	**<0.001**
		Disagree/Strongly disagree (n=181)	25.4	46	74.6	135	
	More confidence in freelance healthcare professional	Agree/Strongly agree (n=341)	34.3	117	65.7	224	**<0.001**
		Disagree/Strongly disagree (n=1421)	47.1	670	52.9	751	
	Healthcare professional's economic interest	Agree/Strongly agree (n=575)	27.1	156	72.9	419	**<0.001**
		Disagree/Strongly disagree (n=1163)	53.2	619	46.8	544	
	Information only on vaccinations benefits not on risks	Agree/Strongly agree (n=646)	29.4	190	70.6	456	**<0.001**
		Disagree/Strongly disagree (n=1090)	53.9	587	46.1	503	

** Chi-squared test, significance level P < 0.05*

Table 3. Association between socio-demografic data, vaccines information sources and trust in health care system and a low level of knowledge about vaccinations

		Low level of knowledge		
		Adj OR*	95%CI	P**
Region	North	Ref		
	Centre	**0.72**	**0.55 – 0.94**	**0.02**
	South	1.08	0.81 – 1.46	0.59
Nationality	Foreign	Ref		
	Italian	**0.57**	**0.36 – 0.88**	**0.01**
Age (years)	<33	Ref		
	≥33	**0.79**	**0.63 – 0.99**	**0.04**
Educational level	High School or inferior	Ref		
	College degree	**0.43**	**0.34 – 0.54**	**<0.001**
Previous deliveries	One or more	Ref		
	None	**2.01**	**1.57 – 2.55**	**<0.001**
Information from General practitioner	No	Ref		
	Yes	**0.74**	**0.58 – 0.96**	**0.02**
Information from Institutional web sites	No	Ref		
	Yes	**0.59**	**0.46 – 0.74**	**<0.001**
Confidence in healthcare professional information	Disagree/Strongly disagree	Ref		
	Agree/Strongly agree	**0.49**	**0.27 – 0.89**	**0.02**
Experienced and knowledgeable healthcare professional	Disagree/Strongly disagree	Ref		
	Agree/Strongly agree	0.64	0.41 – 1.00	0.05
More confidence in freelance healthcare professional	Disagree/Strongly disagree	Ref		
	Agree/Strongly agree	**1.37**	**1.02 – 1.83**	**0.04**
Healthcare professional's economic interest	Disagree/Strongly disagree	Ref		
	Agree/Strongly agree	**2.04**	**1.57 – 2.65**	**<0.001**
Information only on vaccinations benefits not on risks	Disagree/Strongly disagree	Ref		
	Agree/Strongly agree	**2.00**	**1.56 – 2.57**	**<0.001**

Statistically significant results are reported in bold.
**Adjusted for: Region, Nationality, Age (years), Marital status, Educational level, Previous deliveries, Source of information (General practitioner, Gynaecologist, Paediatrician, Institutional information leaflets, Vaccination clinics, Institutional web sites, Non-institutional web sites, Freelance healthcare professional, Prenatal course, Word of mouth, Mass media), Trust in health care system (Confidence in healthcare professional information, Experienced and knowledgeable healthcare professional, More confidence in freelance healthcare professional, Healthcare professional's economic interest, Information only on vaccinations benefits not on risks)*
*** Significance level P < 0.05.*