

Covid-19 Vaccine Hesitation: An Analysis of the Phenomenon in Italy

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Abstract

Vaccination hesitation is a particularly complex phenomenon that encompasses all the feelings of scepticism and rejection that people have towards vaccination. Although there have always been concerns around the issue, in recent years there have been worrying drops in vaccination coverage worldwide. This led the World Health Organization to list vaccination hesitation as one of ten serious threats to global health in 2019. This study has the aim, on the one hand, of monitoring acceptance of the Covid-19 vaccine through a survey carried out in Italy and, on the other hand, of analysing possible causes of vaccine hesitation or refusal in order to understand what lies behind the vaccination hesitation and to suggest more targeted and effective awareness campaigns. The data were collected between 24 March 2021 and 1 April 2021 (when, in Italy, about 4.5% of the population had been vaccinated against Covid-19) through a specific

survey and its formulation was based on a questionnaire submitted to patients at the Tor Vergata Polyclinic, in Rome. The sample on which the analysis is based is made up of 1,371 Italian citizens over the age of 17. A multiple regression model (OLS method) constructed using a stepwise approach has allowed to investigate the factors that influence concerns about getting vaccinated against Covid-19. The results of the research shown that 34% of people are hesitant to get vaccinated against Covid-19, while 66% have no doubts. Compared to similar surveys but conducted in different time frames (before the vaccination campaign started), the percentage of hesitators is showing a decreasing trend. Moreover, the most striking value is the distribution of hesitant respondents among those with a low level of schooling (primary/middle school): more than half of them are hesitant (around 53%). The confidence in Pfizer and Moderna vaccine is virtually identical and significantly higher than confidence in AstraZeneca

vaccine both in general and when stratified into the hesitant and non-hesitant sub-groups. Finally, it has been observed that concern about getting vaccinated against Covid-19 is very common in those who consider themselves hesitant. This concern appears to be significantly linked to the perception that vaccines cause disease and allergic reactions, but even more so to the speed with which the Covid-19 vaccine was developed and the distrust of AstraZeneca vaccine. The research suggests a number of actions with a view to alleviating scepticism and concern surrounding the Covid-19 vaccine should be primarily aimed at combating disinformation and fake news that circulate especially online.

Keywords: Vaccination hesitation; Covid-19; Social media influence

Introduction

The SARS-CoV-2 pandemic and the consequent sanitary emergency severely affected the entire world, and, after a year and a half, is still affecting it. The majority of the Governments had to use extraordinary and strict virus containment measures aimed at limiting the mobility of people by regulating every aspect of life: private, public, and working ones. In these extreme cases such as a pandemic, the compliance with the new prescribed behavioral standards and the implementation of preventive and protective measures is profoundly steered by the perception of risk related to new viruses [1-3]. Indeed, at the beginning of the spread of the virus, especially before it was declared to be a pandemic, many people, including some experts and politicians worldwide, were not particularly worried by the new coronavirus as they considered it comparable to seasonal flu. After many observations, studies and data collections all over the world, the

characteristics of the new coronavirus became better known, revealing its systemic range of symptoms, convincing the majority of people that the virus was different from previous ones and, therefore, the development of a vaccine was the crucial instrument to fight the pandemic [4]. The new awareness and knowledge about the virus accelerated the need to develop an effective vaccine against SARS-CoV-2 in order to avoid a pandemic emergency [5]. A vaccination management program against Covid-19 worldwide has the potential to alleviate the problems related to the spread of the virus on the one hand, but, on the other, has the big challenge for the policymakers to be able to encourage people to accept and receive the vaccine. Indeed, most vaccine skeptics seem to be reluctant to undergo it [6].

Vaccination hesitation is a particularly complex phenomenon that encompasses all the feelings of scepticism and rejection that people have towards vaccination. Although there have always been concerns around the issue, in recent years there have been worrying drops in vaccination coverage worldwide [7,8]. This led the World Health Organization (WHO) to list vaccination hesitation as one of ten into serious threats to global health in 2019 [9]. Although many people agree to receive the vaccine, a high rate of non-compliant people could undermine the hard work of authorities to achieve herd immunity. Understanding people's general attitude towards vaccination is therefore crucial to the successful implementation of a large-scale vaccination program.

Several causes may have led to apprehensive feelings about the vaccine. Among others, the influence of the media and the internet, where disinformation spreads much faster than correct information, should not be ignored. In particular,

according to a study conducted by the Massachusetts Institute of Technology (MIT), fake news is 70% more likely to be shared than real news (the study refers to news shared on the social network Twitter) [10]. One of the most common cases of disinformation about vaccines is undoubtedly the false link between vaccines and autism. This study was conducted by the British doctor Andrew Wakefield and subsequently published in one of the most authoritative medical journals: the Lancet. The news caused a stir because it concerned a vaccination that millions of children receive every year, and the media hype was such that coverage of the trivalent vaccine dropped, especially in the United Kingdom (UK) [11]. Disinformation and fake news circulating on the internet are just one of the many causes of hesitation towards vaccines. Indeed, vaccination hesitation is a complex phenomenon, which is context-specific and varies over time, place and type of vaccine. This concept goes beyond the now simplistic distinction between pro- and anti-vaccine individuals. This attitude must be seen as a continuum, which ranges from unconditional acceptance to complete rejection of the vaccine, but passes through several intermediate degrees.

The complex phenomenon of vaccine hesitation was first defined in 2014 by the Strategic Group of Experts for Vaccinations (SAGE), a body established in 1999 by the WHO to offer strategic advice on all areas of vaccine issues. The definition is as follows: "Vaccine hesitancy refers to 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". This definition underlines firstly that there are different

degrees of hesitation and, secondly, that the phenomenon is varied and dependent on various factors. This is why the SAGE group has developed models to monitor the phenomenon of vaccine hesitation. The main models are: the "3Cs" model, in which three macro-areas of factors are highlighted ("Complacency", "Convenience" and "Confidence") which explain vaccine hesitancy from different points of view; and the "determinants" model, which aims to group the determinants of vaccine hesitancy into more specific categories. The factors included in the models were considered for their potential usefulness in developing indicators to measure the extent of the phenomenon on both a global and national scale [12]. In literature, there are several studies that addressed vaccine hesitancy in the context of Covid-19. It has been analysed the attitudes towards the Covid-19 vaccination process among students from various specialties from several Bulgarian universities [13]. Ousseine et al. [14] have studied the factors associated with uncertainty and unwillingness to vaccinate against Covid-19 in men who have sex with men living in France. Hopfer et al. [15] have investigated parent-adolescent Covid-19 vaccine decision-making. Tsutsumi et al. [16] have analysed the relationship between the psychological state of Japanese university students and their willingness to be vaccinated. Litaker et al. [17] have reported on vaccine hesitancy in Central Texas immediately prior to the release of the two mRNA Covid-19 vaccines in late December 2020. Gao et al. [18], under the context of the breakthrough cases occurring in the Nanjing outbreak, this have explored public perceptions of vaccine effectiveness and have examined whether this wave of the epidemic influenced vaccine hesitancy and distrust. Savoia et al. [19] have presented the results of a survey of

1,591 hesitant U.S. essential workers, conducted over Pollfish in December 2020 when they were the only group eligible for the vaccine, and have described their concerns regarding Covid-19 vaccine safety, effectiveness and distribution policies. Goldman et al. [20] have determined how Covid-19 vaccine approval for adults was associated with caregiver likelihood to vaccinate their children in Canada and Israel. Dratva et al. [21] have addressed the vaccine hesitancy among Swiss university students. Moore et al. [22] have studied the thoughts and feelings of individuals expressing concerns about the Covid-19 vaccine the State of Arkansas. Melin et al. [23] have conducted an online survey among adults in Puerto Rico to identify factors associated with the intention to receive vaccination against Covid-19. AlShurman et al. [24] have reviewed the literature to determine the prevalence of intention to use Covid-19 vaccines among adults aged 18–60, and to identify the demographic, social, and contextual factors that influence the intention to use Covid-19 vaccines. Hudson and Montelpare [25] have reviewed research on determinants of vaccine hesitancy with the objective of informing public health responses to Covid-19. Khubchandani et al. [26] have conducted a national assessment with adult Americans to understand how Covid-19 infections in social networks can influence Covid-19 vaccination willingness. In 2016, Giambi et al. [27] conducted, in Italy, a cross-sectional survey to estimate vaccine hesitancy and investigate its determinants among parents of children aged 16-36 months. La Vecchia et al. [28] studied the attitudes towards influenza vaccination and a potential Covid-19 vaccine in Italy, conducting a nationally representative survey based on 1,055 Italians aged 15-85 years in September 16-28, 2020. Caserotti et al. [29] have investigated the

intention to get vaccinated against flu and against SARS-CoV-2 before, during and after the first national lockdown, covering the period from the end of February to the end of June 2020.

In the above context, this study has the aim of monitoring acceptance of the Covid-19 vaccine through a survey carried out in Italy and of analysing possible causes of vaccine hesitation or refusal in order to understand what lies behind the vaccination hesitation as well as to suggest more targeted and effective awareness campaigns. For the best knowledge of the authors, no related research has been conducted with reference to the period of the analysis, field and sample covered by this paper, which, therefore, aims to fill this gap in the literature. The remaining part of the paper is structured as follows. Section 2 concerns materials and methods of the research. Section 3 contains the results of the analysis and their discussion. Finally, section 4 carries out concluding remarks, limitations of the study and future research directions.

Materials and Methods

The data were collected through a specific survey. Its formulation was based on a questionnaire submitted to patients at the Tor Vergata Polyclinic, in Rome (Italy), with some modifications. The questionnaire was divided into four sections with a total of 60 items: in the first section, questions were asked about the socio-demographic status of the user (age, gender, level of education, professional category, etc.); in the second to fourth sections, the respondent had to express his or her opinions about: vaccines in general, the specific Covid-19 vaccine, doctors and pharmaceutical companies, respectively. Of the items addressed, most expected the respondent to express a degree of agreement with some

statements on a Likert scale ranging from 1 (disagree) to 10 (completely agree). Other questions, however, involved selecting one or, rarely, several options from a predefined list of answers. The sample on which the analysis is based is made up of 1,371 Italian citizens over the age of 17. In terms of numbers, the sample would be representative of the Italian population aged over 18 (or nearly so, considering those aged 17) with a confidence level of 95% and a margin of error of around 5%. As the sampling was non-probabilistic avalanche sampling, the sample cannot be defined as completely random and consequently the results must be considered with a certain degree of approximation. Most of the respondents in this study are resident in central Italy, probably due to the nature of the sampling adopted. The age distribution of the users appears moderately biased towards the youngest: 47.7% of the users are between 17 and 34 years old, 24.8% are aged between 35 and 55, and the remaining 27.5% are over 55. Gender is fairly balanced, with 58% of respondents being female and 42% male. Regarding the participants' level of education: 55% of the respondents have a high school diploma, 34% have a university degree or have gone beyond a degree with a Master's or PhD, and 11% have a level of education that stops at middle school or primary school. Concerning the professional category, 33.2% of the samples were students, 23% full time employees, 13% unemployed, 11.6% self-employed, 11.1% retired and the remaining 8.1% part-time employees. Furthermore, 41.5% have an annual income of less than €15,000, 15.4% between €15,000 and €20,000, 18.1% between €20,000 and €30,000, 10% between €30,000 and €40,000, 5.8% between €40,000 and €50,000 and the remaining 9.2% over €50,000. Finally, 36% of respondents state that they live with 3

or more adults (over 18 years of age), 33.6% with two, 22.5% with one and the remaining 7.9% do not live with any adult. Data collection took place between 24 March 2021 and 1 April 2021. Given the variability with which the context evolves, in the midst of a pandemic emergency, a series of data will be shown and events described below in order to present the epidemiological situation at the time the data were collected. This will ensure a critical reading of the results that will be presented in section 3.

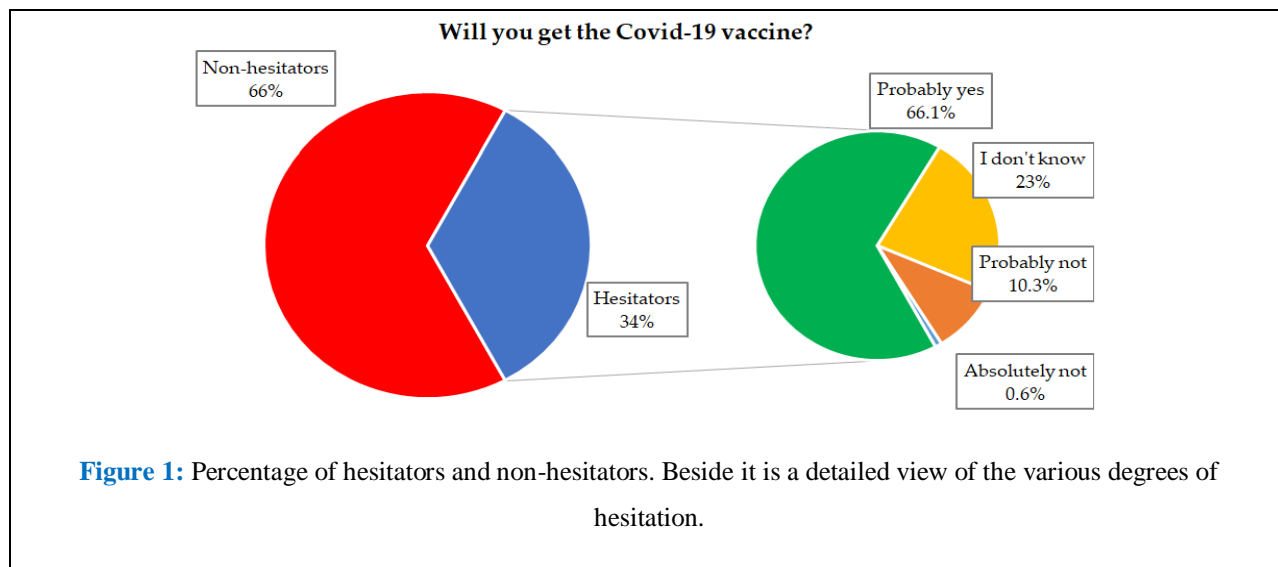
The vaccination campaign in Italy, as well as throughout Europe, started on 27 December 2020, when the first three doses of the Pfizer vaccine were administered at the Spallanzani Hospital in Rome (Italy). This so-called "Vaccine day" started the most complex vaccination campaign ever. At European level, in June 2020, the Member States agreed on a centralized approach with the European Commission to ensure appropriate support for the development, production and supply of vaccines. Negotiations with the vaccine manufacturers were entrusted to the European Commission, acting on behalf of the member states, in order to ensure the supply of the vaccine doses necessary to protect the entire European population [30]. The Ministry of Health report updated to 24 March 2021 (first day of data collection) at 15:31 stated that a total of 8,346,445 vaccines had been administered in Italy and that 2,657,587 people had been vaccinated (i.e., received both the first and second dose of the vaccine). The most vaccinated age group was the 80-89 age group with 2,332,287 doses administered (about 28%), followed by the 50-59 age group with 1,486,370 doses administered (about 18%). The most vaccinated category was, of course, health and social care workers with 2,896,778 doses administered (about 34.7%). The three vaccines distributed and

administered in Italy were Pfizer, Moderna and AstraZeneca. The total number of vaccines distributed was 9,911,100, with a clear predominance of the Pfizer vaccine with 6,610,500 doses (about 67%) compared to 2,474,000 distributed doses of AstraZeneca and 826,600 of Moderna. In Italy, the total number of administrations centers were 1,948 (this figure includes hospital and territorial administration centers but does not include temporary administration centers) [31]. During the data collection period, not only Italy, but all of Europe, experienced a situation of panic due to the alleged deaths and serious allergic reactions that occurred after immunization with the AstraZeneca vaccine. In Italy, AIFA (Italian Drug Agency) decided in a statement issued on 15 March 2021 to extend the ban on the use of the vaccine throughout the country as a precautionary and temporary measure, pending the ruling of the European Medicines Agency (EMA). The decision did not only concern Italy, but was taken in line with the measures taken by other European countries [32]. Despite the subsequent resumption of administration, following an EMA meeting held on 18 March 2021 [33], the chaos generated by the “AstraZeneca case” may have influenced the opinion of citizens regarding Covid-19 vaccines, fueling fear and skepticism, making it even more difficult to achieve the objectives set for the vaccination campaign in Italy and across Europe.

Results and Discussion

Propensity to the Covid-19 vaccine

The administered questionnaire contains the question “Will you get the Covid-19 vaccine?” This made it possible to divide the entire sample into the categories of inclined (or non-hesitant) and hesitant. The first sub-sample includes people who, when asked “Will you get the Covid-19 vaccine?” answered “Definitely, yes”. The sub-sample of hesitators, in line with the definition proposed by the SAGE group [12], comprises those who, when asked the same question, showed a variable degree of hesitation by answering “Probably, yes”, “Don’t know”, “Probably not” or “Definitely not”. Those who are completely opposed to the Covid-19 vaccine were also included among the hesitators, because there is no certainty that they are absolutely “anti-vaccine” and it is possible that they are extremely hostile to the Covid-19 vaccine but in favour of other vaccinations. The survey shows that, among people who had not yet been immunized, 66% have no hesitation in getting the Covid-19 vaccine, while the remaining 34% show a variable degree of hesitation. Among the hesitators, however, most are more inclined towards the decision to get vaccinated. The percentages are shown in **Figure 1**.



Comparison with other research

In this survey, the propensity of Italian citizens to get vaccinated was measured between 24 March 2021 and 1 April 2021, when the vaccination campaign had already been underway, in Italy as in Europe, for about three months. It may be interesting to compare these results with other similar surveys, exclusively concerning Italy, but which were carried out in an earlier time frame. A study conducted between 16 and 28 September 2020, shows that 53.7% would have agreed to receive a potential Covid-19 vaccine, whereas the remaining 46.3% were hesitant; it should be noted that about 20.7% of respondents said categorically “no” to the vaccine, indicating a certain degree of distrust for Coronavirus immunization [28]. Another survey was conducted by YouTrend in collaboration with Sky about a month before the actual start of the vaccination campaign. In this study, it is recorded that 63.2% of citizens did not show any hesitation in receiving the Covid-19 vaccine, assuming that it had full guarantees, and 36.8% said they were hesitant. Among the hesitators, 15.9% were totally opposed to receiving the vaccine [34]. Obviously, discrepancies in results between

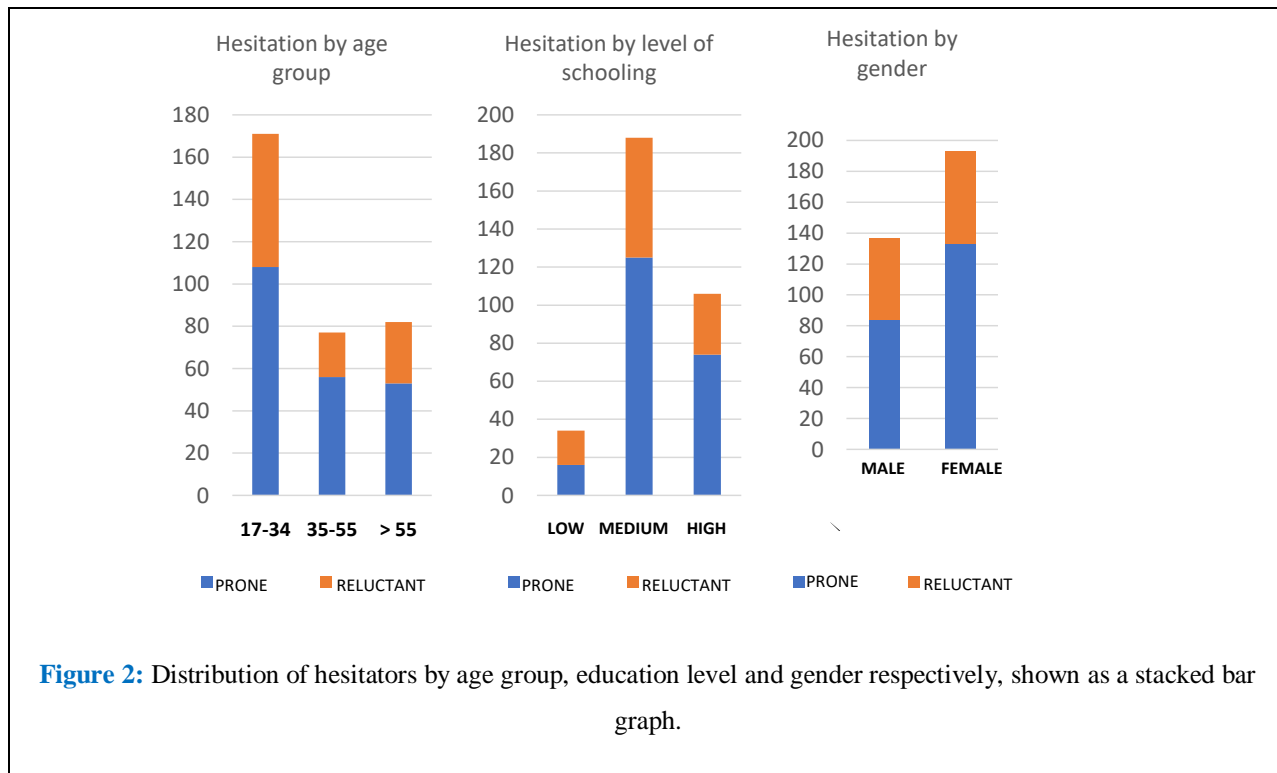
surveys may be due to methodological differences in data collection, differences in sampling or in the way the question is formulated. Comparing the surveys, however, it can be seen that the proportion of hesitant respondents out of the total has a downward trend, but the proportion of people who categorically refuse the Covid-19 vaccine is particularly striking. This percentage fell from 20.7% at the end of September 2020, to 15.9% at the end of November 2020, to only 0.58% in this survey.

Stratification by age group, level of education and gender

Stratifying by age group, there are moderate percentage differences in the concentration of hesitators in each subcategory examined. In particular, the group of respondents aged 35-55 shows the lowest percentage of hesitant people (approximately 28%). On the other hand, the percentage of hesitators among those aged between 17 and 34 (37%) and those over 55 (36%) is very similar. Looking at the degree of schooling, it is evident that there is a significantly high percentage of hesitant people among those with a low (middle school or primary school) level of schooling (around

53%) compared to those with a medium level of schooling (34%) and, above all, compared to those with a high (i.e., bachelor's or postgraduate master's) level of schooling (30%). Stratifying by gender, however, no such evident differences are found between hesitant males (39%) and hesitant females

(32%). In evaluating these percentages, the different numbers of sub-samples extrapolated from the total sample must be taken into account. The stacked bar graphs in **Figure 2** provide this information visually, as each bar represents the absolute number of people in each subgroup.



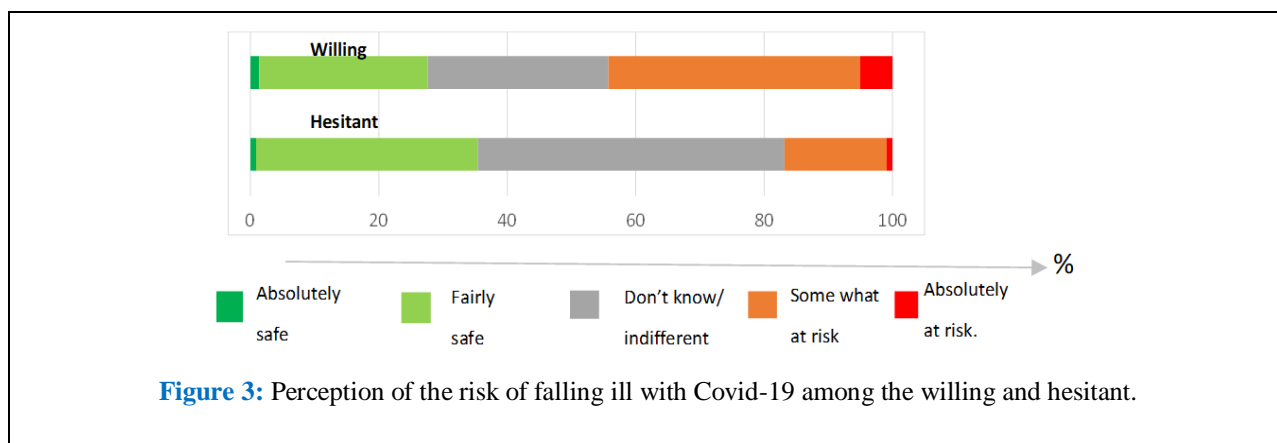
“Complacency” and “Confidence” assessment

With reference to the above mentioned “3Cs” model [12], in this study we tried to investigate the reasons why people are hesitant by carefully assessing the aspects of “Complacency” and “Confidence”. The third “C”, namely “Convenience” was not examined in depth, as it is thought that in Italy, the free vaccine and the large number of centers set up to immunize citizens eliminate both economic and logistical difficulties, making the vaccine easy to access and free of charge for the user. To analyze the “Complacency” factor, data relating to the perceived

risk of falling ill with Covid-19 were considered. Across the whole sample it is observed that: 1.21% consider themselves “Absolutely safe”, 29.09% “Fairly safe”, 21.82% “Indifferent”, 13.03% “Don’t know”, 31.21% “Somewhat at risk” and the remaining 3.64% “Absolutely at risk”. It was found that the concentration of people who feel a greater risk of falling ill increases, in percentage terms, according to the level of schooling: only 17.6% of those with an elementary/middle school education feel at risk of contracting the virus, the percentage increases to 35% for those with a high school

diploma, and to 40% for those with a university degree or higher. In addition to the level of education, it should be noted that the perception of the risk of falling ill is different for different age groups: 27% of those between 17 and 34 years old feel at risk of

falling ill, a percentage that rises to 40% for those aged between 35 and 55, to then reach 45% for those over 55. Considering the willing and the hesitant separately, there is a different sense of risk of falling ill with Covid-19, as can be seen in the **Figure 3**.



The data suggest that those who have no doubts about immunizing against Covid-19 feel a greater risk of falling ill than those who are doubtful or opposed to getting vaccinated. This is confirmed by the percentages of those who feel at risk (somewhat or absolutely) of contracting the disease: only 16.8% of the hesitators compared to 45% of the non-hesitators. That risk perception is a key factor, including in determining willingness to vaccinate against Covid, is further confirmed by a study published in the journal *Social Science & Medicine* by Caserotti et al. [29]. The study shows that, during the lockdown phase associated with a greater perception of the risk of contagion from Covid-19, people were more likely to get vaccinated against the disease. The intention to get vaccinated then decreased in the subsequent reopening phase, where a lower perception of risk was also recorded [29]. Nowadays, it is conceivable that this factor has a greater impact on diseases such as measles [27]. This is because people may

mistakenly think that the disease is remote or has even disappeared, but this perception is a direct consequence of vaccination coverage that has been maintained at very high levels (above the 95% safety threshold) for years. Interpretation of the data shows that, even in a context in which the presence of the disease is undoubted and its spread is extremely rapid (at the time the questionnaire was submitted in Italy there were about 20,000 infections every day), there is a good percentage of people who see the risk of falling ill with Covid-19 as remote; a direct or indirect consequence of this is a lower propensity to get vaccinated. Although the hesitation to immunize against Covid-19 may derive from a low perception of the risk of contracting the disease, acceptance of the Covid vaccine is mainly based on the perception that it is safe and effective. The second factor of the “3Cs” model, namely “Confidence”, relates to trust in the efficacy and safety of vaccines, but also in the bodies that produce and distribute the vaccine, in

doctors, health personnel and the institutions that determine the necessary vaccines [12]. **Table 1** shows the average values of some statements that best represent, as a whole, the “Confidence” factor. The values refer to the entire sample, the statements in quotation marks (“ ”) were reported verbatim as they were placed in the questionnaire, while the results relating to the item “Confidence in vaccines

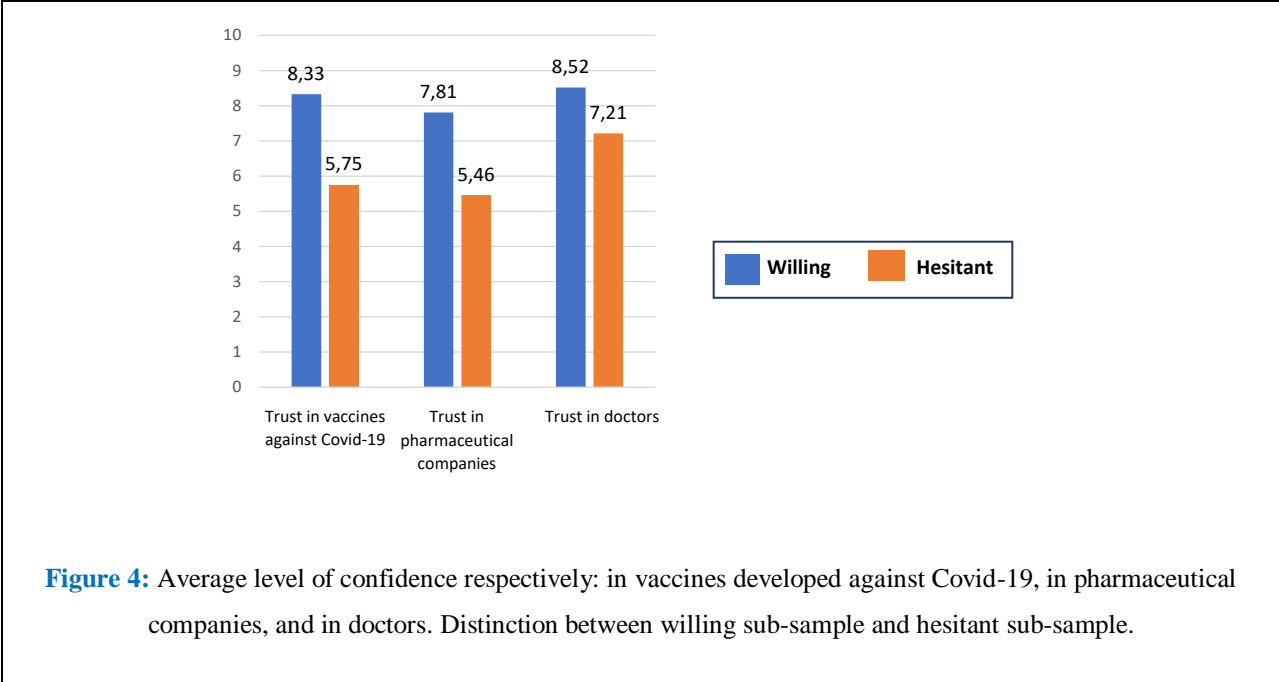
developed against Covid-19” were obtained by averaging the values of the following statements: “How much do you trust the Pfizer vaccine?”, “How much do you trust the Moderna vaccine?” and “How much do you trust the AstraZeneca vaccine?”. All the statements reported in the questionnaire asked respondents to express a degree of agreement between 1 and 10 on the Likert scale.

Table 1: Mean and standard deviation values of some elements used to describe the “Confidence” factor.

	MEAN	ST. DEV.
“I have full confidence in the doctors”	8.12	1.82
“Confidence in vaccines developed against Covid-19”	7.53	2.22
“I have confidence in the pharmaceutical companies that have developed the Covid-19 vaccine”	7.08	2.37
“Vaccine developers have made sure of its safety”	7.53	2.27

Out of the total sample (1,371 observations), this survey shows on average a high level of confidence in doctors (8.12 out of 10) and a medium to high level of confidence with regard to: the vaccines developed against Covid-19 (7.53 out of 10), the pharmaceutical companies that developed them (7.08 out of 10) and the fact that those who developed them

made sure of their safety (7.53 out of 10). The same variables were measured separately on the sub-sample of hesitators and that of non-hesitators in order to observe whether there are significant differences, which are indeed visible in the bar graph of the **Figure 4**.



More specifically, the **Table 2** shows the overall average confidence (of the entire sample, 1,371

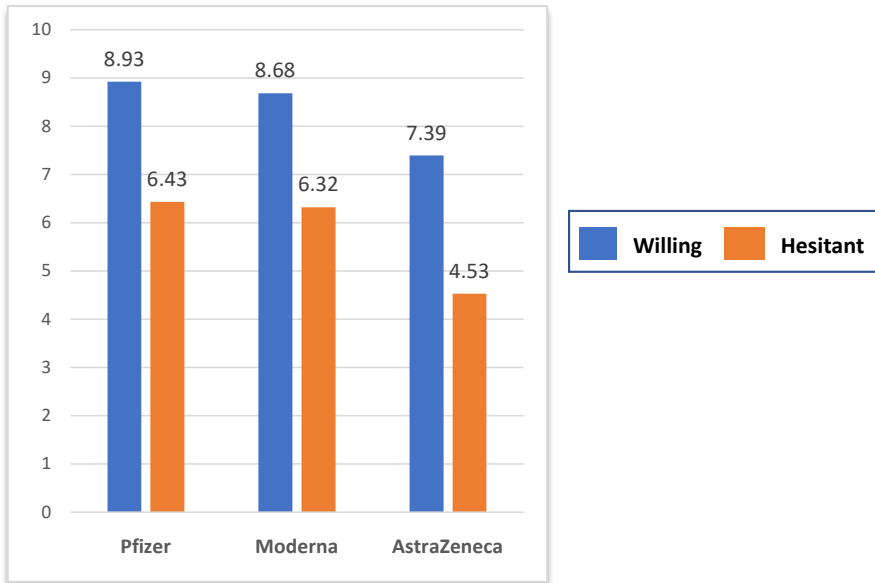
observations) placed in each of the three vaccines developed.

Table 2: Mean and standard deviation values of confidence in Pfizer, Moderna and AstraZeneca vaccines.

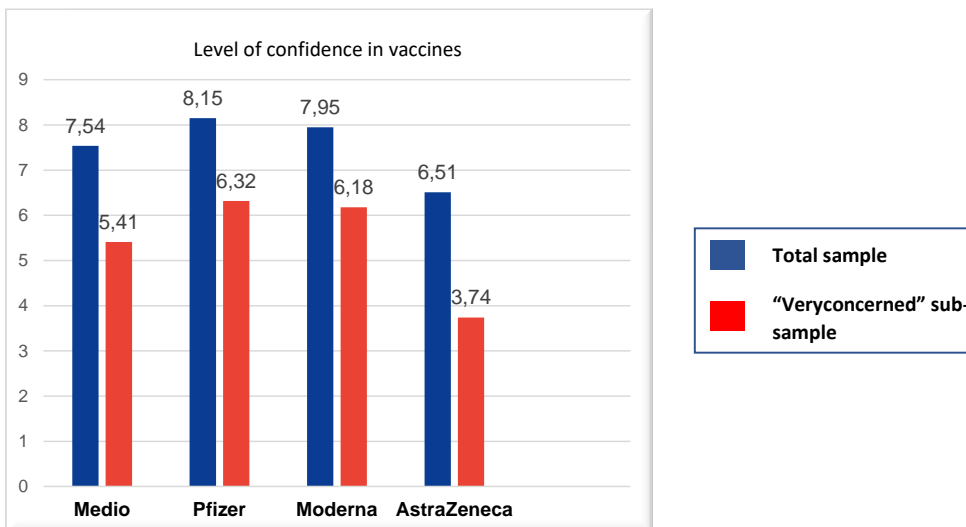
How much do you trust the vaccine	MEAN	ST. DEV.
PFIZER	8.15	2.02
MODERNA	7.95	2.02
ASTRAZENECA	6.51	2.63

Confidence in Pfizer and Moderna is high, significantly higher than in AstraZeneca, which is just above sufficient. When considering Pfizer and Moderna, in addition to the very similar average value, it is observed that confidence in the two vaccines is strongly correlated ($r = 0.88$; $r^2 = 0.76$; p -value < 0.000 ; Pearson’s correlation coefficient). Consistent with the findings across the total sample, for both non-hesitant and hesitant respondents, confidence in Pfizer and Moderna remains similar

and significantly higher than in AstraZeneca. It should be noted, however, that although people who are sure they want to be vaccinated acknowledge greater confidence in Pfizer and Moderna, the average value recorded for AstraZeneca is also quite high (7.39 out of 10). Particularly noteworthy, however, is the low average level of confidence that hesitators attribute to the vaccine produced by AstraZeneca (4.35 out of 10). The values given are shown in the bar graph below of the **Figure 5**.



(a)



(b)

Figure 5: (a) Average level of confidence in Pfizer, Moderna and AstraZeneca vaccines. Distinction between willing sub-sample and hesitant sub-sample. (b) Average level of confidence in Pfizer, Moderna and AstraZeneca vaccines. Distinction between total sample and "Very concerned" sub-sample.

In light of these data, it is necessary to question the reasons that may have led to such a significant confidence discrepancy between the AstraZeneca vaccine and the other two vaccines.

Confidence in the AstraZeneca vaccine may have been strongly influenced by the general panic surrounding the Anglo-Swedish vaccine, due to the very rare cases of serious side effects after

administration. This led to a great deal of confusion: within about a week, the regulatory agencies first reassured people that there was no link between the vaccine and the undesirable effects detected, then withdrew the vaccine as a precautionary measure, and finally reaffirmed that, despite the very rare possibility of developing thrombosis effects, the benefits of the vaccine clearly outweighed the risks and the vaccine was safe (7.8). In the time window in which the data of this study were collected, EMA continued to reassure the public about the reliability of the AstraZeneca vaccine. Between 10 March 2021 and 30 March 2021, the EMA issued a series of official releases reporting updates on the monitoring of rare cases of unusual blood clots found in people vaccinated with AstraZeneca. In each statement, in addition to reiterating that the benefits of the vaccine clearly outweighed the risks, it was stated that cases of serious complications had been observed in only a few dozen people compared with millions and millions of vaccinations [35]. The assurances of the top regulatory bodies, at least as far as can be seen from the data collected by this questionnaire, have not prevented a climate of fear and scepticism being created around the AstraZeneca vaccine. This raises the question of how much media miscommunication may have contributed to these negative feelings. With respect to this situation, the former Executive Director of EMA Guido Rasi, writes in an article: “Communication was objectively difficult, both because of the rapidly changing situation and because of the highly emotional context. Moreover, the communication difficulties of the institutions have been compounded by the sensationalism with which some media have chosen to comment on the vaccination campaign, using scaremongering headlines, placing greater emphasis on individual

cases of potential adverse reactions without simultaneously contextualizing and paralleling the tragic daily outcomes of Covid-19 infection” [36]. Spreading sensationalist news with scaremongering headlines, at a time in history like this, can be a way of dangerously fueling people’s hesitancy to get vaccinated. What happened in Italy in 2014 with the Flud flu vaccine is a clear example of the damage that poor communication can do to vaccination campaigns [37]. In this regard, it may be interesting to show the data collected on the ways in which people obtained most of their information about the Covid-19 vaccine (sub-section 3.5). Regarding perceived efficacy: 20% believe that the Covid-19 vaccine will definitely be effective for them, 64% that it will probably be effective, around 9% “Don’t know”, while around 6% say “Might not work” and tending towards zero are those more or less certain that the Covid vaccine will be ineffective. However, if you look at the distribution of these percentages for hesitant and non-hesitant respondents, there is quite a difference. Despite the fact that the majority of people in both categories believe that the vaccine is likely to be effective (67.28% of the non-hesitants and 58.41% of the hesitants, respectively), it is noted that almost all of the people who are most skeptical about the efficacy of the vaccine are distributed among the hesitant sub-group; on the contrary, the vast majority of those who are confident that the Covid-19 vaccine will be effective belong to the non-hesitant sub-group.

Analysis of the factors of concern surrounding vaccination against Covid-19

Using the data collected, a more accurate analysis of the concerns surrounding vaccination against Covid-19 was made in this study. Exploring

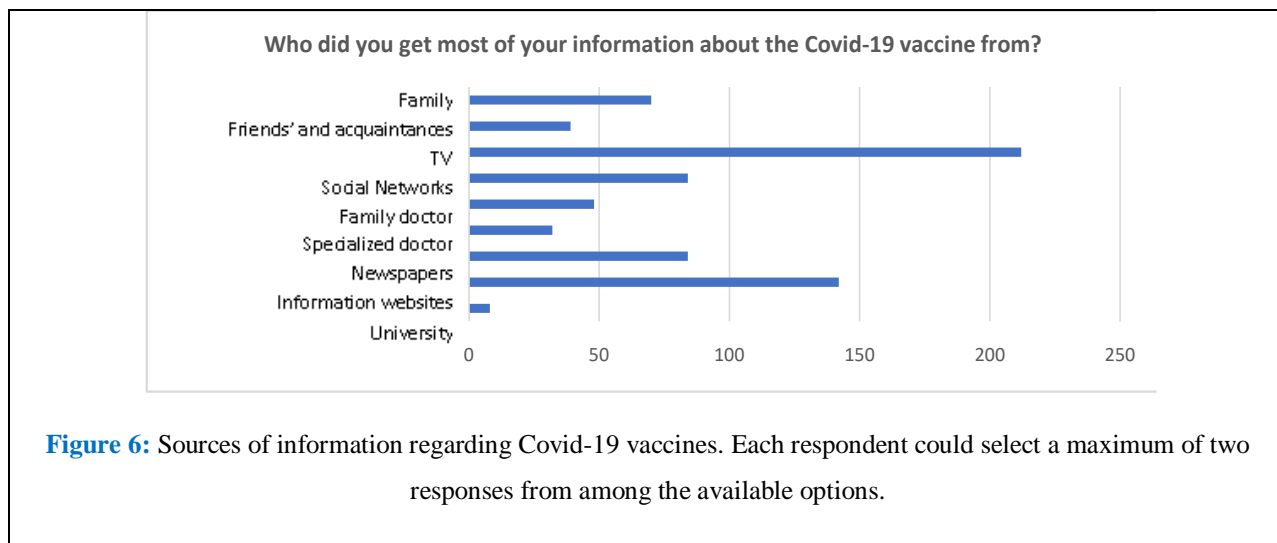
the issues of concern is justified by the fact that the novel elements characterizing the Covid-19-specific vaccine, such as a speed of development unique in history and the use of mRNA technology for the first time in a vaccine, may have fueled scepticism and consequently hesitation. An initial correlation analysis shows that there is a significant link between the propensity to get vaccinated and the concerns about doing so ($r = -0.65$, $r^2=0.42$, $p\text{-value} < 0.000$, Pearson's correlation). The strength of the correlation is conditioned by the presence of "anomalous" values given by people who, despite feeling quite concerned, are very willing to vaccinate. The following observations were also made on the data: 35% of those who said they were "hesitant" had a very high level of concern; 100% of the most hesitant people, who when asked "Will you get vaccinated for Covid-19?" answered "Probably not" or "Definitely not", stated a very high level of concern; 69.1% of those who were undecided whether or not to get vaccinated had a very high level of concern. By "very high" level of concern we mean people who, to the statement "Receiving the vaccine against Covid-19 would make me feel CONCERNED", gave a degree of agreement greater than or equal to eight on a scale ranging from 1 to 10. This sub-sample constitutes about 13.5% of the total sample. In light of the evidence reported, it is clear that trying to analyze what leads to concern can be important to get even closer to the root of the phenomenon of vaccine hesitation. As a preliminary analysis, it may be interesting to assess whether certain parameters measured on the previously mentioned sub-sample of the "Very concerned" (i.e., those who have a "very high" level of concern, recalling that these represent about 13.5% of the whole sample) are significantly different from those measured on the total sample.

Among the "Very concerned", confidence in the pharmaceutical companies that have produced the Covid-19 vaccine is more than insufficient (4.84 out of 10), while in general it is well above sufficient (7.08 out of 10). The low level of confidence that the "Very concerned" have in the companies that have produced the vaccine may stem from a lack of confidence in the vaccine itself. The first value in the bar graph of the **Figure 5(b)** shows the average confidence in the vaccine (averaging for each person the values for the three vaccines Pfizer, Moderna and AstraZeneca). Considering the whole sample, this value is well above sufficient (7.54), while if we consider only the "Very concerned" sub-sample, the average value is insufficient (5.41). It may be interesting to reflect on the fact that, more specifically, if only the data relating to Pfizer and Moderna were taken into account, even the "Very concerned" would have sufficient average confidence. The figure that makes the average value below the threshold of six is that of confidence in the vaccine produced by AstraZeneca, which is seriously insufficient (3.74).

To deepen the analysis, a multiple regression model (OLS method) constructed using a stepwise approach will be presented below. The dependent variable in the model is concern about getting the Covid-19 vaccine, while the independent variables are: gender; age; level of education; perception that vaccines can cause allergic reactions; perception that vaccines can cause disease; speed of Covid-19 vaccine development; and confidence in the AstraZeneca vaccine. The goal of the model is to investigate the factors that influence concerns about getting vaccinated against Covid-19. All the variables included (apart from the demographic variables) were measured by the questionnaire using a Likert scale

which, apart from the statement “How positive do you think it was to develop and approve the Covid-19 vaccine quickly”, ranges from 1 (lowest degree of agreement) to 10 (highest degree of agreement). In the model, the choice was made to include only the variable relating to trust in the AstraZeneca vaccine and not those measuring confidence in the other two

vaccines (Pfizer and Moderna). This is because it is considered that, for the context in which the questionnaire was submitted, and in light of the analyses carried out previously (Figure 6), the variable “Confidence in AstraZeneca” is the most relevant.



The non-inclusion of the confidence variables in Pfizer and Moderna is further motivated both by the adequacy of the model (this would create an excessive redundancy between the variables included), and by respect for the hypothesis of the absence of an exact link between the independent variables (as already seen above, confidence in Pfizer is strongly correlated with that in Moderna: $r = 0.88$; $r^2 = 0.76$; $p\text{-value} < 0.000$). The socio-demographic variables relating to gender and level of schooling have been inserted as dummy variables, in particular the level of schooling is a polytomous explanatory variable with three modalities: “Elementary/middle school”; “High school diploma” and “postgraduate degree/master’s”. For this it was codified using $k - 1$ ($= 2$) dummy variables; the “primary/middle school” mode is the one not codified. In the first step, in

addition to the demographic variables, two variables were included to see how much the concern about getting the specific Covid-19 vaccine is explained by the perception that vaccines (in general, not those developed against Covid-19) may cause disease or allergic reactions. These two variables were chosen because they show different aspects (the simple correlation between the two is low: $r = 0.2$, Pearson correlation) of the apprehension that vaccination can provoke. In the following steps, two variables measuring contingent and specific elements of the Covid-19 vaccine were added. Respectively, the first one (“How positive do you think it was to develop the Covid vaccine quickly”) measures the effect of a “novel element” such as developing the vaccine so quickly, and the second one (“Confidence in AstraZeneca”) captures the impact that the media

boom around the “AstraZeneca case” may have had on concerns about immunization against Covid-19. In this analysis, the following strong assumption applies: the perception that vaccines can cause disease or allergic reactions has not been significantly altered by views on the Covid vaccine and conditioning elements such as, among others, the “AstraZeneca case”. Based on this assumption, the perception that vaccines can cause disease or allergic

reactions can be seen as a proxy for the individual’s concern about the vaccine. **Table 3** shows the regression using the stepwise method. Each column represents a step and involves the addition of one or more variables. The level of significance was expressed with asterisks (“ * ” = p-value <0.05; “ ** ” = p-value <0.01; “ *** ” = p-value <0.001), the notation (ns) stands for “not significant”, i.e., p-value greater than 0.05.

Table 3: Stepwise regression model (OLS) (dependent variable: concern about getting vaccinated against Covid-19).

	(1)	(2)	(3)
Male	- 0.289 (n.s)	- 0.459 (n.s)	- 0.313 (n.s.)
Age	0.009 (n.s)	0.01 (n.s)	0.006 (n.s.)
High school diploma	- 0.172 (n.s)	0.042 (n.s)	- 0.052 (n.s.)
Bachelor’s degree or higher	- 0.138 (n.s)	0.049 (n.s)	- 0.058 (n.s.)
Vaccines can cause disease	0.389***	0.249***	0.190***
Vaccines can cause allergic reactions	0.267***	0.210***	0.181***
Rapid development of Covid-19 vaccines		- 1.300***	- 0.845***
Confidence in AstraZeneca			- 0.366***
Adjusted R-squared	0.30***	0.45***	0.55***

At each step, the model is statistically significant, as seen with the F test, which re-turns a p-value well below 0.05. The analysis does not reveal any significant links between demographic variables and concerns about getting vaccinated against Covid-19, suggesting that concerns about getting vaccinated cut across age, gender and level of schooling categories. It is observed that the concern about getting the

Covid-19 vaccine is significantly related to both the perception that vaccines can cause disease (0.389; p-value < 0.001), and the perception that vaccines can cause allergic reactions (0.267; p-value < 0.001); so, as might be expected, the more people believe that vaccines can cause disease or allergic reactions, the greater the concern about getting the Covid-19 vaccine. In this first step the correct R2 is 0.3.

Although there are clearly omitted variables not captured by the questionnaire, it can be assumed that these two aspects are indicative of concerns about vaccination that existed prior to the development of Covid-19 vaccines. It is interesting to note that factors such as the speed of vaccine development and trust in AstraZeneca show a more than significant link with concerns about getting vaccinated against Covid, although variables that take into account a general concern about vaccines are present in the model (in addition to the demographic ones). This result can be interpreted by trying to capture those elements that specific vaccines against Covid may have added to the general concern about vaccines. One possible explanation is that, since a vaccine has never been developed in such a short period of time, this “novelty” may have raised concerns and fears beyond the apprehension of possible side effects and diseases. The speed of development and approval may have been associated not only with a lack of safety, but also with the perception of a lack of transparency. On the other hand, the negative correlation between distrust in AstraZeneca and concern about vaccination may be an indicator of the effect that any complication in a vaccination campaign, however small, can have in such unprecedented times on the reputation of a specific vaccine and, consequently, on the whole immunization campaign. Social and media involvement around Covid-19 vaccines is so great that everyone is exposed to a multitude of information from the media as well as, for example, through word of mouth or via social media.

Conclusions

Vaccine hesitancy is a phenomenon that has been growing dangerously in recent years. Studies

like this can be useful to quantify the number of people who consider themselves hesitant and investigate the reasons behind this attitude. This would allow the possibility of implementing preventive actions to curb the phenomenon. This research relates to the Covid-19 specific vaccine, the discovery of which started what is very likely the largest immunization campaign ever. Given the immense damage caused by the pandemic, the aim from the outset was to vaccinate the population as quickly as possible. In Italy, for example, about 4.5% of the population had been vaccinated by the time the data for this study were collected, but the declared objective was to achieve the long-awaited herd immunity (which corresponds to about 80% of the vaccinated population) by September 2021 [38]. Therefore, investigating the extent of vaccination hesitancy means quantifying whether, at least from the point of view of willingness to get vaccinated, the individual states’ targets for their vaccination campaigns (such as the declared target for Italy) can be achieved. It would be detrimental, both socially and economically, if the state were to make vaccines available but if they were to go unused due to insufficient adherence. This study, carried out on a sample of the Italian population over 17 years of age, shows that 34% of people are hesitant to get vaccinated against Covid-19, while 66% have no doubts and will definitely get vaccinated. Compared to similar surveys but conducted in different time frames (before the vaccination campaign started), we can observe that the percentage of hesitators is showing a decreasing trend. This difference may be due to a vaccination campaign that got off on the right foot and the positivity with which people report their vaccination experience. Looking at the distribution of hesitant respondents by age group,

gender and level of education, the most striking value is the distribution of hesitant respondents among those with a low level of schooling (low being primary/middle school): more than half of them are hesitant (around 53%). What can this mean? Perhaps the communication campaign in support of vaccines has not been clear enough for even the least educated to understand the characteristics of the vaccines developed, why they were developed so quickly and how the benefits of vaccination outweigh the risks. The data also show that there is a significant difference between hesitant and non-hesitant respondents with regard to their perception of the risk of falling ill with Covid-19, their confidence in doctors, pharmaceutical companies and vaccines. Looking specifically at the different vaccines, it can be seen that confidence in Pfizer and Moderna is virtually identical and significantly higher than confidence in AstraZeneca. This difference is recorded both in general (considering the entire sample n=1,371), and when stratified into the hesitant and non-hesitant sub-groups. In particular, for hesitant respondents, confidence in AstraZeneca is on average seriously insufficient (4.53 out of 10). The observed gap seems unjustified if we simply stick to the official communications by the main regulatory bodies which, despite a couple of days of uncertainty when the AstraZeneca vaccine was suspended as a precautionary measure, have always reassured everyone by reporting the minimal percentages of officially recorded side effects in relation to the total number of people vaccinated [2]. It can therefore be hypothesized that the media impact generated by the “AstraZeneca case” led to a general panic situation, not supported by clear scientific evidence. Furthermore, it has been observed that concern about getting vaccinated against Covid-19 is very common

in those who consider themselves hesitant. This concern appears to be significantly linked to the perception that vaccines cause disease and allergic reactions, but even more so to the speed with which the Covid-19 vaccine was developed and the distrust of AstraZeneca. Based on these observations, with regard to the Coronavirus vaccination campaign, a number of actions can be suggested with a view to alleviating scepticism and concern surrounding the Covid-19 vaccine. In this sense, interventions should be primarily aimed at combating disinformation and fake news that circulate especially online - a very difficult place to regulate. Furthermore, it is suggested that television infomercials be broadcast to disseminate accurate scientific information. These infomercials should be backed by the government, as a source of maximum authority and credibility, and in a few minutes should provide clear and transparent information on the vaccines developed against Covid-19. An example would be a short television message explaining in a simple way how it was possible to develop the Covid-19 vaccines so quickly while meeting strict safety standards. This information could be included in awareness-raising infomercials with emotionally resonant messages, for an accurate and complete communication campaign aimed at familiarizing people with the vaccine.

Limitations of the research and suggestions for future studies

Given that the variables considered measure the degree to which people agree with opinions, this type of survey falls within the field of behavioral sciences where the relationship between variables is often inexact. Furthermore, since the data were obtained by means of self-reporting tools, there is also a risk that respondents may have chosen to

respond with what seems more socially acceptable rather than giving an honest judgment. For the reasons listed above, the model has some limitations: among others, it cannot be excluded that there is multicollinearity, because the variables included often measure different aspects of the same phenomenon (see, for example, confidence in AstraZeneca and the perception that vaccines cause allergic reactions: certainly, one of the reasons for distrust in the Anglo-Swedish vaccine is precisely the perception that it can cause allergic reactions). Furthermore, there is almost certainly a distortion due to omitted variable bias, in this sense it seems obvious that there will be other factors, perhaps relevant, that in addition to those measured by the questionnaire are correlated with a person's concern about getting the Covid-19 vaccine. Due to the reasons listed above, future researches could examine a larger and completely random sample. Furthermore, in order to conduct a more complete statistical analysis, items aimed at capturing instrumental variables could be included in the questionnaire.

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