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RESEARCH ARTICLE

From intention to action: factors of vaccine hesitancy and vaccine refusal during the COVID-19 pandemic

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Abstract

According to results of the vaccination campaign against COVID-19, Russia has failed to reach indicators of the developed countries on vaccination coverage and is sustainably below the global average. The purpose of this article is to identify and quantify factors of vaccine hesitancy and vaccine refusal in Russia during the following periods: prior to mass vaccination campaign and upon completion of its most active phase. We use data from the two surveys conducted in January-February and November-December, 2021. In the framework of the first survey, the respondents provided answers about their intention to be vaccinated, while in the second – about actual vaccination. In addition to socio-demographic indicators of individuals, factors related to respondents' perception of the disease and vaccine specifics, as well as their attitude towards vaccination in general, have been analyzed. The results indicate that distrust in the COVID-19 vaccine and anti-vaxxer convictions are important factors associated with both the intention to receive a vaccine and realized behavior regarding vaccination. There are significant differences across socio-demographic factors related to the intention to be vaccinated and realized behavior. This demonstrates the need to investigate factors determining behavior regarding vaccination rather than only factors affecting intention to receive a vaccine against COVID-19. The pandemic situation is significantly different from the "normal" one: the vaccination program is accompanied, among other things, by pressure on the population to encourage them to get vaccinated. The effects of this policy on the part of the state are yet to be investigated, a deeper understanding of their effect on vaccination behavior is required.

Keywords

health-related behavior, vaccination, COVID-19, vaccine hesitancy

JEL codes: I12, I18

Introduction

At the beginning of 2022, when the mass vaccination campaign against COVID-19 in Russia as a whole was completed, the share of vaccinated added up to 51% including 46% of fully vaccinated and 4.9% of those received at least one dose. This is significantly lower compared to the developed countries: by that time, in the European Union (EU) countries, the share of those received at least one dose equaled to 72%, and 73% - in the U.S. Moreover, this is lower than the world' average: as of January 1, 2022, the share of vaccinated in the world added up to 58% (Our World in Data…). Thus, despite the fact that Russia was the first country in the world to officially register a vaccine against COVID-19, the mass vaccination campaign was not very successful. Availability of technology turned out to be insufficient in situation when a significant part of the population shares beliefs preventing vaccination.

In addition to willingness to be vaccinated, other factors also affect the actual vaccination coverage. First, these are factors of availability of vaccination services –place of residence, income and employment status (Sallam 2021). Second, vaccination behavior was also influenced by different forms of coercion on the part of the state and employers: from bans on service delivery to people without vaccination certificates to dismissal of those who refused to be vaccinated (Maleva et al. 2021). However, forced vaccination has significant costs, both organizational and economic ones as well as directly related to the vaccination campaign itself - it can cause rejection and contribute to radicalization of the position of those population groups who are negative or hesitant about vaccination.

Therefore, comparisons of factors related to unwillingness to be vaccinated before initiation of the mass vaccination campaign and factors related to non-vaccination upon completion of the campaign will help better understand changes in attitudes during the campaign, as well opinions that turned out to be the most important in terms of vaccination behavior.

In the context of the pandemic it is critically important to develop an effective public communication strategy to increase coverage with vaccination and its rate of growth. Development of such strategy is possible only on the basis of a deep understanding of the factors related to decision making about vaccination. First, it is necessary to take into account heterogeneity of population showing distrust about vaccination: literature on vaccine refusal indicates that there are those categorically resistant to vaccination and those questioning the need for vaccination, taking a waiting position, for example, because they doubt the vaccine safety (Rossen et al. 2019; Larson et al. 2014; Dubé et al. 2016). Analysis of specific features of each of these groups will help develop a more focused and, consequentially, more effective communication strategy. Second, it is necessary to understand to what extent the attitude towards vaccination against COVID-19 is determined by the attitude to vaccination in general, and to what extent - by factors directly associated with the COVID-19 pandemic and specifics of the COVID-19 vaccine. Despite availability of extensive literature on vaccination attitudes, the COVID-19 pandemic has become an unprecedented phenomenon, both in terms of its consequences for the public health system and socio-economic consequences.

A deeper understanding is required to learn how vaccination decisions are influenced by specific pandemic-associated factors.

This article examines factors related to attitudes towards vaccination against COVID-19, based on data of the two surveys conducted in January-February and November-December 2021.

Analysis of distrust in vaccination against COVID-19

A negative attitude towards vaccination due to doubts about its effectiveness and safety, as well as religious considerations, has been known since the first application of this medical method at the end of the XVIII century. Currently, we can talk about a scientific consensus wherein experts in public health recognize vaccination as the most efficient and cost-effective medical intervention. Nevertheless, the anti-vaxxer movement turned into a noticeable social phenomenon rather than disappeared (Kata 2010; Kata 2012). To a large extent, this became possible due to the development of social networks, which allowed members of this movement to unite in communities and spread their ideas (Smith, Graham 2019). "Anti-Vaxxers" are united by a strongly negative attitude towards vaccination in any form, while they may have different views and give different arguments explaining why they refuse vaccination. As a result of its high activity, the anti-vaxxer movement is noticeable to society, and poses a problem for the healthcare at the moment when starts affecting wider groups of population, resulting in lower coverage with vaccination.

The COVID-19 pandemic has created special conditions for vaccination. On the one hand, the importance of vaccination turned out to be extremely high – a successful vaccination program can reverse the pandemic situation - significantly reduce mortality and morbidity, and allow to remove restrictive policies and, to a large extent, return to the "pre-pandemic norm". Most countries have undertaken significant efforts to organize national vaccination programs, making the vaccine free and accessible to citizens. On the other hand, the speed of events, novelty of both the disease and vaccines developed under emergency conditions, generate distrust on the part of the population. Specific features of vaccination against COVID-19 are that vaccines have were developed in the shortest possible time, making people consider vaccination high-risk (Callaway 2020).

A review of studies published in May 2021 on attitudes towards vaccination against COVID-19, carried out by Troiano and Nardi (2021), identified the following factors associated with vaccine refusal: negative attitudes towards vaccination in general, female gender, younger age groups (except for one article showing that middle age is associated with lower willingness to be vaccinated than younger and older ages (Palamenghi et al. 2020)), low level of education (with the exception of the article based on Turkish data (Salali, Uysal 2020)), low income (one publication showed no effect (Pogue et al. 2020). The studies failed to identify any statistically significant differences in willingness to be vaccinated between those infected with COVID-19 and those who were not. The most frequent reasons for refusing vaccine against COVID-19 included concerns about its safety and doubts about its effectiveness. It has often been suggested that vaccination is not needed, since COVID-19 is not dangerous.

Among socio-demographic factors associated with attitudes towards vaccination, education and income play a special role. The influence of these factors is extremely ambiguous, some studies indicate that a higher level of education (Troiano, Nardi 2021; Marzo et al. 2022; Reno et al. 2021) and income (Alleaume et al. 2021; Machida et al. 2021; Nguyen et al. 2021) are associated with a greater willingness to be vaccinated. While there are also studies documenting the inverse relationship for both education (McElfish et al. 2021; Solís Arce et al. 2021)), and income (Marzo et al. 2022). Explaining the relationship between these factors and vaccine hesitancy is of considerable interest. On the one hand, people with higher education have higher access to diverse sources of information about vaccination and are more likely to trust scientists and doctors (Maleva et al. 2021). Furthermore, people with a

higher level of education and income tend to show a proactive attitude towards their health, they are more likely to take responsibility for individual decisions on health (Eide, Showalter 2011). The downside of this phenomenon is the fact that people with a high level of education tend to question recommendations of doctors and health authorities, resulting in vaccine refusal or postponement of vaccination.

A large-scale study of attitudes towards vaccination against COVID-19 in 10 low- and middle-income countries, as well as in Russia and the U.S., showed that out of all participating in the study countries Russia is characterized by the lowest share of population ready to be vaccinated (Solís Arce et al. 2021). Readiness for vaccination in low- and middle-income countries equaled to 80.3% on average, 64.6% in the U.S., and 30.4% in Russia. Fear of side effects was the most popular reason for vaccine refusal. Unlike earlier publications, this article shows that neither age nor education had a statistically significant effect on willingness to be vaccinated.

Studies on attitudes towards vaccination in Russia based on samples representative at the national level are presented in publications developed by Ya. Roshchina and co-authors (2021) and T. Maleva and co-authors (2021). The first article is based on data of the Russian Longitudinal Monitoring Survey of the Higher School of Economics (RLMD-HSE). The dependent variable is intention to get vaccinated, respondents were interviewed from October 2020 to January 2021, before initiation of the mass vaccination campaign. There was no statistically significant association between gender and marital status and vaccine refusal. The risk of vaccine refusal decreases with increasing age, higher education, and living in a large city. Health self-assessment and vaccine refusal have a U-shaped relation: respondents who assess their health either very good or bad are more likely to refuse vaccination. Also, respondents who assess their risk of infection with COVID-19 as high are more likely to be vaccinated. Low trust in vaccine and state institutions also increase vaccine refusal. The second mentioned study is based on data of the three cross-sectional telephone surveys conducted in February, May and September 2021. The dependent variable is availability of vaccine. The results indicate that age and education are associated with a lower risk of vaccine refusal. These effects are sustainable, remain unchanged from one survey to another. Gender did not have any statistically significant effect on vaccination. The paper also shows that requirements for vaccination certificates at workplaces increase the likelihood of employees getting vaccinated.

The presented article is the first of the studies that we are aware of to compare factors of attitudes towards vaccination with regard to the intention to be vaccinated and actual vaccination status (action). We expect to see differences between the intention to be vaccinated and implemented vaccination behavior due to the following two main reasons. First, as the vaccination campaign unfolds, individuals who are vaccine hesitant transfer to the category of the vaccinated. This is partly due to the fact that people get convinced of the vaccine relative safety watching their relatives and acquaintances being vaccinated. Thus, we assume that as the vaccination campaign unfolds the share of individuals who are deeply convinced that COVID-19 vaccine or even vaccination in general are dangerous will remain high among the unvaccinated. Second, in addition to willingness to be vaccinated, decision making on vaccination is influenced by coercion on the part of the state and employers. Apparently, different groups of population succumb to this coercion to different degrees and their reaction to coercion varies; comparisons of factors affecting the intention to be vaccinated (which is not dependable upon coercion in any way) and actual vaccination status (action) (which depends, among other things, upon coercion) can shed light on decision-making on vaccination.

Inclusion of factors related to the disease and vaccine specifics (perceived risk of infection with COVID-19 and distrust in the COVID-19 vaccine), the role of beliefs about vaccination in general and identification of a moderate vaccine hesitancy category will provide for better understanding of how people make decisions about vaccination against COVID-19 in Russia.

Data and method

The data were collected during the two anonymous surveys, the first one was conducted from January 3 to February 19, 2021, the second – from November 4 to December 29, 2021. In both cases, respondents were recruited through social networks. The questionnaires were placed on Google Forms, respondents could join the survey by clicking on the link. Upon completion of the survey, the survey link was displayed on the screen to invite the user to help with further dissemination of the questionnaire. Eligible criteria for participation included age over 18 years and living in Russia during the pandemic. This is a convenience sample and it was formed through the "snowball" method. The data are not panel data, not the same individuals participated in the surveys, but the fact that the questionnaire was distributed in a similar way makes the two samples close in terms of socio-demographic structure (Table 1). Females accounted for more than two thirds of each sample. In comparison with the Russian population in general, the respondents in both samples are younger, more educated, have high income and live more often in large cities. The combined share of Moscow and St. Petersburg in the samples equals to 35% in the first survey and 52% in the second. The described age structure leads to the fact that only a relatively small share of respondents has chronic diseases that place them at risk for severe COVID-19. Such diseases included cardiovascular diseases, diabetes, hepatitis, chronic obstructive pulmonary disease, chronic kidney disease and cancer. The study was approved by the Ethics Committee of the St. Petersburg Association of Sociologists (SPAS), all respondents provided informed consent to participate before taking the questionnaire.

Intention to be vaccinated and vaccination status

In the survey conducted in January-February 2021, respondents were asked about their intention to be vaccinated. They were asked the following question "If the new COVID-19 vaccine recommended by the Ministry of Health of the Russian Federation is available to you, will you get vaccinated?", the answer options included "Yes", "No" and "Hesitant". In the survey conducted in November-December 2021 the question read "Have you been vaccinated against COVID-19? (Select "Yes" if you received at least the first dose)". The answer options included "Yes", "No, but planning" and "No and don't plan to". Thus, it was about the *realized* behavior in relation to vaccination. In both cases, the following three categories have been distinguished: in addition to respondents who were either positive or negative, there was also a category of the respondents hesitant to decide about vaccination.

In January-February 2021, only 21% of the sample declared their intention to be vaccinated, in November-December 2021, 66% of the sample were already vaccinated (Table 2). In both surveys, the category of those hesitant about vaccination turned out to be rather high: 39% said they did not know if they were ready to be vaccinated and 19% said they had not been vaccinated yet, but were planning to. Given that by the time of the second survey the active

Table 1. Sample characteristics

Variable	January-February	November-December
Intention to be vaccinated/Vaccination status		
Yes	21%	66%
No	41%	15%
Hesitant/Not vaccinated but planning	39%	19%
Females	75%	73%
Average age, years	36 (SD 14)	35 (SD 14)
Completed higher education	70%	73%
Married	42%	42%
Monthly per capita household income		
Under 20 thou. Rub.	21%	12%
20 - 40 thou. Rub.	31%	33%
40 - 60 thou. Rub.	25%	22%
Over 60 thou. Rub.	24%	33%
Settlement size		
Moscow and St. Petersburg	35%	44%
Over 1 mln. (Moscow and St. Petersburg excluded)	20%	24%
500 thou. - 1 mln.	13%	13%
100 thou. - 500 thou.	21%	10%
Under 100 thou.	12%	9%
Health risk group	24%	19%
Self-perceived risk of infection		
Low	14%	20%
Moderate	56%	61%
Significant	18%	14%
High	13%	4%
Distrust in COVID-19 vaccination	54%	55%
Against vaccination in general	10%	14%
N	598	577

public vaccination campaign has been on for almost a year, we can assume that people who in November-December 2021 were only planning their participation in vaccination can be considered as hesitant. Perception of the COVID-19 as dangerous has not significantly changed, neither did the share of the respondents who declared distrust in the COVID-19 vaccine. The share of respondents refusing vaccination in general increased from 10% to 14%.

Variables related to the COVID-19 pandemic and individual attitudes towards vaccination

In addition to socio-demographic characteristics of individuals, the study included three characteristics of individuals directly related to the COVID-19 pandemic and individual attitudes towards vaccination as factors that could potentially influence decision-making on vaccination. The first factor is perceived danger of COVID-19, assessed through the question: "How do you assess your personal risks of being infected with the new coronavirus?". The answer options included "low", "moderate", "significant risk" and "high risk". The second factor in this group was distrust in the COVID-19 vaccine, manifested in agreement with the statement "the Russian COVID-19 vaccines have not been properly tested". Finally, the third factor is the respondent's negative attitude towards vaccination in general, manifested in agreement with the statement "I am against vaccination in principle".

Statistical analysis

In order to assess the relationship between the above factors and intention to get vaccinated/ vaccination status, a logit model of unordered multiple choice of the following type was used:

$$P\left(y_i = j\right) = \frac{\exp\left(x_i'\beta_j\right)}{\sum_{m=1}^{k}\exp\left(x_i'\beta_m\right)}, i = 1,\ldots,n; j = 1,\ldots k,$$

i is the observation number, j is the alternative number, x_i is vector of the indicators of object i, $ß_i$ - vector of coefficients corresponding to the alternative j, $P(y_i=j)$ is the probability that the object i chooses the alternative j. In our case, the observation is an individual, the number of alternatives is k = 3, namely, in the case of intention to get vaccinated: 1= Ready to be vaccinated, 2= Hesitant, 2= Not ready to be vaccinated. In case of vaccination behavior: 1=Vaccinated, 2=Not vaccinated but planning, 3=Not vaccinated and don't plan to.

The use of the unordered multiple choice model is preferable than the ordered choice model, since we assume that factors associated with vaccine refusal and factors associated with vaccine hesitancy may differ significantly. For example, factors related to the danger of COVID-19 (being at risk for severe COVID-19 and self-perceived risk of infection) may be significant for vaccine hesitancy, while these factors may have no effect on vaccine refusal: individuals who refuse vaccination may not believe in effectiveness of vaccination in general.

In this case, distrust in vaccination does not rank between the consent to vaccination and refusal of it, therefore, the use of models of ordered choice is incorrect. Moreover, even if distrust in vaccination is actually between the refusal and acceptance, and the use of the ordered choice model is justified, the use of the unordered choice model is still possible, unlike the opposite situation, when the use of the ordered choice model would be incorrect.

Both for the intention to be vaccinated and realized behavior with regard to vaccination, the following two models have been evaluated: including only socio-demographic characteristics of individuals and including both socio-demographic characteristics of individuals and factors related to individual convictions regarding COVID-19, vaccination against COVID-19, as well as vaccination in general.

Results

Evaluation results of the logit models of unordered multiple choice are presented in Table 2 and Figures 1-2 in the form of average marginal effects (AME). Marginal effects express changes in predicted probability of an outcome with changes in factors, in other words, it is a way to represent results as a difference in probabilities. For example, if a person is refusing vaccination in general, the probability that he or she will refuse the COVID-19 vaccine increases by 43.8% for vaccination intention (AME = 0.438) and by 20% for the realized vaccination behavior (AME=0.201). Since the probabilities of the three possible outcomes equal to 1 in total, increased probability of one outcome is associated with decreased probability of other possible outcomes, in other words, if a factor increases the probability of consent to vaccination, then it reduces the probability of refusal and/or hesitancy.

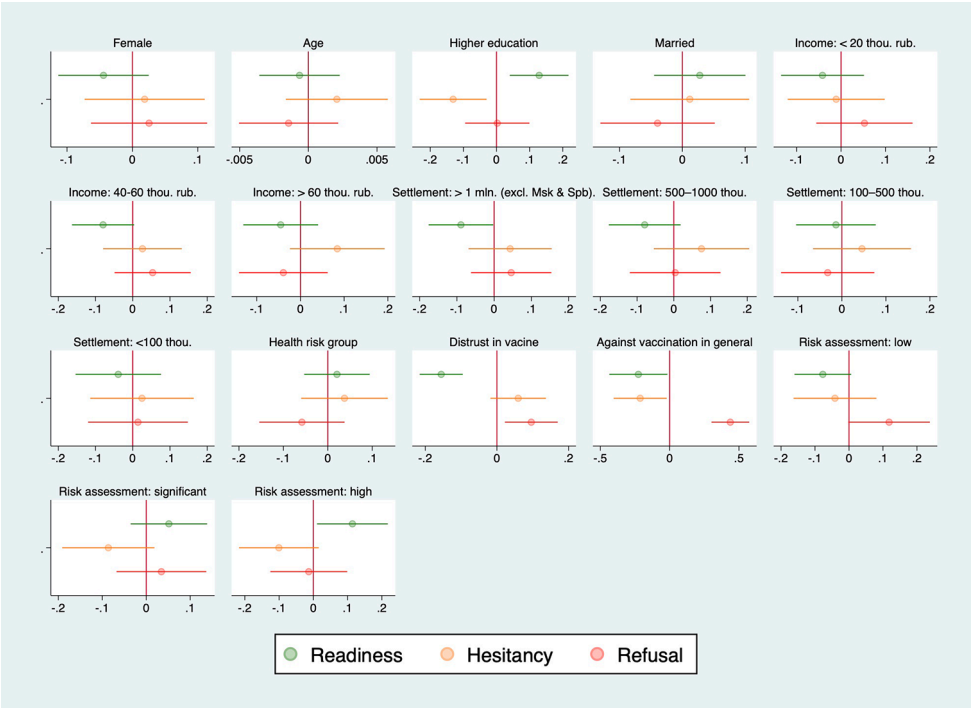

Figure 1. Factors associated with vaccination intention (average marginal effects)

The factors of gender, age, marital status, as well as presence of a chronic disease placing the respondent in the risk group for severe COVID-19 were statistically significant neither for the intention nor behavior regarding vaccination. Distrust in the COVID-19 vaccine is associated with decreased probability of both readiness to be vaccinated and implemented vaccination: for the intention, the probability decreases by 15.6%, for the behavior – by 36.0%. The probability of vaccine refusal increases by 9.7% for the intention and by 26.2% for the behavior.

A negative attitude towards vaccination in general is also associated with decreased probability of both readiness to be vaccinated and implemented vaccination by 22.8% and 17.3%, respectively. The probability of vaccine refusal in case of denial of vaccination in general increases by 43.8% for the intention and by 20.1% for the behavior. It is interesting

that for the intention, anti-vaxxer convictions almost equally reduce the probability of both readiness to be vaccinated (by 22.8%) and hesitancy (by 21.0%), while for the implemented behavior, anti-vaxxer convictions reduce the probability of vaccination (by 17.3%) without any statistically significant effect on hesitancy (the probability of the answer "No vaccinated, but planning"). A high self-perceived risk of COVID-19 infection affects both the intention (increases the probability of readiness to be vaccinated by 11.5%) and the implemented behavior (reduces the probability of vaccine refusal by 12.1%)

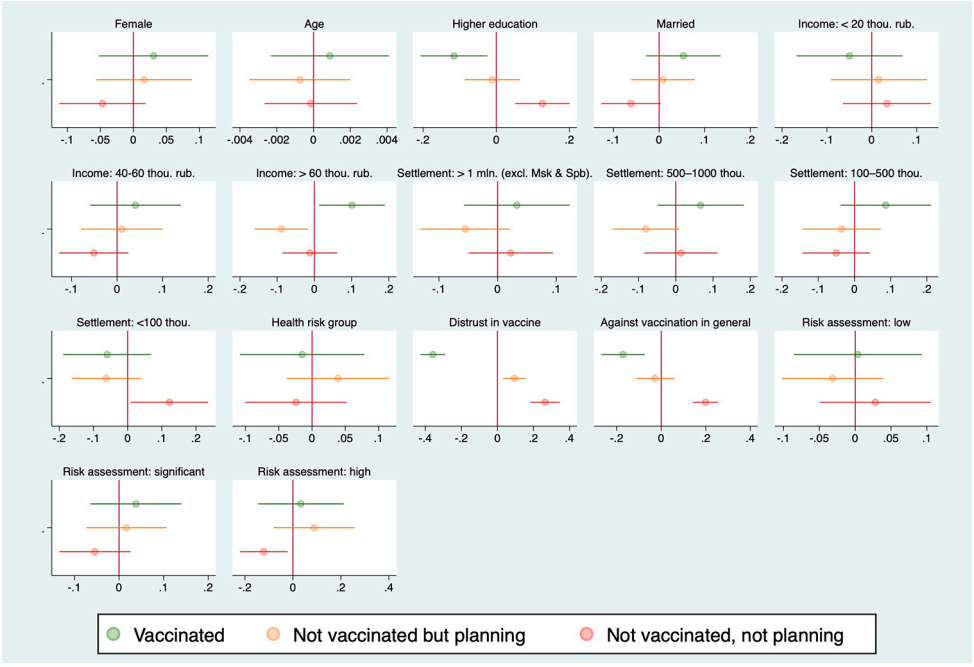

Figure 2. Factors associated with vaccination behavior (average marginal effects)

Higher education is positively associated with the intention to get vaccinated: it increases the probability of readiness to be vaccinated by 15.7% for the model that includes only socio-demographic characteristics, and by 13.2% for the comprehensive model. This effect is mainly due to reduced probability of vaccine hesitancy (by 13.5% for the model that includes only socio-demographic characteristics, and by 13.3% for the comprehensive model), without any statistically significant association between higher education and vaccine refusal. For the realized behavior, there is no statistically significant relationship between higher education and vaccination behavior in the model that includes only socio-demographic characteristics.

However, when we take into account factors related to the COVID-19 pandemic and individual attitudes towards vaccination, education is associated with a lower probability of getting vaccinated (by 11.7%) and a higher probability of vaccine refusal (by 12.5%). Thus, moving away from the intention to actual behavior in terms of vaccination the factor of higher education changes its vector: for the intention to get vaccinated, a higher level of education was associated with a higher probability of readiness to get vaccinated, while for the realized behavior, the relationship is reversed –higher education is associated with a lower probability for a person being vaccinated.

Table 2. Evaluation results of the logit model of unordered multiple choice

	Intention towards vaccination						Behavior towards vaccination					
	Readiness		Hesitancy		Refusal		Vaccinated		Not vaccinated but planning		Not vaccinated, not planning	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Female	-0.062	-0.043	0.021	0.018	0.040	0.026	-0.025	0.031	0.039	0.015	-0.014	-0.046
	(0.037)	(0.035)	(0.048)	(0.047)	(0.047)	(0.045)	(0.046)	(0.042)	(0.037)	(0.037)	(0.037)	(0.033)
Age	0.000	-0.001	0.002	0.002	-0.002	-0.001	-0.001	0.001	0.001	-0.000	0.001	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Higher education	0.157***	0.132**	-0.135**	-0.133**	-0.022	0.001	-0.031	-0.117*	-0.015	-0.008	0.046	0.125**
	(0.048)	(0.045)	(0.052)	(0.052)	(0.051)	(0.049)	(0.052)	(0.046)	(0.038)	(0.038)	(0.044)	(0.038)
Married	0.007	0.021	0.003	0.017	-0.010	-0.037	0.036	0.054	0.012	0.005	-0.048	-0.059
	(0.038)	(0.037)	(0.049)	(0.048)	(0.049)	(0.046)	(0.048)	(0.042)	(0.036)	(0.035)	(0.039)	(0.033)
Income: <20 thou. Rub.	-0.027	-0.040	-0.029	-0.011	0.055	0.051	-0.095	-0.050	0.027	0.017	0.068	0.033
	(0.050)	(0.047)	(0.056)	(0.056)	(0.058)	(0.056)	(0.069)	(0.060)	(0.056)	(0.054)	(0.057)	(0.050)
Income: 40–60 thou. Rub.	-0.061	-0.075	0.019	0.024	0.041	0.051	-0.003	0.042	0.011	0.004	-0.009	-0.047
	(0.044)	(0.042)	(0.055)	(0.054)	(0.055)	(0.052)	(0.056)	(0.051)	(0.046)	(0.045)	(0.044)	(0.039)
Income: >60 thou. Rub.	-0.030	-0.034	0.083	0.078	-0.053	-0.044	0.060	0.097*	-0.082*	-0.084*	0.022	-0.013
	(0.045)	(0.044)	(0.057)	(0.055)	(0.054)	(0.052)	(0.050)	(0.044)	(0.036)	(0.036)	(0.042)	(0.036)
Settlement: > 1 mln. (Moscow	-0.040	-0.045	-0.002	0.009	0.042	0.036	0.012	0.040	-0.071	-0.082*	0.060	0.042
and St. Petersburg excluded)	(0.045)	(0.044)	(0.056)	(0.055)	(0.055)	(0.053)	(0.050)	(0.044)	(0.040)	(0.039)	(0.040)	(0.035)
Settlement: 500–1000 thou.	-0.035	-0.066	0.052	0.064	-0.017	0.002	0.091	0.073	-0.112*	-0.100*	0.020	0.027
	(0.055)	(0.050)	(0.068)	(0.067)	(0.066)	(0.064)	(0.064)	(0.061)	(0.045)	(0.048)	(0.053)	(0.051)
Settlement: 100–500 thou.	0.013	0.000	0.029	0.033	-0.042	-0.034	0.104	0.094	-0.059	-0.057	-0.045	-0.037
	(0.049)	(0.047)	(0.059)	(0.058)	(0.057)	(0.055)	(0.069)	(0.065)	(0.057)	(0.057)	(0.050)	(0.048)
Settlement: <100 thou.	-0.041	-0.022	0.009	0.010	0.032	0.011	-0.108	-0.053	-0.076	-0.083	0.184*	0.136*
	(0.057)	(0.059)	(0.073)	(0.071)	(0.073)	(0.069)	(0.079)	(0.067)	(0.055)	(0.053)	(0.072)	(0.058)
Health risk group	0.031	0.018	0.042	0.040	-0.073	-0.058	-0.029	-0.013	0.039	0.035	-0.010	-0.021
	(0.039)	(0.038)	(0.050)	(0.050)	(0.051)	(0.049)	(0.055)	(0.048)	(0.039)	(0.039)	(0.046)	(0.039)

	Intention towards vaccination						Behavior towards vaccination					
	Readiness		Hesitancy		Refusal		Vaccinated		Not vaccinated but planning		Not vaccinated, not planning	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Distrust in vaccine		-0.156***		0.059		0.097*		-0.360***		0.098**		0.262***
		(0.031)		(0.040)		(0.038)		(0.035)		(0.031)		(0.041)
Against vaccination in general		-0.228*		-0.210*		0.438***		-0.173***		-0.029		0.201***
		(0.108)		(0.098)		(0.070)		(0.050)		(0.044)		(0.029)
Risk assessment: low		-0.079		-0.041		0.120		0.004		-0.031		0.027
		(0.042)		(0.062)		(0.061)		(0.045)		(0.036)		(0.040)
Risk assessment: significant		0.050		-0.085		0.035		0.036		0.022		-0.059
		(0.045)		(0.054)		(0.052)		(0.053)		(0.046)		(0.040)
Risk assessment: high		0.115*		-0.102		-0.013		0.035		0.086		-0.121*
		(0.053)		(0.059)		(0.057)		(0.091)		(0.086)		(0.052)

Note: n= 598 and n = 575, standard errors in parentheses, basic categories: 20-40 thou. for income, Moscow and St. Petersburg for settlement size, moderate for subjective risk assessment, * p<0.05 ** p<0.01 *** p<0.001

Income turned out to be statistically insignificant for the intention, while for the behavior, a high level of income (over 60 thousand rubles per month per household member) is associated with a higher probability of getting vaccinated (by 9.7% in the comprehensive model) and a lower probability for a person joining the category of vaccine hesitancy (by 8.4% in the comprehensive model).

Finally, the size of the settlement is not statistically significant for the intention, while for the behavior compared with the basic category of Moscow and St. Petersburg, living in other million+ cities, as well as cities with the population size from half a million to one million, is associated with a lower probability for an individual joining the vaccine hesitancy category(8.2% for million+ cities and 10.0% for cities with half a million to one million population). Living in settlements with less than 100 thousand people is associated with a higher probability of vaccine refusal (13.6%) in the comprehensive model.

Discussion

The study made it possible to compare factors related to the intention and action regarding vaccination. We were expecting differences due to the following two main reasons: first, studies indicate that there is a gap between the intention and actual action regarding vaccination (see e.g. Fall et al. (2018)). This gap is due to psychological and behavioral reasons. Second, differences between the intention and behavior regarding vaccination against COVID-19 may be associated with a large-scale public vaccination campaign, which was accompanied by various restrictions for the unvaccinated. The intention to be vaccinated is not dependable upon external pressure, while the received COVID-19 vaccine could be associated with such pressure, therefore, comparisons of factors related to the intention and behavior will help better understand how government vaccination policy affects behavior of individuals.

Key differences among factors related to the intention and behavior regarding vaccination, are registered in education, income and settlement size. For the intention to get vaccinated, while a higher level of education is associated with higher probability for an individual being ready to get vaccinated, for the behavior, there is an inverse relationship – a higher level of education is associated with a lower probability of receiving COVID-19 vaccine. There was no relationship between the intention to get vaccinated and income, while for the behavior there is a higher probability of being vaccinated for individuals with high income. Thus, the two characteristics of socio-economic status affect vaccination behavior in the following different directions: a higher level of education reduces the likelihood for a person being vaccinated, while a high income increases this probability. The size of the settlement is not statistically significant for the intention to get vaccinated, while for the behavior, living in settlements with a population of less than 100 thousand is associated with a higher probability of vaccine refusal.

From extensive research literature on factors related to attitudes towards vaccination, we know that the role of income and education is ambiguous: there is evidence that people with higher income (Alleaume et al. 2021; Machida et al. 2021; Nguyen et al. 2021) and education (Troiano, Nardi 2021; Marzo et al. 2022; Reno et al. 2021) show a greater willingness to be vaccinated, while there is opposite evidence, both for income (Wang et al. 2014, Yang et al. 2016) and level of education (Salali & Uysal 2020). People with a higher level of education and income tend to be more informed and have a higher level of trust, however, they are

more likely to take responsibility for individual health decisions (Eide, Showalter 2011), which can lead to a conscious refusal of vaccine.

An important factor unique to vaccination during the pandemic is active coercion to vaccination by the State and employers through restrictive politics. It can be assumed that individuals with a higher socio-economic status are less likely to be forced to get vaccinated or have more resources to resist it. To test this hypothesis, we have undertaken an additional analysis of the survey data conducted in November-December 2021. The survey included two questions that were asked of only those respondents who were positive about question of whether they had been vaccinated against COVID-19. The first question was about whether it was a coerced vaccination because of the employer (30% answered "Yes").

The second question was about willingness to have a repeated vaccination against COVID-19 ("No" - 12%, "Hesitant" - 16%, "Yes" and "Already had" - the rest). Higher education and settlement size were not statistically significantly related either to coercion to vaccinate on the part of the employer, or to refusal to re-vaccination. There are no statistically significant differences in willingness to be re-vaccinated across income groups, however, high income (more than 60 thousand rubles per household member) is associated with a lower probability of coercion on the part of the employer (AME=-0.132). In other words, our hypothesis that among those with higher education there is a lower probability for being vaccinated is associated with the fact that those people are less subject to coercion on the part of the employer has not been confirmed.

A number of socio-demographic characteristics included in the study turned out to be statistically insignificant: we failed to identify any differences either in the intention or behavior depending on gender, age and marital status. In literature, males are generally more likely to be vaccinated than females (Ahmed et al. 2021; Khaled et al. 2021; Troiano, Nardi 2021), although studies based on the Russian data show no relationship (Maleva et al. 2021; Roshchina et al. 2021). Age is usually positively associated with the willingness to be vaccinated (Maleva et al. 2021; Roshchina et al. 2021), the difference in our results may be explained by specifics of the sample, which is relatively young and unrepresentative for the general population.

An interesting and somewhat paradoxical result of the study is lack of any relationship between high risks for severe COVID-19 and willingness to be vaccinated. In our models, we have used a binary variable reflecting presence of at least one chronic disease from the list that attribute an individual to the risk group for severe COVID-19 (cardiovascular diseases, diabetes, hepatitis, chronic obstructive pulmonary disease, chronic kidney disease and cancer). To test sustainability, we have replaced this variable with another one, which is also a good predictor of the risk for severe COVID-19 – body mass index, however the results remained unchanged. Therefore, objective measures of the risk for severe COVID-19 have nothing to do with the willingness to be vaccinated. The study conducted by Roschina and co-authors (Roshchina et al. 2021), shows that there is a relationship between willingness and health self-assessment (respondents who assessed their health either as very bad or very good are more likely to refuse vaccination), however, these results are not quite comparable with those obtained in this study, as they reflect self-assessment of health.

An important factor influencing vaccination behavior is distrust in COVID-19 vaccines and anti-vaxxer convictions in general. An important difference between these two beliefs is that distrust in the COVID-19 vaccine is much more widespread than a more radical refusal of vaccination in general. So, in the first survey, 54% of respondents said they did not trust the COVID-19 vaccine versus only 10% who were against vaccination in general. In the

second survey, the number of these groups equaled to 55% and 14%, respectively. However, while these characteristics of individuals had no statistically significant correlation in the first survey, in the second survey they were interrelated (r=0.27, p=0.0000). Distrust in the COVID-19 vaccine and a negative attitude towards vaccination in general were associated with the rejection of both the intention to be vaccinated and implemented vaccination. At the same time, the scale of the effects varies from the intention to action: the role of anti-vaxxer convictions in decision-making decreases, while the role of distrust increases.

Cross-sectional nature of the data is the study limitation. If panel data were available, we could make much more confident conclusions about possible explanations of the observed effects. The second important limitation of the study is unrepresentativeness of the data used at the population (national) level. However, it seems that this limitation is less significant compared to the comparability of samples, in the context where the focus of the study is to compare factors influencing the intention to be vaccinated and the realized behavior in terms of vaccination.

The obtained results indicate the need to analyze factors affecting behavior in relation to vaccination rather than factors influencing the intention to be vaccinated. Promising directions of future research in this area are mainly related to, first, studies on factors influencing the intention and behavior regarding vaccination on the basis of panel data, and second, analysis of factors affecting behavior regarding vaccination on the basis of representative samples at the national level. A deeper understanding of how vaccine refusal and education are interrelated is needed – so far, the obtained results show that this relationship is complex and ambiguous. In addition, there is a need for a deeper understanding of the impact of the state vaccination campaign on individual vaccination behavior, as well as individual beliefs about vaccination.

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Other sources of information

Our World in Data COVID-19 Pandemic Database (https://ourworldindata.org/coronavirus)

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