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RESEARCH ARTICLE

Socio-demographic determinants of COVID-19 vaccine uptake in Russia in the context of mandatory vaccination of employees

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Abstract

The paper offers an analysis of socio-demographic factors determining uptake of COVID-19 vaccine in Russia in 2021. The study focuses in particular on the role of mandatory vaccination of workers in certain sectors of the economy. The study is empirically based on three rounds of a nationally representative telephone survey, conducted in February–October 2021, which investigated the situation and behaviour of a cross section of the Russian adult population in the context of the spread of coronavirus.

The paper shows that the key factors behind vaccine uptake are age and education of the individual. People in older age groups and people with higher education are most inclined towards vaccination. By contrast, young people and people with low levels of education are least likely to be vaccinated. Other significant determinants of vaccination are experience of COVID-19 infection (self or a household member) and elderly or chronically ill members of the household. Among the employed, the economic sector where they work is an important determinant: workers in education, health care, and state and municipal administration are more likely to be vaccinated. The introduction of mandatory vaccination at a firm/organization with sanctions for unvaccinated employees has significant positive effect: the likelihood of an employee being vaccinated increases by 10 percentage points. The effect of mandatory vaccination is slightly greater for men than for women.

Keywords

COVID-19, coronavirus, vaccination, socio-demographic groups, mandatory vaccination, Russia

JEL codes: I12, I18, J10

1. Introduction

The COVID-19 pandemic has had dramatic impact worldwide. The new virus has already claimed five million lives, and the losses continue to rise. At national level, governments are taking various measures to contain the pandemic, from actions to slow down its spread (mandatory mask regime, restrictions on mobility and mass gatherings, remote work and study, isolation of patients and contact persons) to complete lockdowns in parts of the country or the country as a whole. While these measures are helping to contain the virus, vaccination is the main hope for a return to normality. It is estimated that over 80% of the population in each country may need to be vaccinated to prevent further increases in morbidity and guarantee herd immunity (see (Anderson et al. 2020; Britton et al. 2020; Sanche et al. 2020)). So immunization of the population has top priority for national governments.

The success of a national vaccination campaign depends on two key factors. The first is availability and easy access to the vaccine for all of the country's residents, regardless of socio-economic status, place of residence, gender, age, ethnic and religious affiliation, etc. The second, perhaps even more important factor in the success of vaccination is the desire of people to get vaccinated. Even before the COVID-19 pandemic, in 2019, the World Health Organization (WHO) made "vaccine hesitancy" (people postponing or refusing vaccination when it is on offer) one of the top-10 global threats to public health and healthcare (WHO 2019).

It is not surprising that hesitancy about vaccination against COVID-19 is particularly high. The novelty of the infection itself, the speed with which the vaccines were developed, the limited amount of information on practice of using the new vaccines, their effectiveness and long-term effects, can significantly reduce the willingness of people in countries with very different levels of socio-economic development to be vaccinated (Solís Arce et al. 2021; Prickett et al. 2021; Dubé et al. 2021; Yahia et al. 2021; Neumann-Böhme et al. 2020). Special motivational measures are required in order to achieve high rates of vaccination against COVID-19 at national level.

The situation in Russia

Russia is on the list of countries most affected by the COVID-19 pandemic (measured both by the number of cases and deaths, and by excess mortality). According to (Johns Hopkins University database), at the end of October 2021, Russia was fifth among all countries in the world by the number of cases of coronavirus (8.4 million people) and sixth by the number of deaths (234,000 people). According to some experts, the excess mortality rate calculated on annual basis was approaching 43% in Russia by the end of September 2021, which is a significantly higher level than in most developed countries (Karlinsky and Kobak 2021; World Mortality Dataset). So the coronavirus situation in Russia can fairly be considered to be close to critical. Clearly, therefore, mass immunization against COVID-19 is a particularly urgent matter in Russia.

Russia began vaccinating certain groups of the population on December 5, 2020, and a campaign for mass immunization of the adult population was launched on January 18, 2021. Five vaccine types have been developed and are being used, of which the Sputnik V vaccine is most prevalent. Vaccination is free and available in all regions of the country without exception. The federal and regional governments are making significant efforts to motivate the

population by making vaccination more easily available (opening more vaccination points, including mobile points, offering vaccination at home to people with limited mobility, etc.), and through material incentives (lotteries, gifts and payments). But the results have been disappointing. More than nine months after mass vaccination began, the share of the population who have been vaccinated and the rate of uptake remain unsatisfactory (see Fig. 1). As of October 22, only 36% of all Russians had received at least one dose of the COVID-19 vaccine, and 33% were fully vaccinated.

Compared to OECD countries and their key partners, the level of vaccination in Russia is unprecedentedly low (see Fig. 2). At the end of October, the share of the population that had received at least one component of the COVID-19 vaccine exceeded 80% in four OECD countries and another ten countries showed levels of 75–80%. Countries with vaccination rates comparable to Russia include Azerbaijan, Bolivia, Venezuela, Honduras, and Romania.

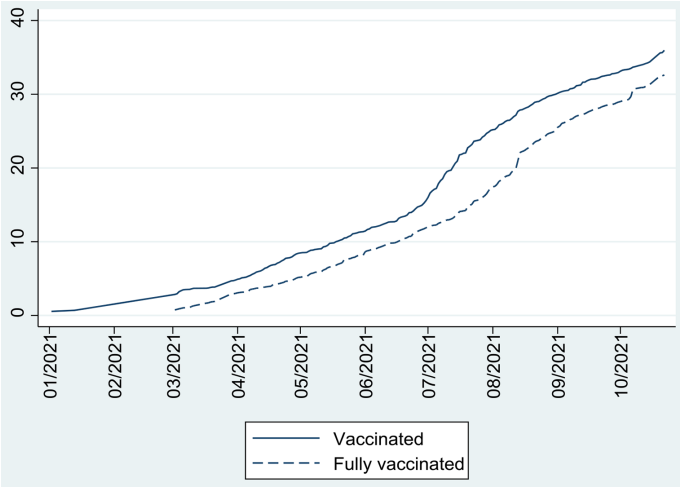

Fig. 1. Vaccination rate in Russia, % of population, January—October 2021. *Source:* (Our World in Data database)

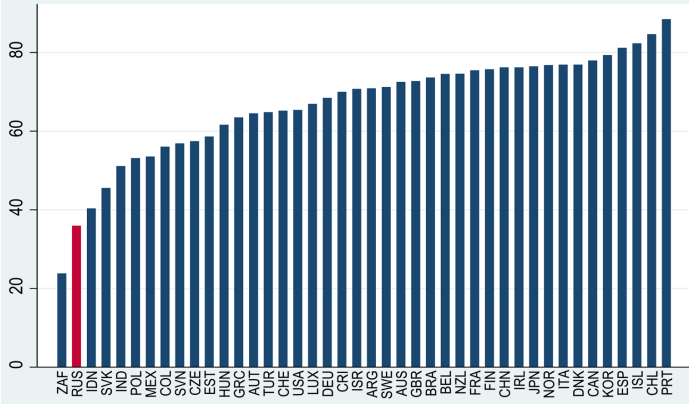

Fig. 2. Vaccination rate in Russia and OECD countries and their key partners, % of population who received at least one dose of vaccine, October 2021. *Source:* Our World in Data database

The grave epidemiological situation and the low proportion of vaccinated people in many Russian regions has led the government to introduce mandatory vaccination of workers who are in daily face-to-face contact with many other people. The mandatory vaccination rules require firms and organizations to ensure that the share of their employees who have been vaccinated is above a specific threshold (60–100%) by a specific date. A firm that fails to meet the requirements may be fined up to one million rubles and its business may be suspended for up to three months. Types of business and other activities that are subject to mandatory vaccination are determined at regional level, but, in practice, they are very similar across the country. They include trade, public catering, transport, health care, education, client departments of financial organizations, consumer service providers, housing and utility services, culture, sport and leisure, as well as government and municipal employees. These are all activities where workers are regularly in face-to-face contact with other people. The first region to introduce mandatory vaccination of workers was Moscow on July 16, 2021 (the cities of Moscow and St. Petersburg count as "regions" in their own right, being defined as "cities with federal status"). At the end of October, mandatory vaccination was imposed in all regions of Russia, except the Republic of Ingushetia (V Rossii ostalsya... 2021). Russia is not the only country that has pursued mandatory vaccination of specific social groups: a number of other countries took the same path in the summer and autumn of 2021 (Reuters 2021).

Success of a policy to encourage vaccination depends to a large extent on proper understanding of how various socio-demographic groups are likely to behave. Such understanding makes it possible to nuance the policy correctly, to introduce new incentive measures and modify those already in place. The main aim of the present paper is to obtain quantitative estimates of how various socio-demographic factors impact uptake of coronavirus vaccination in Russia, using nationally representative data. Separate analyses are carried for the Russian population as a whole and for the employed population. The paper also evaluates the effectiveness of mandatory vaccination of workers (overall and in specific socio-demographic groups).

The paper is structured as follows: the second section gives an overview of the existing literature on socio-demographic aspects of willingness to vaccinate against COVID-19; the third section describes the empirical basis of the study in detail; the fourth section deals with research methodology; the fifth section presents main results of the study; the main findings of the study are formulated in the sixth section.

2. Literature review

In 2020–2021 the social challenges associated with mass vaccination and motivating people to get vaccinated prompted a number of empirical studies that analyze socio-demographic determinants of vaccination against coronavirus in both developed and developing countries. In this review, we mainly focus on papers based on nationally representative data. Table A1 in the Appendix provides a list of studies and the countries concerned as well as key features of the data used.

The results of studies outside Russia confirm that a person's socio-demographic profile is a key determinant of whether or not they get vaccinated against coronavirus. Vaccination intentions are strongly differentiated by age: older people are more likely to get vaccinated, while young people (18 to 24–29 years old) are least willing to be vaccinated. Analysis of age

characteristics of willingness to vaccinate gave similar results in different countries (see, for example, (Alleaume et al. 2021; Böhme et al. 2020; Hwang et al. 2021) and other papers; see the detailed list in the Appendix).

Health factors may influence the decision to be vaccinated. People suffering from chronic diseases are more likely to seek vaccination (Seale et al. 2021). Interestingly, other members of the household with chronic disease also has a positive effect on vaccine willingness (Alleaume et al. 2021; Dubé et al. 2021). It is natural to assume that people want to protect their loved ones who are at greater risk of a severe course of the disease.

Research findings on gender differences regarding willingness to vaccinate are ambiguous. Studies carried out for a number of countries (see, for example, (Szilagyi et al. 2021, Lindholt et al. 2021; Solís Arce et al. 2021) and others) have shown that men are more willing than women to be vaccinated and, although refusal to vaccinate usually does not differ by gender, men are more likely to be confident in their intention, while women are more likely to be hesitant about vaccination (Neumann-Böhme et al. 2020; Prickett et al. 2021). (Seale et al. 2021), on the contrary, found a higher willingness to vaccinate among women. In an international study involving 19 of the 35 countries most affected by COVID-19, no significant gender differences in willingness to vaccinate were found (Lazarus et al. 2021).

Level of education is another significant factor in vaccination willingness. In countries with above-average per capita incomes, propensity to vaccinate often increases with the level of education. People with higher education are most likely to be vaccinated against COVID-19, while people with secondary education or lower are least likely to be vaccinated (Alleaume et al. 2021; Dubé et al. 2021; Lazarus et al. 2021; Prickett et al. 2021; Green et al. 2021; Yahia et al. 2021). However, in countries with below-average per capita incomes, there may be an inverse relationship between education and willingness to vaccinate (Solís Arce et al. 2021; Cooper et al. 2021; Analysis of Public... 2021).

Financial well-being is an independent factor: people with high incomes are more willing to be vaccinated than those with low incomes (Lazarus et al. 2021; Alleaume et al. 2021; Hwang et al. 2021; Analysis of Public... 2021). However, this correlation may be mediated by other features of the respondents, in particular, by their level of education. For example, one study (Prickett et al. 2021) found that the social gradient in propensity to vaccinate lost its significance after controlling for level of education.

Other significant socio-demographic factors of vaccination looked at by foreign literature include marital status (Alleaume et al. 2021; Yahia et al. 2021) and ethnicity (Szilagyi et al. 2021; Green et al. 2021; Prickett et al. 2021; Cooper et al. 2021).

Review of the foreign literature offers some conclusions about the situation in Russia. A number of papers that carry out cross-country comparisons of vaccination intentions include Russian data and they find that willingness to vaccinate in Russia is very low, both in comparison with low- and middle-income countries and compared with high-income countries (Solís Arce et al. 2021; Lazarus et al. 2021). (Tran et al. 2021) analyze socio-demographic factors that determine propensity to vaccinate against COVID-19 in Russia. According to their results, the key factors are gender (men are more likely to get vaccinated) and age (older people are more vaccine-willing than young people). However, data for the study were collected by the "snowball" method (the primary core consists of students and teachers of a Russian medical university) and are not representative of the population as a whole.

In the Russian literature, so far as we know, there is only one published study that uses statistics to assess socio-demographic aspects of COVID-19 vaccination in Russia (Vasileva et al. 2021). The paper uses data from a large-scale online survey of the adult population, carried out in March 2021, as its empirical basis (design of the survey leaves doubts about representativeness of the data). The main method of analysis is statistical comparison of means. Results of the study confirm that vaccine willingness depends on age: as in other countries, in Russia, older people are most likely to get vaccinated. It was also found that men trust the vaccine more than women.

So information on socio-demographic factors of vaccination against COVID-19 in Russia is very limited and requires expansion and updating. The aim of our study is to obtain quantitative estimates of how various socio-demographic factors impact vaccine uptake in Russia. It is important to note that we do not analyze a hypothetical propensity to vaccinate, but actual participation in vaccination, by which we mean people who have been vaccinated or have made an appointment to be vaccinated. The empirical basis of the study is the unique nationally representative data of three population surveys conducted in 2021, which offer a picture of the current situation and of trends. The authors carry out an econometric analysis in order to evaluate the role of various factors.

3. Empirical base and descriptive statistics

Data

The study is based on the data of three rounds of telephone surveys of households monitoring social situation and behaviour in the context of the spread of coronavirus, which were carried out by the Institute for Social Analysis and Forecasting of the Russian Presidential Academy of the National Economy and Public Administration (InSAF RANEPA) on May 20–26, February 23–25 and September 29–October 5, 2021. The respondents were Russian citizens aged 18 years and older. The target sample size for each round was 1600 respondents. The sample was formed by randomly generating phone numbers based on DEF-codes of mobile operators (for more details see: (Osmanov, Rogozin 2013: 35)). The survey data are representative of the adult population of the Russian Federation by gender and age. The monitoring questionnaire contains questions on vaccination, as well as questions to determine main socio-demographic characteristics of the respondents.

The socio-demographic structure of the respondents remained fairly stable over the course of three rounds (see Table 1). Over half (58-60%) of the survey participants are women. The average age of the participants is 47–48 years. The share of respondents with higher education varies from 43% to 49%, and 78–80% of respondents live in urban settlements. The average household size is three people and 27–28% of survey participants reported that their household includes people of pensionable age. About half of the survey participants (52–53%) are paid employees in various firms and organizations.

The monitoring data identify respondents who have had close encounters with the coronavirus. We treat a respondent as having experience of COVID-19 infection if he or she was ill or someone in his/her household was ill with the virus. At the end of February, 32% of respondents had experience of COVID-19, at the end of May the figure was 34%, and by the end of September there had been an increase to 45%.

Table 1. Socio-demographic characteristics of respondents in three rounds of monitoring, 2021

Characteristic	1st round (February 23–25)	2nd round (May 20–26)	3rd round (September 29 — October 5)
Women	58.3%	59.5%	58.0%
Average age, years	47.8	47.9	47.2
18–34 years old	25.5%	25.6%	26.5%
35–54 years old	36.1%	36.4%	37.3%
55+ years old	38.5%	38.0%	36.2%
Secondary general education (or lower)	14.3%	10.3%	11.6%
Vocational education	43.1%	41.0%	41.8%
Higher education	42.6%	48.7%	46.5%
Urban dweller	77.5%	79.7%	80.2%
Average household size, persons	3.0	3.0	2.9
People of pensionable age in the household	(no data)	27.3%	27.6%
In employment	51.8%	52.8%	52.4%
Experience of COVID-19 infection	31.6%	34.1%	45.1%

Source: calculated by the authors based on InSAF RANEPA monitoring data.

COVID-19 vaccine uptake

According to the autumn monitoring data, 53.2% of respondents had been vaccinated against coronavirus (received at least one dose of the vaccine), while 0.9% had made an appointment for vaccination. So at the end of September, 54.1% of respondents were vaccinated or due to be vaccinated, up from 10.5% in February and 25.9% in May. Note that, for simplicity of expression, in what follows we include those who have made an appointment for vaccination in a single group with those who have already been vaccinated.

The monitoring estimate of vaccination levels in the adult population is slightly higher than official figures. The discrepancy is partly explained by bias of the monitoring sample towards people with higher education, who may be more vaccine-willing (43–48% of respondents reported having higher education, while the share of the adult population with higher education, according to the 2015 Russian micro census, was 27%). It should also be noted that some of the respondents who claim to have been vaccinated may have bought a fake vaccination certificate and therefore do not figure in official databases of people who have been vaccinated. Finally, some respondents may simply claim falsely to have been vaccinated, fearing negative consequences if they admit to vaccine hesitancy.

The level of vaccine uptake varies significantly across different socio-demographic groups (see Table 2). Levels are highest among older and more educated people and lowest among young people (18–34 years) and people with only general secondary education. In February and May, the vaccination rate for people with experience of COVID-19 infection was significantly lower than for those without such experience, but vaccination levels of the two groups had levelled off by the end of September.

Table 2. COVID-19 vaccination take-up among adults, February–September 2021, %

Group	1st round (February 23–25)	2nd round (May 20–26)	3rd round (September 29 — October 5)
18–34 years old	4.9	16.3	46.9
35–54 years old	11.4	21.6	56.1
55+ years old	13.4	36.5	57.3
Women	11.5	25.5	54.8
Men	9.8	26.2	53.5
Secondary general education (or lower)	8.2	23.5	38.5
Vocational education	9.6	26.2	51.7
Higher education	12.1	26.2	60.3
Urban area	10.6	24.9	53.7
Rural area	10.8	30.6	54.6
In employment	10.7	26.7	61.1
Not working	10.4	25.2	46.8
Experience of COVID-19 infection	8.2	18.1	53.2
No experience of COVID-19 infection	11.6	30.2	54.9

Source: calculated by the authors based on InSAF RANEPA monitoring data.

Mandatory vaccination of the employed population

The questionnaire for the third round of monitoring, which was carried out in late September–early October, included a number of questions to employed people regarding mandatory vaccination. The answers that were obtained offer a picture of the extent of mandatory vaccination and how employers deal with employees who refuse it.

According to our findings, 43% of employed respondents had received a warning from their employer that special measures would be applied to unvaccinated workers. Such warnings were most frequent in retail trade, health care and education (reported by 50–60% of employed respondents in those sectors). Interestingly, although services dominate the government list of sectors that must require their workers to be vaccinated, workers in other industries also reported being required to do so: 38% of workers in agriculture and industry had received such a warning. This may be due in part to the survey allowing respondents to make their own selection of the industry in which they work, which can lead to errors. But it also indicates that heads of enterprises in sectors that are not included in the approved lists of mandatory vaccination are taking the initiative by compelling their workers to be vaccinated.

In 72% of cases, the employer had stated that unvaccinated workers may be put on leave without pay. Every fifth employee (22%) has been warned of possible dismissal, 11% were warned of restrictions on certain types of work for the unvaccinated and 10% were threatened with fines in case of refusal to vaccinate. However, at the time of the survey, punitive measures had rarely been applied in practice: only 16% of those employed at firms/organizations where there was mandatory vaccination knew of cases when threatened sanctions had been applied.

3. Research methodology

Simple comparison of average indicators does not provide valid estimates of socio-demographic differentiation in vaccine uptake. To identify statistically significant factors, we need to carry out a regression analysis in order to assess the effect of a specific parameter, all else being equal.

We use a binary logit model with the following specification:

$$P\left(vac_i = 1 \mid x_i\right) = \Lambda\left(x_i'\beta\right) \qquad \text{(model 1)}$$

where Λ is the logistic distribution function, vac_i is the dependent variable, an indicator of an i-th individual getting vaccinated against coronavirus, which takes the value 1 if a person was vaccinated (or signed up for vaccination), and 0 otherwise, and x_i is the vector of socio-demographic characteristics of person i, including gender, age (three groups), education (three groups), household (number of household members, people of pensionable age in the household), place of residence (settlement type, federal district), and an indicator of experience of COVID-19 infection.

An analogous model was assessed in order to identify factors influencing vaccination among the employed population:

$$P\left(vac_i = 1 \mid x_i\right) = \Lambda\left(x_i'\beta + \mathrm{sec}_i'\theta + \gamma meas_i\right) \qquad \text{(model 2)}$$

The model (2), in addition to the vector of socio-demographic characteristics of an individual, includes variables characterizing the sphere of his/her employment (sec_i) and an indicator of the application of mandatory vaccination measures in the workplace ($meas_i$). This model is used to analyze socio-demographic variation in the effect of mandatory vaccination on vaccine uptake by workers. It also includes cross terms, which are a product of the main socio-demographic indicators and the indicator of mandatory vaccination.

The models are assessed independently for each round of monitoring.

4. Results

Factors of vaccine uptake in the Russian population

Table 3 shows the impact of various socio-demographic characteristics on the likelihood of vaccination for an individual (model 1). The econometric analysis confirmed that age is the most important factor: people over 34 years old are significantly more likely to get vaccinated than people aged 18-34 and the magnitude of the effect is greater for the older age group (55+). Education has major positive effect on vaccination willingness: the higher a person's level of education, the greater the likelihood that he/she will be vaccinated, and higher education has the greatest effect. At the end of September, when the average vaccination rate was 54%, the probability of vaccination for a person with higher education, all else being equal, was 24 percentage points higher than for a person with only general secondary education. These effects of age and education are quite stable, being observed in each round of monitoring.

Table 3. Results of regression analysis: dependence of vaccine take-up on socio-demographic characteristics (model 1, marginal effects)

Variable	1st round (February 23–25)	2nd round (May 20–26)	3rd round (September 29 — October 5)
Age (reference category — 18–34 years old)			
35–54 years old	0.085***	0.056**	0.079***
	(0.025)	(0.031)	(0.032)
55+ years old	0.106***	0.169***	0.100***
	(0.025)	(0.030)	(0.034)
Gender			
Women	-0.029	-0.007	-0.022
	(0.021)	(0.022)	(0.026)
Education (reference category — general secondary education or lower)			
Vocational education	0.011	0.029	0.141***
	(0.026)	(0.039)	(0.042)
Higher education	0.045**	0.077***	0.239***
	(0.026)	(0.039)	(0.041)
Household characteristics			
Number of household members	-0.003	-0.017	0.004
	(0.006)	(0.018)	(0.009)
People of pensionable age in the household	(no data)	0.049**	0.015
		(0.025)	(0.030)
Experience of COVID-19 infection			
YES	-0.045***	-0.110***	-0.026
	(0.018)	(0.024)	(0.025)
Place of residence			
Urban dweller	-0.009	-0.045*	-0.029
	(0.019)	(0.027)	(0.032)
Dummy variables for Federal Districts	+	+	+
Number of observations	1,595	1,558	1,548

Source: calculated by the authors based on InSAF RANEPA monitoring data.
Note: ***, **, * indicate significance at levels of 1%, 5% and 10%, respectively. Standard errors are indicated in parentheses.

The modelling found no gender variation in vaccine uptake: all else being equal, the average probability of being vaccinated is not statistically different for women and for men.

The number of household members is not a determinant of vaccine uptake, but household composition can have significant impact on a person's decision to vaccinate. In particular, living with people of pensionable age increases the likelihood of vaccination (this effect is statistically significant only in the second round). A plausible explanation is that

those living with elderly relatives understood the danger of coronavirus for older people and decide to protect loved ones from infection by getting vaccinated. Likelihood of vaccination does not depend on the type of settlement: all other things being equal, people living in urban settlements are as likely to be vaccinated as country dwellers. We suppose that this result reflects the blanket rollout of vaccination in Russia: by the third round of monitoring, 95% of respondents reported that vaccination against coronavirus had been provided at the place where they live.

In February and May, the biggest determinant of vaccination was experience of COVID-19 infection. If a person or someone from his/her household has been infected with coronavirus, the likelihood of vaccination for that person was significantly lower than for a person without such experience. By the end of September, this effect had lost its statistical significance. This can be partly explained by the fact that in the autumn, people who had been infected with coronavirus more than six months earlier began to be vaccinated en masse (in Russia people who have been ill with the virus are recommended to be vaccinated six months after recovery).

Factors of vaccine uptake by the working population

Table 4 shows factors determining vaccine uptake among the employed population (model 2). They vary hardly at all from the factors, which are significant for vaccination in the population as a whole. Age and education have pride of place. Employees aged 34–54 or older are more likely to be vaccinated than young workers (18–34 years old). The effect is most pronounced for the oldest group of workers (55+ years old). Education has a positive effect, but less so than for the general population. Experience of coronavirus infection reduced likelihood of vaccinating among workers in the first two rounds of monitoring, but had no significant impact in the third round. Urban workers are less likely to be vaccinated than those living in rural areas, but this effect is statistically significant only in the third round of monitoring.

The worker's occupation influences probability of vaccination. Vaccination is more prevalent in education, health care, and state and municipal employment than in industry and agriculture. In February and May, people working in trade were less likely to be vaccinated than those in industry and agriculture, but by September the difference had become insignificant.

The introduction of mandatory vaccination of workers in certain sectors had a significant positive impact on the level of vaccination among the employed. In the September round, when the average level of vaccination among the employed was 61%, likelihood of vaccination among workers at firms/organizations where the employer had warned of special measures for the unvaccinated was 10 percentage points higher than for workers at other firms/organizations. Clearly, mandatory vaccination of workers is effective in stimulating uptake. Since only a few regions had introduced mandatory vaccination at the time of the third round of monitoring, it can be expected that uptake levels among the employed will increase significantly in the near future as mandatory vaccination expands to workers in other regions.

In order to identify socio-demographic variation in the impact of mandatory vaccination of workers, the authors estimate an extended model 2, which includes interactions of the mandatory vaccination indicator with various characteristics of workers as explanatory variables. Five model specifications were used in order to simplify interpretation. The results are presented in Table 5, which shows estimates of the coefficients for cross effects. The values of coefficients for other factors do not change fundamentally when the model is expanded (the authors can provide these estimates upon request).

Table 4. Results of regression analysis: dependence of vaccine uptake on socio-demographic characteristics (model 2, marginal effects)

Variable	1st round (February 23–25)	2nd round (May 20–26)	3rd round (September 29 — October 5)
Age (reference category — 18–34 years old)			
35–54 years old	0.103***	0.061**	0.056*
	(0.030)	(0.033)	(0.031)
55+ years old	0.117	0.139***	0.112**
	(0.035)	(0.045)	(0.056)
Gender			
Women	-0.053	-0.039	0.018
	(0.034)	(0.033)	(0.036)
Education (reference category — general secondary education or lower)			
Vocational education	-0.028	-0.027	0.087
	(0.038)	(0.060)	(0.064)
Higher education	0.018	0.016	0,176***
	(0.038)	(0.058)	(0.062)
Household characteristics			
Number of household members	-0.001	-0.014	0.011
	(0.008)	(0.011)	(0.012)
People of pensionable age in the household	(no data)	0.058*	-0.009
		(0.035)	(0.042)
Experience of COVID-19 infection			
YES	-0.042**	-0.106***	-0.020
	(0.021)	(0.032)	(0.033)
Place of residence			
Urban dweller	-0.039	-0.045	-0.084**
	(0.028)	(0.038)	(0.046)
Dummy variables for Federal Districts	+	+	+
Occupation			
Dummy variables for industries	- (trade)	+ (education, healthcare, public administration) - (trade)	+ (education, healthcare, public administration)
Mandatory vaccination (reference category — industry, agriculture)			
Mandatory vaccination	(no mandatory vaccination)	(no mandatory vaccination)	0.102***
			(0.035)
Number of observations	817	807	815

Source: calculated by the authors based on InSAF RANEPA monitoring data.
Note: ***, **, * indicates significance at levels of 1%, 5% and 10%, respectively. Standard errors are indicated in parentheses.

Table 5. Results of regression analysis: socio-demographic variation in the effect of mandatory vaccination (extended model 2, marginal effects), September 29 — October 5 2021

Variable	Specification				
	1	2	3	4	5
Mandatory vaccination indicator (MVI)	0.139***	0.199***	0.114	0.124**	0.115***
	(0.049)	(0.049)	(0.359)	(0.053)	(0.049)
(Age 34–54 years old) * (MVI)	-0.101				
	(0.076)				
(Age 55+ years old) * (MVI)	-0.128				
	(0.125)				
(Women) * (MVI)		-0.131***			
		(0.059)			
(Vocational education) * (MVI)			-0.055		
			(0.135)		
(Higher education) * (MVI)			0.018		
			(0.133)		
(Urban dweller) * (MVI)				-0.074	
				(0.101)	
(Experience of COVID-19 infection) * (MVI)					-0.027
					(0.070)

Source: calculated by the authors based on InSAP RANEPA monitoring data.
Note: ***, **, * indicates significance at levels of 1%, 5% and 10%, respectively. Standard errors are indicated in parentheses.

The analysis showed a significant gender variation in the effect of mandatory vaccination. For men, the likelihood of being vaccinated when required to do so at work increases by almost 20 percentage points, while for women it increases by only 7 percentage points. This may be because men, who in Russia are often the main breadwinners in the family, are more afraid of losing their jobs. No differentiation in the effect of mandatory vaccination was identified across other socio-demographic groups. However, it should be noted that the results obtained for subgroups of the employed should be treated with caution due to the small sample size. The authors plan to increase the monitoring coverage in the future, which will enable more accurate analysis.

6. Conclusions

The results of our analysis show that age is the most important factor determining COVID-19 vaccination uptake in Russia. Uptake is strongest among people of the older age group (55+ years old), while young people (18–34 years old) are least likely to be vaccinated. This confirms earlier conclusions in the literature for Russia and a number of other countries. The observed age-related differences in vaccination uptake reflect the fact that morbidity and mortality from COVID-19 increase exponentially with age (Levin et al. 2020; O'Driscoll et al. 2021), helped by a focus on vaccinating the elderly during the first part of the immunization campaign.

Education is another key driver of COVID-19 vaccination in Russia. The more educated a person is, the more likely they are to get vaccinated. This effect is most pronounced among those with higher education. People without higher education or even vocational education are least likely to be vaccinated. A similar effect of education has been observed in upper-middle-income countries. The explanation may be that educated people have more access to a variety of sources of information about the disease and vaccines, and are more disposed to trust scientists and doctors. They are also likely to have a greater degree of social responsibility for their own health and the health of those around them.

Unlike most previous studies carried out on both foreign and Russian data, our estimates show no gender variation in vaccine uptake. The likelihood of being vaccinated is not statistically different for men and women. This can be partly explained by differences in the vaccination indicator used: in previous papers hypothetical intentions were analyzed, while we only consider people who have actually been vaccinated (including those who have signed up for vaccination). It could be that women are more cautious than men when speaking about their plans as part of the survey.

Men and women who live in the same household as people of pensionable age are more likely to be vaccinated. In such cases, desire to protect their loved ones from the disease may be an additional incentive for vaccination. A similar effect is noted in (Alleaume et al. 2021; Dubé et al. 2021), who found that propensity to vaccinate increases when there are people with chronic disease in the household.

Experience of coronavirus infection (COVID-19 illness of the person him/herself or of a household member) significantly reduced the likelihood of vaccination in the first half of 2021, but this factor lost its significance by the end of September. People who had been ill six months before or earlier began to be vaccinated en masse in Russia in autumn 2021 (vaccination is recommended six months after recovering from COVID-19).

The set of socio-demographic determinants of vaccination among the employed mostly coincides with that for the entire population: age, education, and experience of COVID-19 infection are the main factors. The sector in which a worker is employed also plays a role: people employed in education, health care, state and municipal administration are more likely to be vaccinated than those employed in other sectors. This is mainly because vaccination of workers in these areas was a priority from the beginning of the immunization campaign.

One of the most significant findings of the present paper concerns mandatory vaccination of workers. The analysis shows that mandatory vaccination has significant positive impact on uptake. All else being equal, employment at a firm/organization that penalizes unvaccinated employees (complete suspension from work, suspension from certain types of work, reduction of wages, dismissal, etc.) increases the likelihood of vaccination by 10 percentage points. So mandatory vaccination of workers has already increased vaccine uptake in Russia overall. It can be assumed that this effect will increase in the near future, since decisions on mandatory vaccination of certain groups of workers, which had only been adopted in a few regions of the country at the time of the third monitoring round in September, were in place in almost all regions by the end of October.

The effect of mandatory vaccination is more pronounced for men than for women, but there was no significant variation in its effect across other socio-demographic groups. So mandatory vaccination should be a universal means of stimulating vaccination, affecting all groups of workers.

The results of this study can assist drafting of a policy to stimulate vaccination in Russia. In particular, special attention should be paid, when designing measures to increase vaccine uptake, to young people and people with a relatively low level of education. It may also be worth expanding mandatory vaccination of workers, both by increasing the number of sectors, firms and organizations affected, and by raising the required threshold for the share of employees who must be vaccinated at firm or organization. Mandatory vaccination of other groups that are in close and regular contact with a wide range of people (for example, students of universities and technical colleges, and air and rail passengers) might also be considered. Mandatory vaccination of particular groups can serve as an "accelerator", enabling rapid increase of vaccine uptake in a short period of time.

Our findings also suggest that the vaccination campaign needs to be reformatted. In particular, it should work harder to reach young people since they are currently the least disposed to get vaccinated.

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Appendix

Table A1. Sources used in the reference list

Article	Country	Poll type	Representativeness of data	Time of the survey
Alleaume et al. 2021	France	Online survey of the adult population (18+)	Data are representative at the national level by gender, age, place of residence	April-May 2020 Survey Series
Analysis of Public… 2021	Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, Uzbekistan	Personal interview / telephone / online survey of the adult population (18+) (interview/ survey type varying between countries)	Data are representative at the national level by gender, age, place of residence	December 2020 - January 2021
Cooper et al. 2021	South Africa	Telephone/online surveys	Data from five out of nine surveys are nationally representative by sex and age	February 2020 - March 2021
Dubé et al. 2021	Canada, province of Quebec	Online survey of the adult population (18+)	Data represent the population of the province by sex, age, place of residence, language (English, French), education level	Survey Series March - December 2020
Green et al. 2021	Israel	Online survey of the population aged 30+	The description of the survey methodology casts doubt on representativeness of the data.	October 2020
Hwang et al. 2021	South Korea	Personal survey of the population aged 15+. The analysis uses data on respondents aged 20+	Data are representative at the national level by gender, age, place of residence	October - December 2020
Lazarus et al. 2021	China, Brazil, South Africa, South Korea, Mexico, USA, India, Spain, Ecuador, UK, Italy, Canada, Germany, Singapore, Sweden, Nigeria, France, Poland, Russia	Personal interview/telephone/ mail surveof the adult population (18+) (interview/survey type varying between countries)	Data are representative at the national level by gender, age, education level	June 2020

Article	Country	Poll type	Representativeness of data	Time of the survey
Lindholt et al. 2021	Denmark, Sweden, Germany, France, Italy, UK, Hungary, USA	Online survey of the adult population (18+)	Data are representative at the national level by gender, age, place of residence	Autumn 2020 - winter 2021
Neumann-Böhme et al. 2020	Germany, UK, Denmark, Netherlands, France, Portugal, Italy	Online survey of the adult population (18+)	Data are representative at the national level by gender, age, place of residence	April 2020
Prickett et al. 2021	New Zealand	Online survey of the adult population (18+)	Data are representative by sex, age, education level, place of residence	March 2021
Seale et al. 2021	Australia	Online survey of the adult population (18+)	Data are representative at the national level by gender, age, place of residence	March 2020
Sherman et al. 2021	United Kingdom	Online survey of the adult population (18+)	Data are representative by sex, age, ethnicity	July 2020
Solís Arce et al. 2021	Burkina Faso, Colombia, India, Mozambique, Nepal, Nigeria, Pakistan, Rwanda, Sierra Leone, Uganda, Russia, USA	Online polls in Russia and the USA, telephone polls in other countries.	Data are nationally representative. The level of representativeness varies by country	Surveys in different countries at different times between June 2020 and January 2021.
Szilagyi et al. 2021	USA	Online survey of the adult population (18+)	Data are representative of gender, age and location	Survey Series October 2020 - March 2021
Tran et al. 2021	Russia	Online survey of the adult population (18+)	The data do not represent the population of the Russian Federation	September - November 2020
Yahia et al. 2021	Saudi Arabia	Online survey of the adult population (18+)	Data are representative of sex and age	March 2021

Source: compiled by the authors.

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