It Is Heyday for Viruses!

Prevalence and Determinants of Negative Attitudes toward Vaccines in Italy

Abstract

The paper investigates negative attitudes toward vaccines in Italy, where anti-vaccination movement has gained significant momentum in recent years. Considering the substantial health risk to the herd immunity the issue poses, it has become increasingly important to study the prevalence and diffusion of anti-vax beliefs. Using the data from 2017 European Social Survey's (ESS) country specific questions for Italy, the manuscript examines the prevalence of anti-vaccination attitudes, and how they are influenced by structural, attitudinal, and value orientation determinants. The results show that 15 percent of the Italian public strictly hold negative views toward vaccination, and the prevalence of anti-vaccination attitudes is most commonly found among those who are less educated and aged between 25 and 34. While religiosity and political conservatism do not have an effect on anti-vaccination beliefs, our results indicate a strong positive link between anti-vaccination attitudes and distrust in the country's health care and political institutions.

Introduction

Vaccination is considered one of the most renowned achievements in public health. Owing to the developments in immunization during the last two centuries, vaccinations prevent millions of deaths, birth defects and disabilities associated with infectious diseases. Moreover, vaccinations led to the worldwide reduction of child and infant mortality rates; and once very common and deadly diseases, such as smallpox, are now eradicated (Orenstein and Ahmed 2017). Despite being one of the most significant public health successes, there has been a contemporary reduction in vaccination coverage and an upsurge in vaccine hesitancy and skepticism particularly in Western countries (Douchleff 2014; Dubé et al. 2013; Gallup 2019; Signorelli 2017; Skea et al. 2008).

Vast majority of people who are in the medical field promote the importance of vaccination of individuals, yet a growing number of parents are deliberately choosing not to vaccinate their children. Moreover, some members of the general public are questioning the safety of the vaccines and oppose vaccination mandates (Dubè et al. 2013). As a result, vaccine preventable diseases

(VPD), such as measles, mumps, and pertussis have been on the rise in Europe (CDC 2003; ECDC 2018; Yaqub et al. 2014) and in the United States for the first time in a century (Gallup 2019; Hornsey et al. 2018; Smith 2017).

Considering the significant individual and public health concern the vaccination issue poses, it becomes urgent to understand what lays beyond anti-vaccination attitudes and how spread are such attitudes.

Our article investigates the prevalence of negative attitudes toward vaccination and the possible determinants of the increasingly prominent anti-vaccination sentiment, with a specific focus on structural, attitudinal, and value orientation factors. Namely, we consider: education, age, general and institutional trust, religiosity and political orientation. We do so in Italy, a country where the vaccination issue has become particularly contentious in the recent years, and where the impact on public health has been substantial.

Given that vaccination attitudes have been predominantly investigated in the U.S. and some parts of Europe, contemporary Italian public opinion orientation regarding vaccination has since remained extremely limited. Accordingly, our paper aims at filling this regional gap in the literature.

This is of particular interest as Italy has experienced one of the worst epidemics in measles since the post vaccination period in Europe (CDC 2003; WHO 2018), especially due to the stark decrease in vaccination coverage. The number of measles cases reached a record high in 2017, the second highest in Europe after Romania (Guardian 2017; 2018; Siani 2019). At the same time, a tenacious anti-vaccination movement is gaining momentum, taking advantage from the ambiguous position on the topic of the newly established populist government. Before coming into power with a populist coalition in the general elections of 2018, members of the anti-establishment Five Star Movement (M5S) publicized vaccines to be unsafe, and anti-vax sentiments are commonly expressed by the supporters and exponents of M5S (Siani 2019).

In addition to the regional importance, the high-quality data employed coming from European Social Survey Round 8, also carry significant methodological strength to our analysis and allow inference of the findings to the general Italian population aged 15 and older.

The aim of the paper is also to provide sound information for policy makers to shape programs that will enhance the prevention of the spread of infectious diseases. We should note that we start from the assumption that vaccination against preventable diseases represents an element of medical rationality, and persons expressing negative attitudes toward vaccination goes against this rationality. Nevertheless, for the purposes of this study we are not concerned with arguments that people make to rationalize their negative position toward vaccines. Instead, we focus on the possible determinants of such attitudes.

Increase in anti-vaccination attitudes and the situation in Italy

In a recent survey (conducted on 140 countries with over 140,000 respondents) discovers that 21 percent of the world's population do not believe vaccines to be safe (Gallup 2019). Moreover, compared to other countries, Italy is found to be among those having the lowest levels of vaccine confidence (Larson et al. 2016). Examining the rates of vaccination coverage in Italy, Signorelli and colleagues (2017) report that national coverage targets set by the Ministry of Health under the issue of the *Piano Nazionale di Prevenzione Vaccinale (The National Plan for Prevention through Vaccines)* (PNPV) have been only partially met. In 2016, the mandatory vaccinations against polio, tetanus, diphtheria, and hepatitis B were all below the coverage target of 95 percent at the national level. Specifically, the MMR vaccine coverage rate has never reached the 95 percent coverage target. In fact, the coverage rate for the mandatory vaccines has decreased for the last 4 years. For instance, the MMR vaccine coverage was around 87 percent in 2016 for all regions of Italy, a 3.6 percent decline from 2013 (Signorelli et al. 2017).

Historically between 25,000- 90,000 measles cases used to be reported in Italy annually before the pre-vaccination era. With the introduction of the measles vaccination, the cases have significantly dropped. In 2002, measles outbreak increased sharply again, affecting 1000s of children predominantly in Catania region, where there was an inadequate vaccination coverage (CDC 2003). Cases of measles continue to occur, particularly in regions that have low vaccination coverage (WHO 2018). Just between February 2017 and January 2018, there were around 5000 reported measles cases in Italy, accounting for 35 percent of all cases in Europe (ECDC 2018).

The mentioned increase both in the prevalence of anti-vaccination and vaccine skepticism pose significant public health concerns for all citizens. This is because vaccination coverage is vital for maintaining herd immunity in communities and reducing the risk of disease for the general

population. When large number of individuals are not vaccinated, it becomes much easier for diseases to spread. Thus, unvaccinated individuals do not only pose a risk to themselves, but also for others (Smith 2017). In this light, seeing vaccination as a social responsibility in order to maintain herd immunity can have a positive effect on vaccination approval (Dubè et al. 2013).

Among those who are against mandatory vaccination, it is also common to find a vocal skepticism toward the scientific elites. This scientific skepticism is often fueled by the mass media's presentation of the government, pharmaceutical companies, and doctors in medical conspiracy theories (Jolley and Douglas 2017). Surely, this is the case in Italy, where the plausibility of the danger of vaccines on individual health goes hand in hand with other conspiracist believes in a significant portion of the population (Mancosu et al. 2017).

This evidence is in line with the idea that some section of the Italian general public is losing confidence in vaccination, and both the anti-vaccination movement and the government complacency could be contributing factors to the alarming phenomenon. Some even have suggested that the two recent Italian court rulings in favor of parents of children diagnosed with autism after vaccination have further legitimized the standpoint of the anti-vaccination advocates (Paravicini 2016).[1]

In the next section, we lay out potential predictors of vaccine skepticism in Italy.

Determinants of anti-vaccination attitudes

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[1] The increasing parental vaccine hesitancy and vaccine refusal often stem from a public fear of a not empirically proven or bluntly false negative effects of vaccination, especially on children. Possibly the most remarkable example concerns the presumed relationship between Measles Mumps Rubella (MMR) vaccine and autism (Skea 2008). While the study that links MMR vaccine to autism conducted by Andrew Wakefield (1998) was found to be fraudulent, the fears about vaccination and vaccine safety remained prevalent both in the U.S. and in Europe (Smith 2017), and it is not rare to find vague references to the above-mentioned forged results in casual talks.

Our article explores determinants of vaccination attitudes at three dimensions: structural, attitudinal, and value orientation. At the structural level, we examine the relationship between one's demographic characteristics, such as their education and age, and their vaccination attitudes. At the attitudinal level, we investigate the link between general and institutional trust and anti-vaccination sentiment. Lastly, regarding value orientation determinants, we look at how people's religious and political orientation impact their views on vaccination.

Structural determinants

For the relationship between age and vaccination, previous research indicates that elderly individuals are more supportive of vaccination (Larson et al. 2016; Larson et al. 2018; Peretti-Watel et al. 2013). The older generation have been raised in an era in which infectious diseases were still prominent in their communities. Consequently, we think that the older generation will be able to better identify the benefits of vaccination than the younger generation.

Individuals' level of education can also play a fundamental role in health-related outcomes in general and vaccination attitudes in particular. Based on decades long research both in the developed and developing world, it has been shown that there is a strong positive association between education and health related outcomes (Eide and Showalter 2011; Goldman and Smith 2011; Zimmerman and Woolf 2014). We know that people with higher level of education live longer, engage in less risky behaviors, have the cognitive ability to understand their health needs, communicate more effectively with their health care providers, and have more opportunities to learn about health and health risks (Zimmerman et al. 2015), all of which is closely linked to people's vaccination decisions. Although less common, anti- vaccinations attitudes are sometimes found among highly educated and niche communities, deviating from the general trend (Yang et al. 2015). However, previous research generally finds a positive correlation between low education and reduced vaccinate uptake and anti-vaccination attitudes (Larson et al. 2016, 2018).

Therefore, we test the following structural hypotheses:

H1a: Older individuals are less likely to express anti-vaccination attitudes.

H1b: As individuals' education decrease, their anti-vaccination attitudes increase.

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Attitudinal determinants

General trust, also known as social trust, whether it is interpersonal or impersonal, is a crucial aspect of civic-culture (Misztal 1996; Larson et al. 2018). Thus, general trust can play an important role in individuals' behavior and attitudes. This can be understood through the relationship between trust and social responsibility. That is, social trust ignites a type of social responsibility and a type of moral obligation within individuals to act in a way that is beneficial for the common good (Hearn 1997). Regarding vaccination decisions, previous research identifies social responsibility and the welfare of others in the form of ensuring herd immunity and avoiding harm to others as significant predictors among parents who decide to vaccinate their children (Bish et al. 2011; Dubè et al. 2013; Skea et al. 2008). This is in line with the idea of Hardin (2006), who describes trust and trustworthiness as the expectation that the actor or actors taking into account the wellbeing and the interests of the other person or persons when making decisions. Thus, the higher is one's social trust, the higher will be the consideration of the opportunities that can increase the general well-being, e.g. diffuse vaccination.

Trust as a relationship does not only manifests between individuals but also between individuals and systems. In the case of vaccinations, parents are asked to place an impersonal trust in what Giddens (1990:80) calls "abstract systems," such as health care and political institutions. This is because these institutions bring a "warrant of trust" due to their professional reputation (Brownlie and Howson 2005).

Among governmental institutions, the health care system undoubtedly has the most direct effect on people's values on vaccination. For the majority of people, the most trusted information on vaccination comes from the health care institutions and can have crucial impact on determining vaccination attitudes. Since the positive belief regarding vaccination are often cultivated by health care institutions and providers (Gottval et al. 2011; Oscarsson et al. 2011; Yakub et al. 2014), a loss of trust in health care institutions is directly related to anti-vaccination attitudes. Studies on this phenomenon find a positive association between anti-vaccination attitudes and lack of trust in the health care system. The less people believe in medical institutions, the less support they demonstrate for vaccinations (Salmon et al. 2005, Dubè 2013; Yakub et al. 2014).

Also, a more general attitude of distrust in government's political institutions can jeopardize the government's credibility on public decision-making regarding the well-being of individuals. When individuals distrust the government, they tend to believe that the government agents do not have the incentive to act in the citizens' best interest (Hardin 2006). Once individuals' trust in abstract systems is breached, their general attitude toward public decision-making of the government on public health care and well-being of individuals can also deteriorate. When individuals lose their trust in the political system, they could also lose trust in the messages they advocate, such as vaccination. This is shown in previous studies that link mistrust in government to less favorable views of vaccination (Brownlie and Howson 2005; Gefenaite et al. 2012; Hubson-West 2007).

Accordingly, we posit the following attitudinal hypotheses:

H2a: *As individuals' general trust increase, their anti-vaccination attitudes decrease.*

H2b: *As individuals' institutional trust decrease, their anti-vaccination attitudes increase.*

Concerning the second hypothesis, more specifically:

H2b$_1$: *Lower satisfaction with the health care system is associated with stronger anti-vaccination attitudes.*

H2b$_2$: *Lower satisfaction with the political institutions is associated with stronger anti-vaccination attitudes.*

Value orientation Determinants:

Previous research elucidates that both political and religious beliefs can shape people's vaccination attitudes. Evidence shows that vaccination refusals are often linked to strong religious convictions (Mckee and Bohannon 2016), and those who ask for vaccination exemptions due to religious reasons have been increasing (Domachowske and Suryadevara 2013). Those who hold religious convictions often express anti-vaccination attitudes because of their personal beliefs regarding the origin of illness (Dubè et al. 2013). These individuals consider both health and illness as an act of God, in which humans are not meant to interfere (Streefland 2001). Qualitative studies on this issue indicate that vaccine refusal for religious reasons have been found particularly high among the Orthodox Calvinists in the Netherlands and the Amish in the U.S. (Dube et al 2013). Other

studies also find a link between attendance to religious services and refusal of the HPV vaccination. As the attendance to religious services increases, the acceptance of HPV vaccination decreases (Barnak et al. 2010; Constantine and Jerman 2007).

Nevertheless, most of this evidence refers to countries with a religious landscape that is very different from Italy. Italy presents a rather homogenous religious landscape, with a strong predominance of Roman Catholics. There are very little data that demonstrate the influence of Catholic faith on people's vaccination attitudes empirically. As in most major religions, there are no direct prohibitions against vaccination in the Catholic faith; and within Catholic teaching, there is a strong emphasis on doing what promotes the common good (Carson and Flood 2017). Catholics tend to express more favorable views of vaccination, compared to other sects of Christianity and other faiths (Carson and Flood 2017; Larson et al. 2016; Larson et al 2018). For instance, according to a global survey on vaccination confidence in Europe, Catholics were more likely to report higher confidence in vaccination safety, confidence, and effectiveness (Larson et al. 2018). Accordingly, we think that religiosity and vaccination attitudes will be positively associated.

In conjunction with religious values, political values can also influence vaccination attitudes. Our motivation for this hypothesis in the case of Italy can be further supported by the prevalence and widespread diffusion of beliefs in conspiracy theories, particularly the suspicious attitudes toward the scientific establishment (Mancosu et al. 2017). In this study, the authors include an item on vaccines in their index of conspiracist ideation, and they show a significant association between this index and the voting choices of the interviewees. Considering the close connection between conspiracist beliefs and voting behavior, we think that anti-vaccination and conservatism will be inversely linked.

The connection between reluctance to vaccination and political ideology has been controversial. In the US, despite some vocal vaccination skepticism among well-known liberals, such as John F. Kennedy and Bill Mayor, evidence suggests that conservatives are more likely to hold anti-vaccination attitudes (Baumgaertner et al. 2018; Rabinowitz et al. 2016). Closely linked to religious values, previous enquiries show that conservatives are also more likely to express a lack of trust for the scientific and the medical community, particularly on issues regarding climate change, evolution, stem cell research, and AIDS prevention (Blank and Shaw 2015; Mooney

2012). However, these studies are limited in scope, referring only to the US context. Thus, we extend this hypothesis to the Italian case.

Investigating the relationship between individuals' value orientations and their attitudes toward vaccination, we test the following hypotheses:

H3a: Higher levels of religiosity is associated with lower levels of anti-vaccination attitudes.
H3b: An increase in political conservatism is associated with greater levels of anti-vaccination attitudes.

In the next section, we present the data and statistical methods we use to test our hypotheses and explicate on our operationalization of vaccination attitudes and their determinants.

Data, operationalization and methods

In order to measure vaccination attitudes in Italy, we use the data from the European Social Survey (ESS) Round 8. The ESS collects information on many European countries, using a common questionnaire that measures people's attitudes on a variety of topics, such as the media, religion, immigration, health, politics, and institutions. In every wave, the ESS allows each participating country to implement some country-specific questions. The vaccination questions we use for our analysis come from the country-specific question section of the ESS that is unique to Italy.

The ESS Round 8 Italian data were collected in 2017 (September – November) face to face by using CAPI (Computer Assisted Personal Interviewing) from individuals who were 15 years or older, officially living in the country regardless of their nationality or citizenship status. The sample is selected by using a multi-stage probability sampling technique, in which the first stage involves selecting Italian municipalities, and the second stage includes individuals selected from the municipality population registers (ESS 2016). The total sample size includes 2,626 individuals, and all the interviewers are collected in Italian. The response rate is 49.7 percent, and no quota sampling or substitutions were allowed. ESS protocols assures the production of a representative sample of Italians living in households, which allows for inference to the population.

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Operationalization of Variables

Dependent Variable

Two country specific questions in the ESS Round 8 Italian dataset measure attitudes toward vaccination. The questions ask respondents to report their level of agreement with the following statements:

> *Vaccines wear the immune system and expose it to several diseases.*

> *When it comes to vaccines, you can trust the recommendations of the scientific community.*

The response choices for both questions range from strongly agree, agree, neither agree or disagree, disagree to strongly disagree. The reading of the first item is straightforward, as agreeing with the statement means to be skeptical toward vaccines. The reading of the second item needs a qualification. A disagreement with the statement signals a lack of confidence in what the scientific community holds on vaccines. As the scientific community generally support the use and diffusion of vaccination, a skeptical answer thus likely implies a negative attitude toward vaccines.

The polarity of the two items is thus clearly opposite; agreeing on the first means to be skeptical about vaccines while the opposite holds for the second item. In line with our conceptualization, we chose to recode the items in a way to measure anti-vaccination attitudes. For the recoded items, thus, the higher values of the answer categories indicate greater anti-vaccination attitudes. We computed a cumulative scale, which is discussed in detail in the findings section.

Independent Variables

To predict respondents' vaccination attitudes, we use the following structural, attitudinal, and value orientation variables: education, age, general trust, institutional trust, religiosity and political orientation.

We operationalize age as age groups, namely 6 groups (15-24, 25-34, 35-44, 45-54, 55-64, 65 and older), and education in three levels: *primary*, *secondary* (up to secondary school) and *tertiary* (university degrees and above). Regarding education, 41 percent of the individuals have a primary, 46 percent have a secondary, and 13 percent has a tertiary education.

To measure general trust, we adopt the instrument proposed by van der Veld and colleagues (2011), building a scale composed by the following indicators: Trust in other people, Perceived fairness of other people, Perceived helpfulness of other people. Answer categories are on a 11-point scale (0-10). Pca analysis confirms a high internal consistency of the set of items considered, with the first extracted component accounting for 73% of the total variance and high reliability (std alpha = 0.81). We combine these 3 variables into a single *general trust* index, by computing the mean of the three indicators.

In addition to general trust, we also examine two indicators of institutional trust: trust in health care institutions trust in political institutions. The first dimension concerning health institutions (satisfaction with the health institutions in the country) is measured with a single item on an 11-point scale. To measure political trust, we use four variables: satisfaction with the national government and how democracy works in their country; trust in the country's parliament and politicians. These questions are measured on 11-point scales. Pca analysis show a high level of internal consistency, with the first component accounting for 73% of total variance (std alpha = .88). We combine these four indicators into a single political trust index, by averaging their scores. Italian individuals generally express low levels of political trust; the mean level of political trust is 3.20 (s.d. = 2.05).

As far as religiosity is concerned, we used three indicators of individual religiosity. The first religiosity question asks survey respondents to report how religious they consider themselves to be on an 11- point scale. In addition, two questions ask how often respondent attend to religious services and pray. The response categories for both questions range from every day, more than once a week, once a week, at least once a month, only in special holidays, less often, to never. We transform these frequencies into implied probabilities, weekly for attendance and daily for praying, with 0 indicating certainty of not attending/praying and 1 certainty of attending/praying. Also, this set of items shows high internal consistency (first Pca component accounting for 71% of total variance, std alpha = .79). We combine the 3 indicators into a single religiosity index by averaging their scores, after having harmonized their scales on a range from 0 to 10.

We derive respondents' political conservatism using the question on self-placement on the left-right scale. In the Italian political landscape, it is reasonable to assume that moving right-ward on the scale implies a higher level of conservatism. The left-right scale is recoded to include the

following categories: left, centre-left, centre, centre-right, right, refusal to use the scale, and do not know.

Finally, we also control for other socio-demographic variables that may have an influence on individuals' vaccination attitudes. These include respondents' gender (male or female), working status (employed, actively unemployed, or inactively unemployed), and the area they reside (the northwest, the northeast, the red zone, the center, or the south)[2].

Descriptive results of all variables are supplied in the appendix.

Methods

Given our dependent variable is an ordinal scale, with increasing values indicated more negative attitudes toward vaccines, we estimate an ordinal logistic regression equation to ascertain the degree of association between anti-vaccination attitudes and structural, attitudinal, and value orientation determinants while controlling for socio-demographic variables. We estimate 3 models. Model 1 examines the relationship between structural determinants (age and education) and anti-vaccination attitudes along with the control variables. In Model 2, we add the attitudinal determinants (general and institutional trust) to the regression equation. Lastly, we add value orientation predictors (religiosity and left-right scale dummies) to the equation in Model 3. We also use probability sampling weights (pweights) to correct for possible selection biases in the data.

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[2] The Northwest includes municipalities of Piemonte, Valle D'Aosta, Liguria, and Lombardia. The Northeast is composed of Veneto, Trentino-alto Adige, and Friuli-Venezia Giulia. The Red Zone includes Emilia-Romagna, Marche, Toscana, and Umbria. The Centre is composed of Lazio, Abruzzo, and Sardegna. Lastly, the South includes municipalities of Campania, Puglia, Basilicata, Calabria, and Sicilia.

Findings

To measure individuals' anti-vaccination attitudes, we develop an instrument using *Non-Parametric Item Response Theory* (IRT), namely the Mokken model for polytomous items (Mokken 1971, Sijtsma and Molenaar 2002, van Schuur 2011). Unlike factor analysis, the Mokken model does not work on correlations and does not assume items included in the analysis to be parallel, meaning their marginal distribution can vary. An easy understanding of the differences in margins of the items included in a scale refers to their different levels of difficulty, where difficulty is measured by how many people will give positive answers to a question. This extends also to polytomous items (van Schuur 2012). This is precisely the situation of our items, whose marginal distributions differ, as shown in Table 1[3]. The idea that vaccines can be harmful to individuals' health is backed by a smaller proportion of respondents, making it the most difficult item among the two. More people are ready to trust scientists when it comes to vaccines.

Table 1. Distribution of the two questions on vaccines (n = 2292)

	Vaccines are harmful			Trust scientists on vaccines	
	%	cum %		%	cum %
Anti-vaccines strongly	5	5		4	4
Anti-vaccines	16	21		7	11
Nor pro nor against	23	44		24	35
Pro-vaccines	34	78		46	81
Pro-vaccines strongly	22	100		19	100

Source: ESS 2017

The adherence of the empirical data to the Mokken model is measured in terms of Loevinger's Homogeneity (H) coefficient for scalability. Mokken (1971) suggests that Homogeneity (H) coefficients greater than 0.30 are homogenous enough to form a cumulative scale. We find that the H-coefficient for the two anti-vaccination items is 0.49[4], which allows us to construct a cumulative anti-vaccination scale using these two items.

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[3] The complete cross tabulation of the two items and relative correct response pattern under the Mokken model is presented in appendix.

[4] Beside the good result in terms of homogeneity, the analysis shows that the joint distribution of our items does not produce any significant violation of monotonicity, confirming the scalability of the two items. The complete joint response pattern for the two items as well as the detailed analysis are available in Appendix.

Based on this analysis, an anti-vaccination scale with 8 item steps, ranging 0 to 8, has been built summing up the answers on the two original items[5].

We find that anti-vaccination attitudes are prominent among Italian citizens. As shown in table 1, 21 percent of the respondents either agreed or strongly agreed with the statement that vaccines wear the immune system and expose it to several diseases. In addition, 11 percent of the respondents mentioned that they do not trust the scientific community when it comes to vaccines. When considering the two items together in the anti-vaccination scale, ranging 0 to 8, 15% of the respondents are placed on the high-end of the scale, manifesting negative attitudes toward vaccination, as shown in table 2.

Table 2: The Distribution of the anti-vaccination scale (n=2,446)

Anti-vax scale	Polarity of the scale	%	cum %
8	High (extreme) anti-vaccination	2	2
7		2	4
6		4	8
5		7	15
4		23	38
3		13	51
2		26	77
1		12	89
0	Low (none) anti-vaxination	11	100

Source: ESS, 2017

Next, we test how structural, attitudinal, and value orientation factors influence individuals' anti-vaccination attitudes.

The first aspect to consider is the impact of age, as the consequences of anti-vaccination attitudes can vary depending on the probability of those who are opposed to vaccination to be in a position to take vaccination decisions for their children.

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[5] After summing up the original values of the two anti-vaccination items ranging 1 to 5, we rescaled the cumulative scale in order to have it starting from 0. This is obtained simply subtracting 2 from the original values. To reduce the number of missing, when a respondent had only one valid answer, we imputed the same answer to both items.

As shown in table 3, although not significant for other age groups, anti-vaccination attitudes are most eminent among those who are aged between 25 and 34 (the age group in which individuals are more likely to make vaccination decisions for their children). When compared to those who are 65 and older, the odds of having an anti-vaccination score above either of the eight fix levels are 39 percent higher for those who are aged between 25- 34.

We also find higher education and anti-vaccination attitudes to be inversely related, meaning that anti-vaccination values are widespread among the less educated. As shown in table 3, having tertiary education significantly reduces the odds of having an anti-vaccination score above either of the eight fixed levels by 45 percent. This is predominantly in line with the previous literature on the relationship between education and anti-vaccination attitudes.

Overall, while our structural H1a (age) is only partially supported, the H1b (education) coincides with our expectation.

Regarding our attitudinal hypotheses, a lack of trust in institutions (for both health care institutions and political institutions) are both significant predictors of higher anti-vaccination attitudes. As individuals' satisfaction with the health care institutions increase, their odds of having an anti-vaccination score above either of the eight fixed levels diminish by 14 percent (See Table 3). Similarly, as trust in the political institutions decrease, the odds of having an anti-vaccination score above either of the eight fixed levels also reduce by 12 percent. Therefore, our hypotheses $2b_1$ (healthcare institutions) and $2b_2$ (political institutions) are both confirmed, and trust in health care institutions is the strongest predictor of anti-vaccination attitudes.[6] These findings are also in line with previous literature on the relationship between institutional trust and anti-vax opinions.

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[6] The standardized coefficients are not reported on the table. However, they are available upon request.

Table 3: Odds Ratio Results: Determinants of Anti-vaccination Attitudes, Italy 2017

Anti-vax scale	Model 1	Model 2	Model 3
Control Variables			
Female	0.91	0.91	0.90
Work Status (ref. Employed)			
Unemployed (active)	1.22	1.12	1.13
Unemployed (inactive)	1.04	1.04	1.05
Regions (ref. Centre)			
Northwest	1.65***	2.21***	2.18***
Northeast	2.11***	2.67***	2.64***
Redzone	0.89	1.14	1.12
South	1.56***	1.48**	1.46**
Independent Variables			
Age (ref. 65 or older)			
15-24	0.87	0.98	1.00
25-34	1.36+	1.37*	1.39*
35-44	1.28	1.23	1.23
46-54	1.31+	1.23	1.21
55-64	1.03	1.04	1.06
Education (ref. Primary)			
Secondary	0.85+	0.91	0.93
Tertiary	0.46***	0.53***	0.55***
General Trust		1.11***	1.11***
Health Trust		0.86***	0.86***
Political Trust		0.86***	0.88***
Religiosity			1.00
Political Orientation			
(ref. Centre)			
Left			0.84
Center-left			0.80+
Center-right			1.03
Right			1.25
No position			1.48**
Don't Know			0.99
Constant cut1	0.16***	0.08***	0.08***
Constant cut2	0.38***	0.20***	0.21***
Constant cut3	1.29	0.71+	0.77
Constant cut4	2.24***	1.26	1.37
Constant cut5	8.18***	4.84***	5.32***
Constant cut6	18.82***	11.40***	12.58***
Constant cut7	44.08***	27.17***	30.07***
Constant cut8	88.23***	55.03***	61.00***
df_m	14.00	17.00	24.00

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Source: ESS 2017   N=2,368

Paradoxically, while general trust significantly predicts anti-vaccination attitudes, it is in the opposite direction that what we have originally hypothesized. A higher trust in others in fact lead to greater anti-vaccination sentiment. This is a surprising finding that emerges from our analysis and is against our expectations. We posit potential explanations that may improve our understanding of the paradox of horizontal trust in the discussion section in more detail.

We mentioned that Italian religious landscape is very homogenous, and unlike in other Christian denominations, Catholicism does not actively promote anti-vaccination. However, we did not find religiosity to be a significant predictor of anti-vaccination attitudes. Similar to religiosity, we also did not find a significant association between political conservatism and anti-vaccination attitudes. The direction of the relation is in line with our expectations: those who lean toward right have higher anti-vax attitudes. Nonetheless the effects are small. This partly comes unexpected given the fact that vaccination attitudes have been largely politicized in the recent years. However, it is interesting to note that people refusing to use the left-right scale to describe their self are significantly more negative toward vaccination. Those who report no political position have 48 percent higher odds of reporting an anti-vaccination score that is above either of the eight fixed levels.

A last point to mention is that the spread of anti-vax attitudes is not homogenous throughout the Italian landscape. The findings do not follow the traditional north and south divide, but they rather show a contrast between the center of the country, holding a more positive view of vaccination, compared to the north and south regions. This also signals that the detected regional differences are not easily explained by the indicators related to economic and human development usually indicated to underline the differences between the North and the South of the country (Cartocci 2007; Ballarino and Schadee 2005).

Discussion

The first significant outcome of the analysis concerns an estimate of the prominence of anti-vaccination attitudes in Italy. This is the first time this estimate is produced starting from a quality sample (ESS Round 8 2017), with a large N sample representative of the Italian population living in households, aged 15 or older.

Our results indicate that 15 percent of the public strictly hold negative views toward vaccination while another 25 percent is placed in the neutral intermediate position. The number of people expressing anti-vaccination attitude is substantial if we consider that herd immunization is reached only when vaccination rate exceeds 90 to 95% of the population. If vaccination decisions are consistent with attitudes, then in the medium term this could represent significant concerns about the achievement of the WHO targets on vaccination in Italy.

To better understand how serious such a concern could be, it is necessary to examine the profile of those citizens who express skeptical opinions on vaccination, and what are the underlying determinants of such opinions.

We find that prevalence of anti-vaccination attitudes is most commonly found among those who are aged between 25 and 34, the age category in which individuals are most likely to make vaccination decisions about their young children. Assuming that attitudes can predict behavior, this is also an alarming finding for keeping herd immunity in Italian society.

In addition, we also find that those who are least educated tend to hold more anti-vax opinions. Against the common wisdom regarding existence of a niche of highly educated people that supports anti-vaccination values, we found that education is still one of the most relevant elements to steer opinions in favor of vaccination in the case of Italy.

A prominent aspect of our investigation was the exploration of the attitudinal determinants of anti-vaccinations opinions. In line with the previous literature, our findings illustrate a strong link between distrust in institutions and anti-vaccination attitudes. Both dissatisfaction with the healthcare and the country's political institutions increase anti-vaccination attitudes, and the trust in healthcare institutions is the strongest predictor of anti-vaccination sentiment.

Previous research indicates a positive association between religiosity and anti-vaccination attitudes. However, these studies refer to Anglo-American countries with a very different religious landscape than Italy. Italy is a religiously homogeneous country, with still 68% of Italians declaring to belong to the Catholic church (ESS 2017). And for our specific interest, it must be noted that the most recent pronouncements concerning vaccines of the Pontifical Academy for Life has removed any possible ethical and moral concern related to the characteristics of vaccines most commonly used in childhood. Nonetheless, we did not find religion to be a significant factor

determining anti-vaccination values in Italy. This result could partly reflect the fact that, despite the official position of the Catholic Church noted above, there has not been an extensive public engagement on the topic in the Church hierarchy. In the future, an alternative measurement that operationalizes individuals' supernatural beliefs may also better explain the relationship between religiosity and antivaccination.

In addition to religiosity, we also found results differing from our expectations as far as political orientation is concerned. Against our hypothesis, we did not find a relation between higher level of political conservatism and anti-vax attitudes. This is particularly surprising given the high level of politicization of the issue in the Italian public opinion arena. This dimension thus deserves a closer look. Political orientation was measured in terms of the left-right self-placement, assuming the right-wing leaning to be an indication of more conservatism. In this way, we also located a residual category of those people refusing to place themselves on the left-right scale (approximately the 17 percent of the sample). The remarkable finding is this group of people hold significantly more negative attitudes toward vaccines than the rest of the population.

In the past, the group of people refusing to describe themselves in left or right terms was small and mainly measured people who were uninterested in politics whereas in the last decade the meaning of non-placement has achieved a political content in Italy (Segatti and Baldassari 2018). In fact, in the recent national political history an extremely successful populist movement, the Movement 5 Star made one of its main tenants as being neither left nor right. The achievements of the movement were astonishing, as it became the collector of a long-standing political discontent and apathy that had not found a channel of expression before (Barisione, Bellucci, Vezzoni 2018). The Five Star Movement received the quarter of the votes on its first appearance on the national ballot box in 2013, and an even surprising 33 percent on the following national elections in 2018 (Ceccarini 2018).

The movement included also the most outspoken representative of skeptical views on vaccines. Considering this element and the wide success among the Italian public, our finding no longer appears as a coincidence. It seems that some form of spreading of populist rhetoric is associated with a significant prevalence of anti-vaccination opinions.

Our last significant result, namely the relation that exists between anti-vax positions and horizontal trust; it is also the most surprising and challenging result to understand and is undoubtedly against our expectations.

The result has been checked and controlled in several ways, and it seems to be robust. Thus, we are left wondering what is happening when people show a higher level of trust in others that bring them to be more negative toward vaccines.

We do not have conclusive answers to this apparent paradox, but we followed a trail of possible explanations that might suggest different meaning of horizontal trust depending on education or the way a person perceives his or her institutional surroundings.

This technically would suggest that our negative effect of horizontal trust would emerge from an interaction effect, where either a high level of education or low level of institutional trust match high level of horizontal trust in producing an effect that is not additive (both lowering negative attitudes toward vaccines) but multiplicative and specific of that group of people.

Consequently, we have run two different models including explicitly the interaction terms both for education political trust. However, we did not find neither of the interaction terms to be significant. Thus, the effect positive effect of trust on anti-vaccination attitudes remain genuine.

An alternative explanation for this effect may be linked to the way in which horizontal trust is connected to individuals' subjective risk perception, in particular for the risk of diseases. That is, when individuals have high trust in their communities and feel to be embedded in a safe environment, their subjective perception of disease could decrease; and therefore, their perceptions of the usefulness of vaccinations also decrease. At the moment, this reading is at the level of speculation and deserves further research to be tested.

Conclusion

Even though immunization continues to be one of the most conspicuous public health achievements in history, there has been a contemporary upsurge in anti-vaccination sentiment, particularly in Western societies. Relatedly, the stark reduction in vaccination coverage and the contemporary outbreaks in vaccine preventable illnesses such as measles, mumps, and pertussis, have begun to be a major health concern for Western governments (Gallup 2019).

In this article, we investigated vaccination attitudes in Italy, a country where anti-vaccination propaganda has been gaining momentum in recent years. The growing controversy around the vaccination debate has been negatively influencing people's vaccination decisions and leading some Italian regions to experience one of the worse measles epidemics in Europe (ECDC 2018). Given the potential health concern the issue poses, it becomes crucial to investigate the prevalence and diffusion of anti-vaccination beliefs. Accordingly, we explored three major determinants of anti-vaccination attitudes: structural, attitudinal, and value orientation in general. More specifically, we inquired about the influence of age, education, general and institutional trust, religiosity and political orientation on vaccination attitudes.

Overall, we find that anti-vaccination values are prevalent in Italy and are most common among those who are less educated and aged between 25 and 34. Both the age group and the prominence of anti-vaccination sentiment leaves us with significant concerns for achieving herd immunity in Italian society.

Moreover, we found that disapproval of vaccinations is strongly linked with distrust in country's institutions. Considering our strong evidence concerning the interlink between distrust in governmental institutions and anti-vaccination attitudes, we argue that top-down pro-vaccination advocacy by the governmental level will be ineffective in the case of Italy. A pro-active campaign lead by the center of the country could even jeopardize the attempt to increase the vaccination rate in the country, given the widespread bad reputations enjoyed by the government. In the short term, we suggest local advocacy could have a higher level of success, through grassroot activism and citizen outreaches, targeting those people expressing the least trust in institutions. This would possibly be more successful improving vaccination coverage and diffuse pro-vaccination attitudes. This advocacy at the local level can be prioritized in Italian regions where anti-vaccination coverage is lowest.

Last but not the least, we have confirmed that education plays a role in fostering positive attitudes toward vaccines. Logically, an increase in tertiary education among Italian people will also reduce anti-vaccination attitudes. However, this remains a long-term resource. More interesting to consider is to promote a more diffuse knowledge of vaccines and vaccination effects (also in historical terms) in schools of any level, also to contrast the grip anti-vax opinions have among young generations.

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Appendix

Evaluating homogeneity and monotonicity:

Table A1 gives the cross tabulation of the two items and relative correct response pattern under the Mokken model.

As shown in the table, there are 9 valid scale responses (highlighted in gray in Table A1) to form a perfect scale, and the rest are model violations (observed errors). In order to determine whether we can form a cumulative scale from using these two items, we evaluate the severity of the model violations (or their lack of homogeneity) by calculating the Loevinger's Homogeneity (H) coefficient for scalability. After comparing the sum of weighted number of errors observed and expected, we find a H coefficient of .49.[7] Considering H coefficients greater than 0.30 are satisfactory to form a cumulative scale (Mokken 1971; Sijtsma and Molenaar 2002), we were able to build the cumulative anti-vaccination scale using these two items.

In addition to the satisfactory results regarding homogeneity, we also check the monotonicity assumption of the joint distribution of the two items and find no significant violations of monotonicity, also confirming the scalability of the two items.

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[7] For a detailed explanation of cumulative scaling with polytomous items see van Schuur 2012.

Table A1:Cross tabulation of the 2 items with 5 response categories and each item step

Item 1: *Vaccines wear the immune system and expose it to several diseases.*	Item 2: *When it comes to vaccines, you can trust the recommendations of the scientific community*					
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Total
Strongly Agree	45	20	11	18	29	123
Agree	15	66	128	161	6	376
Neither Agree or Disagree	1	33	269	187	29	519
Disagree	3	36	117	503	109	768
Strongly Disagree	21	8	30	183	264	506
Total	85	163	555	1052	437	2292

Table A2. Descriptive Statistics

	Mean	SD	Min	Max
Dependent Variable				
Anti-vaccination Scale	2.789	1.818	0	8
Independent Variables				
Age				
15-24	0.127	0.333	0	1
25-34	0.135	0.342	0	1
35-44	0.160	0.367	0	1
45-54	0.195	0.396	0	1
55-64	0.158	0.365	0	1
65 or older	0.225	0.418	0	1
Education				
Primary	0.414	0.493	0	1
Secondary	0.459	0.498	0	1
Tertiary	0.127	0.333	0	1
General trust	4.571	1.969	0	10
Political trust	3.200	2.047	0	10
Health trust	5.362	2.398	0	10
Religiosity	3.898	2.836	0	10
Political Orientation				
Left	0.054	0.227	0	1
Center-left	0.184	0.387	0	1
Center	0.165	0.371	0	1
Center-right	0.220	0.414	0	1
Right	0.062	0.241	0	1
No position	0.172	0.378	0	1
Don't know	0.143	0.350	0	1
Control Variables				
Female	0.514	0.500	0	1
Employment Status				
Employed	0.474	0.499	0	1
Unemployed (active)	0.099	0.298	0	1
Unemployed (inactive)	0.427	0.495	0	1
Regions				
Northwest	0.253	0.435	0	1
Northeast	0.133	0.340	0	1
Red zone	0.207	0.405	0	1
Center	0.106	0.308	0	1
South	0.301	0.459	0	1

Source: European Values Survey 2017   N= 2,368