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Personality and vaccination: regional variation and determinants of COVID-19 vaccination attitudes among the elderly in Central and Eastern Europe

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Abstract. The level of vaccination against COVID-19 in Europe varied widely, despite the generally widespread availability of vaccines since 2021. This study investigates the regional diversity of vaccination attitudes among people aged 50 or over in Central and Eastern European countries (CEE) and the association between personality and COVID-19 vaccination attitudes on the individual level. The data were obtained from *Survey of Health, Ageing and Retirement in Europe (SHARE)*, Eurostat and the European Quality of Government Index. The 11 countries were divided into 62 to 259 regions, primarily based on SHARE Internal NUTS release. The logistic regression of vaccination attitudes showed that high agreeableness, low neuroticism and, less importantly, high openness, are positively associated with vaccination willingness. Vaccination willingness increases with age and education and is higher for each of three respondent characteristics: multimorbidity, living with a partner, and living in urban areas. Potential confounders and reasons for the unexpected negative association between vaccination willingness and median weekly excess mortality were also investigated.

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1. Introduction

The year 2021 was a period of mass distribution and administration of COVID-19 vaccines. The European Union vaccination strategy ensured that all member states would simultaneously gain access to COVID-19 vaccines on a population-wide basis (European Commission, 2020). Despite the widespread availability and information campaigns encouraging vaccination, the level of vaccination of the EU population varied widely both within and between countries up until the end of the global emergency status as announced by the World Health Organization in May 2023.

Particularly low vaccination rates are recorded in Central and Eastern European (CEE) countries. According to the European Centre for Disease Prevention and Control, after the main pandemic waves, all 11 CEE countries of the European Union held the lowest 11 places in the ranking of vaccination rates among the 27 member states, in terms of the uptake of at least one dose. Vaccination rates of people aged 60+ in Bulgaria and Romania were particularly low, at 38.5% and 46.8%, respectively. The problem of vaccine reluctance had already been observed in CEE countries before (European Commission, 2018).

Several review studies investigating the determinants of COVID-19 vaccination show that vaccination intention is a complex process and is determined by many individual and contextual factors. One of the individual factors most significantly associated with vaccination willingness is age – older adults were more likely to accept COVID-19 vaccines than younger adults (AlShurman et al., 2021; Joshi et al., 2021; Lazarus et al., 2021; Robinson et al., 2021; Nehal et al., 2021; Nindrea et al., 2021; Galanis et al., 2022; Steinert et al., 2022; Terry et al., 2022; Limbu & Gautam, 2023). Other highly relevant factors positively relate to vaccination willingness include higher education, high household income, living in a multi-person household, living in an urban setting, individual multimorbidity, trust in authorities and frequent previous influenza vaccination (Lin & Beitsch, 2020; Joshi et al., 2021; Paul et al., 2021; Raciborski et al., 2021; Delerue et al., 2022; Popa et al., 2022; Terry et al., 2022; Ulaszewski et al., 2022; Dinga et al., 2023; Limbu & Gautam, 2023). The remaining individual-level factors include gender, social networks, pregnancy, ethnicity, religiosity and personality (Daly, 2021; Robertson, et al., 2021; AlShurman, et al., 2021; Halstead, et al., 2022; Howard, 2022; Nanteer-Oteng, et al., 2022; Terry, et al., 2022; Weikl, et al., 2022; Baker & Merkley, 2023; Ngo, et al., 2023; Webster, et al., 2023). It can be noted, however, that the results on the association between gender and COVID vaccine attitudes are divergent.

Contextual factors, such as municipal or regional-level morbidity and mortality, may also contribute to vaccination willingness. One key predictor of differential COVID-19 vaccination uptake at the regional level is the organisation of the health system and access to primary care doctors (Petrovici et al., 2023). Based on evidence concerning outbreaks of other diseases, vaccination willingness may also be higher in the regions with higher COVID-19 case rates (Baumgaertner et al., 2020). Investigation of excess mortality seems particularly helpful in analysing the severity of the pandemic, including the estimation of the actual number of cases, even those recorded before mid-March 2020 (Śleszyński et al., 2023).

Given that personality traits are associated with a multitude of outcomes across various domains of functioning, one can also investigate the association between vaccination acceptance and individual differences in personality traits. In academic research, the most commonly used model of personality is the five-factor (Big-5) model encompassing five global personality: agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience (Cattell, 1996). In certain multi-theme surveys in which assessment time and questionnaire space are limited, the information about these five traits is often collected on the basis of simplified methods and short personality-related sets of questions. The ten-item five-factor personality trait assessment referring to Rammstedt and John (2007) concept is used in, for instance, the *Survey of Health, Ageing, Retirement in Europe* (SHARE). Such brief measures have been shown to correlate highly with more sophisticated ones (Soto & John, 2017a; 2017b).

The existing literature on COVID-19 vaccines and personality focuses on both vaccination attitudes and the resulting vaccination behaviours – for example, full-vaccination rates in regions or countries (Webster et al., 2023). A handful of studies distinguish between three main vaccination statuses reflecting individuals' attitudes: vaccine-hesitancy, vaccine-refusal (or resistance) and vaccine-acceptance. Emerging research conducted in such countries as Canada (Baker & Merkley, 2023), Qatar (Reagu et al., 2023) or the United States (Webster et al., 2023), dealing with COVID-19 vaccination and personality shows that the pattern of association between each Big-5 trait and vaccination attitudes is nuanced.

The relationship between agreeableness and COVID-19 pro-vaccination attitudes is null or positive across different studies (Murphy, et al., 2021; Halstead, et al., 2022; Howard, 2022). If a negative association is found, it is likely to be due to the particular formulation of the model, and results vary depending on the model specification (Nanteer-Oteng et al., 2022; Webster et al., 2023). Quite interestingly, the association between conscientiousness and positive vaccine attitudes or behaviours was most commonly negative (Nanteer-Oteng et al., 2022; Webster et al., 2023). It should be pointed out, however, that findings vary country-wise and depend on whether vaccine hesitancy or refusal are compared with vaccine acceptance (Murphy et al., 2021; Baker & Merkley, 2023). The link between vaccine hesitancy and extraversion has been found to be generally negative across different studies (Howard, 2022; Webster et al., 2023). Meanwhile, there is some evidence that extraverted individuals are more likely to describe their chances of becoming seriously unwell due to COVID-19 as low (Halstead et al., 2022). Individuals high in neuroticism are generally more likely to have positive attitudes towards COVID-19 vaccines, which can possibly be attributed to their worries or anxiety related to pandemics (Halstead et al., 2022; Kalebić Maglica & Šincek, 2022). Nevertheless, the negative link between neuroticism and COVID-19 vaccine hesitancy is in contrast with papers dealing with beliefs about vaccination in general, not only COVID-19 vaccination (Lin & Wang, 2020). Finally, the association between openness to experience and provaccination attitudes is generally found to be either positive or null (Nanteer-Oteng et al., 2022). Individual studies that found negative associations concern rather specific aspects of vaccine attitudes. For instance, Halstead et al. (2022) found that people scoring high on openness to experience were more likely to doubt that they will get seriously unwell from COVID-19, but they were also more trusting towards vaccines.

Importantly, psychological correlates of COVID-19 vaccination may depend on pandemic conditions. The analysis by Baker and Merkley (2023) indicated that, unlike other Big-5 traits, neuroticism and extraversion mattered more as predictors of vaccine refusal as the COVID-19 caseload and vaccination rates increased.

Despite the existence of a study addressing the issue of personality traits and COVID-19 vaccine attitudes in Croatia (Kalebić Maglica & Šincek, 2022), to the best of our knowledge, no thematically similar prior studies have focused on CEE as a whole. Furthermore, studies concerning single CEE countries are sparse.

Our article aims to analyse factors associated with COVID-19 vaccination attitudes among elderly residents of CEE countries. Among the individual-level determinants analysed, special attention is paid to the relationship between personality traits and individuals' vaccination status. Importantly, the study was complemented by a regional-level analysis aiming to account for specific within-country differences. We performed the disaggregation of 11 analysed countries into 62–259 regions based on the SHARE internal NUTS codes release, as well as information from different SHARE modules.

2. Data and methods

All data concerning individual attitudes towards COVID-19 pandemic were retrieved from the SHARE Corona 2 Survey conducted between June and August 2021. Attitudes towards vaccination (vaccination willingness) were measured using a binary variable. This variable is equal to unity for respondents who were either vaccinated or had not yet received the vaccine but had their vaccination scheduled or wanted to be vaccinated. This variable was later used as a dependent one in an econometric analysis.

The remaining individual-level data used in this study come primarily from SHARE Wave 7 conducted in 2017. Additionally, the data are supplemented with the information from Wave 8 conducted between October 2019 and March 2020, as well as the post-pandemic Wave 9 from the late 2021 and 2022 (refreshment samples of Wave 9 being a continuation of Wave 8 fieldwork) (Bergmann et al., 2024). Whenever the information from more than one SHARE edition was available for a given respondent, the preference was given to data from Wave 7. Such a solution was dictated by the fact that fieldwork for Wave 8 was disrupted by the pandemic outbreak, with only 70 percent of longitudinal interviews having been conducted before March 2020 (Scherpenzeel et al., 2020). The data about personality traits were obtained from the SHARE Activities module, containing ten Big-5 items with two items per Big-5 personality dimension. Each item is measured across a five-point Likert scale. A person's score on each Big-5 dimension is calculated as an average of the pair of corresponding items.

Macro-level data, including data on median weekly excess mortality from March 2020 to June

2021, used in the regional-level part of the analysis, were retrieved from Eurostat and the dataset of the European Quality of Government Index (EQI) (Charron et al., 2022).

Econometric analysis is preceded with the presentation of maps in Figures 1–8 reflecting the regional-level vaccination willingness, median weekly excess mortality, as well as Big-5 personality traits in 11 CEE countries. Information on regions from which SHARE respondents were sampled was disaggregated from the country level to the regional level in such a way as to maintain the balance between sample size, similarity in economic development level, historical connections and language differences. The data used to develop the maps come from different sources: SHARE, Eurostat and EQI. As a consequence, the information on vaccination willingness is disaggregated into 62 regions, data on excess mortality into 66 regions, and data on personality traits into 81 regions. A detailed division into 259 regions was also performed. The disaggregation of the data retrieved from the SHARE database was based on the internal NUTS codes release for the SHARE-COVID19 project (Börsch-Supan, 2024a; 2024b), as well as two modules of SHARE database (Housing Generated-Variable and Retrospective Accommodation modules) and information about the language in which the questionnaire was conducted for Baltic countries.

Two-level logistic regressions, explaining vaccination willingness, were applied, with respondents being the first level, nested within regions at the second level. This approach accounted for the hierarchical structure of the SHARE data. Multilevel analyses are relatively commonly used in the literature based on the SHARE database. Nevertheless, previous works only consider the division into individual respondents, the household level and the country level. Thus, using precise data from the 2024 internal NUTS codes release on the region of respondents' origin or residence created the opportunity to address the methodological research gap. The multilevel approach enabled the simultaneous investigation of the relationships at both the regional and individual level (Goldstein, 1987). The regression was estimated using the *melogit()* function implemented in the STATA statistical software (Rabe-Hesketh & Skrondal, 2022). Regressions included the explanatory variables related to personality traits, standard socio-demographic controls, as well as regional-level variables.

3. Descriptive results

COVID-19 vaccination willingness, measured by the percentage of respondents in 62 regions who were already vaccinated, had a vaccination scheduled or were willing to get vaccinated, is visualised in Figure 1. Bulgaria and Romania stood out as particularly hesitant towards vaccines compared to the rest of CEE countries. One of the possible explanations here might be culturally driven sensitivity to governmental mandates. A study by Pancheva et al. (2023) showed that safety concerns and low trust in the effectiveness of vaccinations, including possibly mistrust in public healthcare, were significant factors for avoiding COVID-19 vaccination in Bulgaria.

Aside from Bulgaria and Romania, the other regions characterised by relatively low willingness to vaccinate were Latvia, parts of Lithuania, Eastern Poland, Central Slovakia, and the poorest Croatian region of Pannonia, as well as Slovenian Styria and Prekmurje.

In Estonia and Latvia, vaccination willingness seems to differ significantly depending on ethnicity. People who responded to the questionnaire in Estonian and Latvian declared much higher approval towards vaccines than those who replied in Russian. The percentage of Estonian-speaking respondents with positive vaccination attitudes amounted to nearly 84.5%. The corresponding share of Russian-speaking respondents from Estonia was only 56.8%. In Latvia, the respective percentages for Latvian and Russian-speaking respondents amounted to 60.9% and 34.3%, respectively. Thus, the vaccination rates are particularly low in the Ida-Viru County in Estonia and Latgale in Latvia – regions marked by the high prevalence of a stateless Russian-speaking minority who stayed in Baltic countries after the collapse of the USSR in 1991. Existing meta-analyses confirm that people belonging to ethnic minority groups are less likely to vaccinate (Robinson, Jones & Daly, 2021).

The SHARE data also confirm that vaccination acceptance was much higher in Hungary. In early 2021, the vaccination pace in Hungary was one of the fastest in the UE and the EU-organised supply of vaccines was supported with importing Chinese Sinopharm and Russian Sputnik-V. Bíró-Nagy and Szászi (2023) showed that COVID-19 vaccination hesitancy in Hungary began steadily declining as of December 2020, with more than 60% of Hungarians declaring in April 2021 that governmental communication is one of the factors influencing their vaccination attitudes. A relatively high share

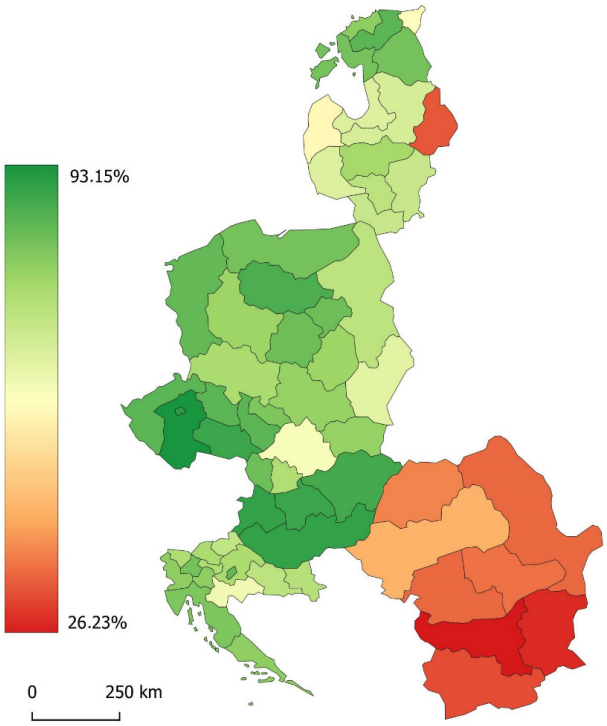

Fig. 1. Percentage of SHARE respondents who were already vaccinated, had a vaccination scheduled or were willing to get vaccinated
Source: Own elaboration based on SHARE data using QGIS software

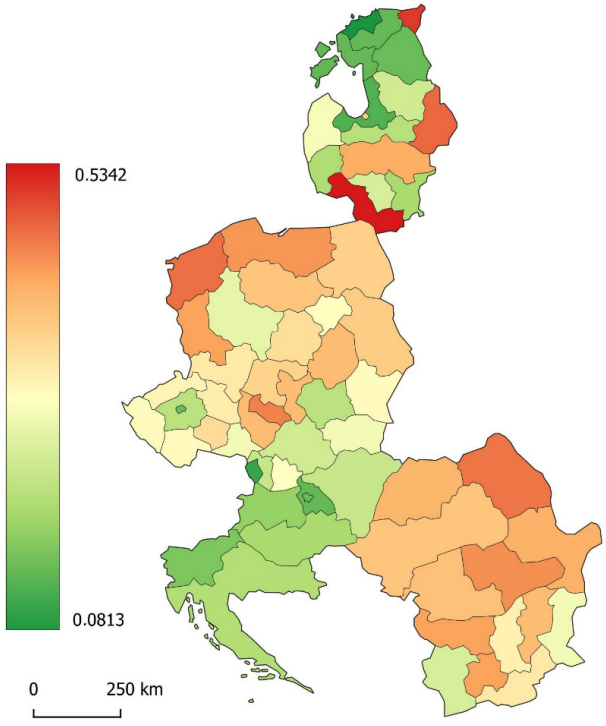

Fig. 2. Median of a weekly excess mortality from week 14 of 2020 to week 25 of 2021
Source: Own elaboration based on SHARE data using QGIS software

of Hungarians (over 70%) was also concerned that the pandemic was severe.

The map in Fig. 2 shows the median weekly number of deaths per 10,000 inhabitants compared with the average level from 2014–2019 (based on Eurostat) in 81 regions. The median values presented in Fig. 2 were computed for excess weekly deaths from week 14 of 2020 to week 25 of 2021. This timespan was selected so as to reflect the maximum period from the COVID-19 outbreak until the beginning of the fieldwork for the SHARE Corona 2 survey. Figure 2 can be examined in terms of similarities and differences relative to Fig. . The relatively vaccine-sceptic regions of Bulgaria, Romania and eastern parts of Latvia and Estonia are also characterised by high excess mortality. Nevertheless, the median excess mortality presented in Fig. 2 shows that comparable mortality anomalies are characteristic of Poland, Lithuania and Czech Silesia.

Figure 3 shows the prevalence of trust in the country's government, which is particularly high in Estonia, Lithuania and Hungary, and particularly low in Bulgaria, Poland or East Latvia – somewhat similarly to Fig. 1. In order to calculate variables from the EQI database, several underrepresented regions in Estonia, Latvia, Croatia and Slovenia were aggregated. That is why the aggregation presented in the map is differentiated into 71 regions only.

Figures 4–8, based on data on 31,196 respondents, illustrate the percentage of respondents scoring higher than the median in Big-5 personality traits. Specific values of the median for CEE countries computed for agreeableness, conscientiousness, extraversion, neuroticism and openness were equal to 3.5, 4, 3.5, 2.5 and 3, respectively. The prevalence of these five-factor traits roughly corresponds to shares presented for countries in the study of Schmitt et al. (2007) based on 17,000 respondents.

Figures 4–8 indicate that there are geographical patterns in the distribution of personality traits. The distributions of high conscientiousness and extraversion follow a north–south gradient, possibly reflecting the cultural and historical differences between the Balkans and the rest of Central and Eastern Europe. Given that around 40–60% of the five-factor trait variance can be explained by genetic factors, with openness to experience most

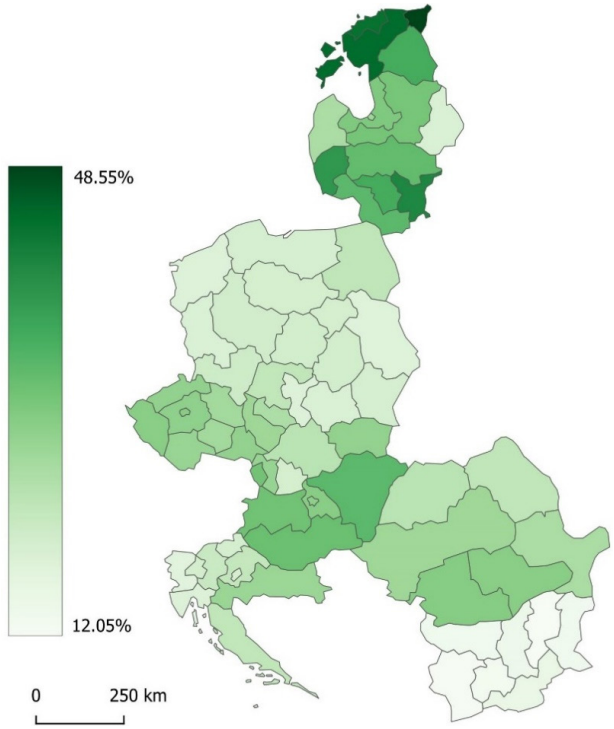

Fig. 3. Percentage of respondents to the EQI survey stating that they trust in their country's government in 2021
Source: Own elaboration based on SHARE data using QGIS software

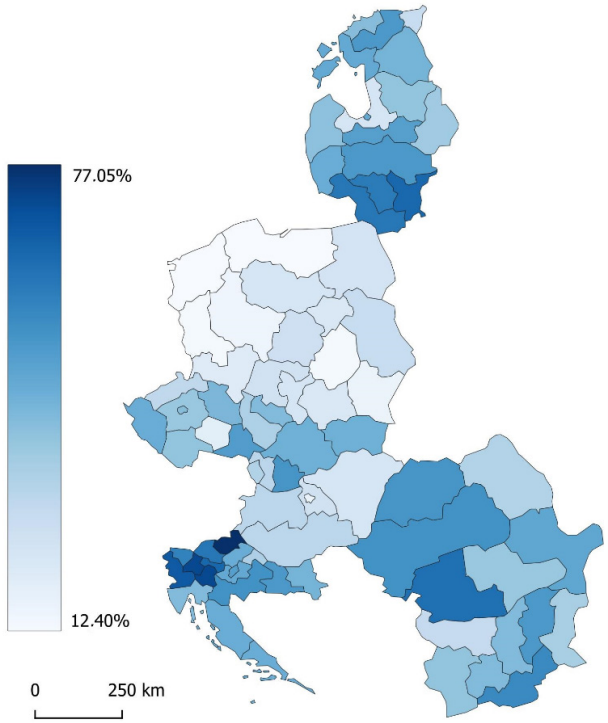

Fig. 4. Percentage of SHARE respondents with high agreeableness (higher than CEE median)
Source: Own elaboration based on SHARE data using QGIS software

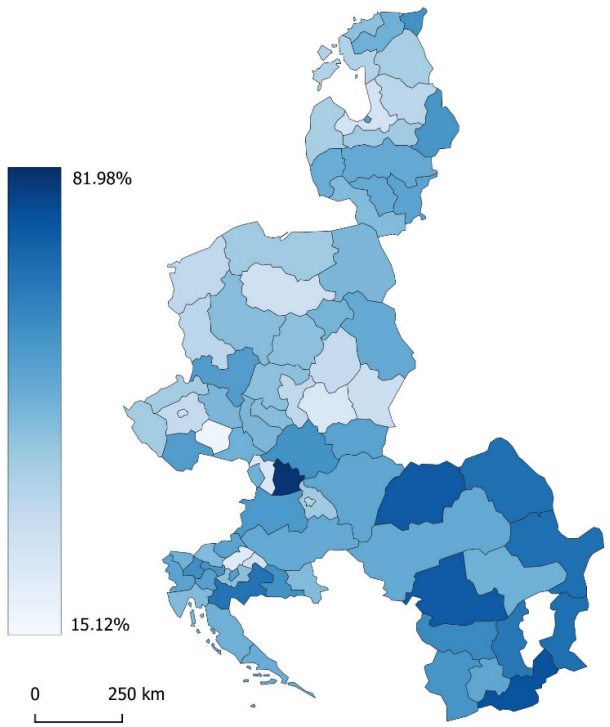

Fig. 5. Percentage of SHARE respondents with high conscientiousness (higher than CEE median)
Source: Own elaboration based on SHARE data using QGIS software

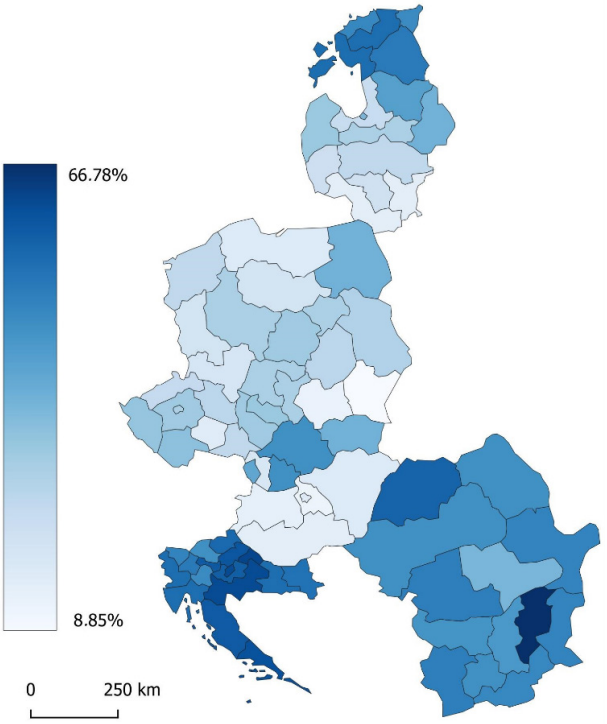

Fig. 6. Percentage of SHARE respondents with high extraversion (higher than CEE median)
Source: Own elaboration based on SHARE data using QGIS software

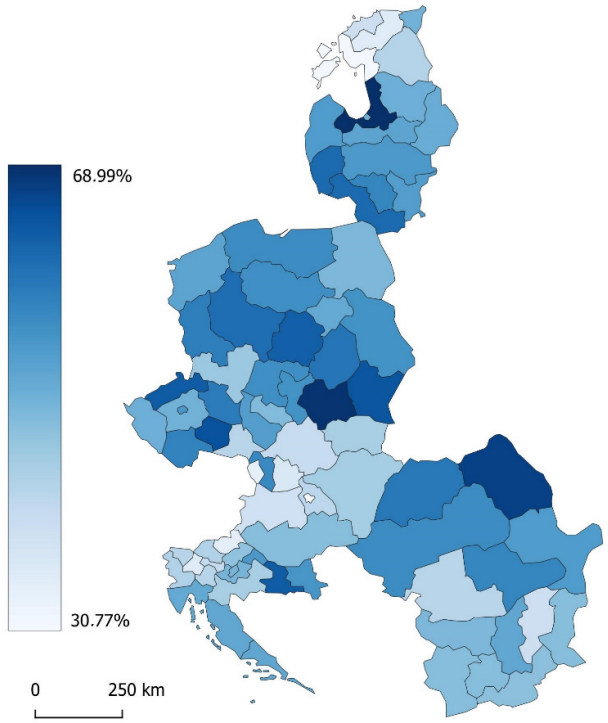

Fig. 7. Percentage of SHARE respondents with high neuroticism (higher than CEE median)
Source: Own elaboration based on SHARE data using QGIS software

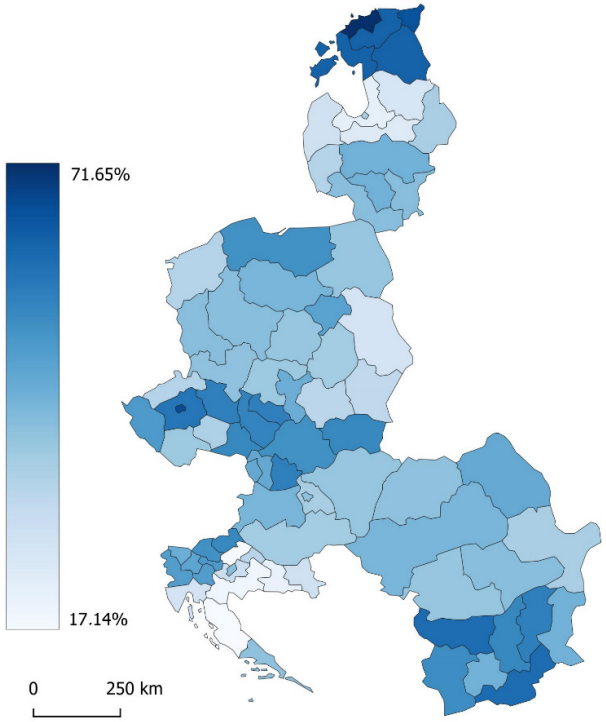

Fig. 8. Percentage of SHARE respondents with high openness to experience (higher than CEE median)
Source: Own elaboration based on SHARE data using QGIS software

commonly found to be the most highly genetically inherited (Lang, Livesley & Vernon, 1996), the geographical distribution of five-factor traits may be connected with genetic differences between the societies of the analysed countries. For instance, relatively high openness to experience and low neuroticism in Estonia compared to other CEE countries might be partially genetically driven and related to closer genetic associations with Finno-Ugric and Nordic populations (as shown by the prevalence of haplogroups N-M231 and I-M253) (Lappalainen et al., 2008). Finnic populations are found to have higher openness to experience (Kajonius & Mac Giolla, 2017; Schmitt et al., 2007). Meanwhile, higher neuroticism is related to the "s" genotype in the 5-HTTLPR polymorphic region of the SLC6A4 gene – which is less prevalent in Estonia, similarly to Nordic countries (Chiao & Blizinsky, 2009; Proto & Oswald, 2014). However, any possible genetic explanations to the distribution of traits in Figs 4–8 should be approached with caution because our understanding of this these issues is relatively new and constantly developing.

4. Regression results

To investigate the association between COVID-19 vaccination willingness and personality, three multi-level logistic regressions were computed: the main regression (Model 1), regression based on a more detailed regional disaggregation (Model 2), and regression including regional-level variables based on the EQI database (Model 3). Two-level logistic regressions were applied with respondents being the first level, nested within regions at the second level. In all models, the binary dependent variable reflected vaccination willingness – it was equal to unity for respondents who were either vaccinated or had not yet received the vaccine but had their vaccination scheduled or wanted to be vaccinated.

The main econometric model was complemented with two additional regressions aiming to check the structural validity of the results. The first was based on a more detailed disaggregation into 259 regions and constituted a robustness check of individual-level estimates. The stability of the coefficient related to excess mortality was also checked by the addition

of regional-level variables derived from the EQI database. These variables measure the percentage of people trusting in the country's government as well as the percentage of people declaring that, during the year preceding the interview conducted in 2021, a family member had been asked for an informal gift by a healthcare worker. The latter measure may reflect low accessibility to priority care or, in general, low quality of healthcare. For historical reasons, under-the-table payments in the healthcare sector are relatively problematic in certain CEE countries, especially Romania, Bulgaria, Hungary, Lithuania, and Latgale in Latvia, whereas the problem seems marginal in Slovenia, Estonia and the Czech Republic (Charron et al., 2022; Julesz & Kereszty, 2023).

Coefficients related to personality traits indicate that high agreeableness and low neuroticism are positively associated with vaccination willingness. In Model 1, the estimate for openness to experience is also significant and the association itself is positive. Nevertheless, the significance of the latter estimate was more dependent on the number of regions used at the second level.

Controls indicate that vaccination willingness increases with age and with education, is higher for respondents with multimorbidity, those living with a partner, and those in urban areas.

The regional-level variable reflecting median weekly excess mortality between March 2020 and June 2021 leads to a rather counterintuitive result: lower excess mortality (or lower pandemic severity) goes in line with higher vaccination willingness. Thus, the effect of increased pandemic-related mortality motivating people to get vaccinated due to increased caution or fear has not been confirmed for CEE countries. One explanation may lie in the fact that the vaccination willingness of people aged 50 or over is in general less prone to change with pandemic severity, which is related to their high at-risk status. Secondly, the perceived inefficacy of pre-vaccine precautionary measures imposed in 2020 by the government might have, at least partly, discouraged citizens from another measure in the form of vaccines. This last interpretation is supported by the weakening of the parameter value of the excess mortality variable following the inclusion of a regressor reflecting trust in the country's government (the latter being significant and intuitive in terms of the direction of its positive association with vaccination willingness). The significance of excess mortality is even lost after accounting for the prevalence of informal payments in healthcare. Nevertheless, including these two regional-level variables separately did not result in the complete loss of significance of median weekly excess mortality. Excess mortality is also significant in different versions of Model 3, based on disaggregation into different number of regions. Therefore, unobserved common factors related to healthcare quality and trust in the government may alter the association between vaccination willingness and excess mortality, but the counterintuitive sign of the latter variable is persistent. At the same time, given the high significance of the variable related to the prevalence of informal gifts in healthcare, the accessibility of adequate healthcare was found to be an important factor not accounted for in Model 1.

It is noteworthy that models accounting for interactions between gender and personality traits were also estimated. However, no significant interactions between personality traits and gender were found. It can be also noted that weighted one-level logistic regressions with clustered standard errors were also applied as robustness checks, but they lead to different and less intuitive results than the multilevel models presented in Table 1. Moreover, additional multinomial models differentiating between vaccination willingness, vaccination hesitancy and vaccination reluctance indicated that agreeableness is potentially more relevant for lower vaccine hesitancy – and neuroticism for higher vaccination reluctance.

Additional results might be driven from average marginal effects calculated for Model 1, juxtaposed in Fig. 9. To obtain these results, subjective financial wellbeing and education were added to auxiliary models and treated quasi-continuous variables taking 4 and 7 possible values, respectively (based on the response to the question of how easy it is for the household to make ends meet financially and on the ISCED 1997 level).

Figure 9 shows that the influence of personality traits on vaccination willingness is relatively weak. This finding is strengthened by the comparison of average marginal effects related to the one-standard-deviation change in personality traits and other variables: On average, a one-standard-deviation increase in agreeableness corresponds to a 0.8 percentage-point increase in the probability of being a pro-vaccine individual. Similarly, one-standard-deviation increases in subjective financial wellbeing and education are associated with stronger increases – of 4.5 and 4.9 percentage points, respectively.

Table 1. Parameter estimates of the two-level logistic regression models for COVID-19 vaccination willingness

Variables	Model 1	Model 2	Model 3
Agreeableness	**0.059****	**0.059****	**0.059****
	(0.025)	(0.026)	(0.025)
Conscientiousness	0.001	0.001	0.007
	(0.025)	(0.025)	(0.025)
Extraversion	0.025	0.015	0.026
	(0.025)	(0.023)	(0.023)
Neuroticism	**-0.040***	**-0.038***	**-0.038***
	(0.021)	(0.021)	(0.021)
Openness to experience	**0.040***	0.024	**0.038***
	(0.023)	(0.023)	(0.023)
Education (ref.: pre-primary, primary or lower secondary)			
Upper and post-secondary	**0.427*****	**0.426*****	**0.423*****
	(0.046)	(0.047)	(0.046)
Tertiary	**0.929*****	**0.936*****	**0.919*****
	(0.066)	(0.067)	(0.066)
Age	**0.281*****	**0.281*****	**0.281*****
	(0.027)	(0.028)	(0.027)
Age^2	**-0.002*****	**-0.002*****	**-0.002*****
	(0.000)	(0.000)	(0.000)
Gender (ref. female)	0.045	0.046	0.045
	(0.040)	(0.041)	(0.040)
Area (ref. urban)	**-0.093****	**-0.094****	**-0.083****
	(0.042)	(0.044)	(0.042)
Household size (ref. living alone)	**0.107****	**0.107****	**0.107****
	(0.047)	(0.047)	(0.047)
Multimorbidity (ref. less than 2 chronic illnesses)	**0.184*****	**0.208*****	**0.192*****
	(0.040)	(0.040)	(0.040)
Financial wellbeing (ref. diff. making ends meet)	**0.525*****	**0.546*****	**0.522*****
	(0.041)	(0.042)	(0.041)
Median weekly excess mortality (per 100,000 inhabitants)	**-0.361*****	**-0.357*****	-0.146
	(0.108)	(0.067)	(0.097)
Trust in the country's government			**2.197***
			(1.282)
During the last year, a family member was asked for an informal gift in healthcare			**-9.008*****
			(2.319)
Constant	**-9.280*****	**-9.143*****	**-9.705*****
	(1.054)	(1.032)	(1.111)
Var(constant)	**0.843*****	**0.916*****	**0.607*****
	(0.160)	(0.115)	(0.113)
Number of observations	17,489	17,489	17,489
Number of regions	66	259	71

Explenation: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Source: own calculations based on SHARE, EQI and Eurostat data

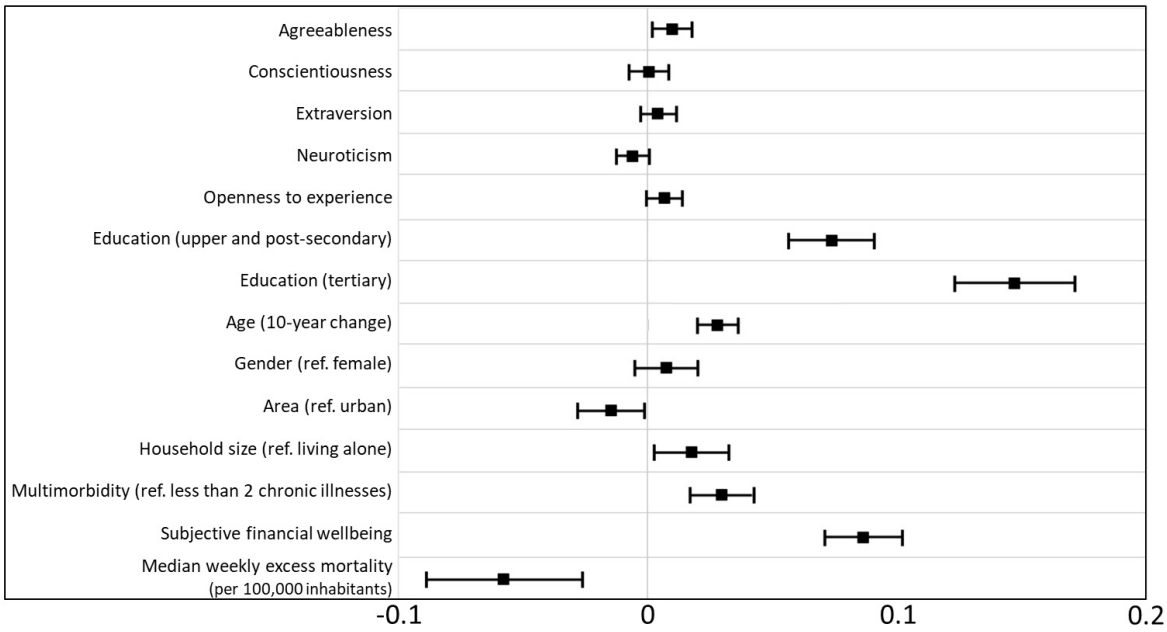

Fig. 9. Forest plot for the average marginal effects of the main two-level logistic regression
Source: own calculations based on SHARE, EQI and Eurostat data

5. Conclusion

Our article investigated factors associated with COVID-19 vaccination attitudes among elderly residents of CEE countries.

We found that CEE countries display substantial internal (even within-country) variability. Moreover, high agreeableness and low neuroticism and, less importantly, high openness to experience, are positively associated with vaccination willingness. Average marginal effects indicated that the influence of personality traits on vaccination attitudes is much weaker than the influence of education or subjective financial wellbeing. Results related to socio-demographic variables indicated that vaccination willingness increases with age and education and is higher for respondents with multimorbidity, those living with a partner, and those in urban areas. Significant differences between men and women were not observed.

The outcome of our analysis, although generally corresponding to the existing literature, yielded certain unexpected results. While the direction of the influence of agreeableness and openness to experience on vaccination willingness was rather in line with the literature, the direction related to neuroticism was rather in line with broader literature on vaccination attitudes in general and different from the literature on COVID-19 vaccination.

A quite unexpected result is related to the negative association between median weekly excess mortality from March 2020 to June 2021 (proxy for pandemic severity) and vaccination willingness from June to August of 2021. The reason for this association remains uncertain and is, at least partly, due to confounding factors. The addition of various regional-level variables prepared based on the individual-level EQI data indicated that trust in the country's government or accessibility of priority care and adequate healthcare may constitute particularly relevant regional-level factors altering the association between excess mortality and vaccination willingness. We speculate that the finding related to healthcare (and the variable measuring the prevalence of informal gifts in healthcare) is specific to certain countries from the former Eastern Bloc where informal payments constituted a large part of incomes in healthcare until the late 20th century. Future papers may also check the association between pandemic severity and vaccination willingness of people younger than 50 years old, who were not covered in our analysis. Possibly, the effect of increased vaccination willingness as a result of increased pandemic severity and associated fear of contagion may be more prevalent among younger individuals – people aged 50 or over may not need this type of encouragement due to being at higher risk for serious COVID-19 infection.

More generally, explanations for the high scepticism towards vaccination in CEE countries should focus on why trust in government and trust in public healthcare authorities differ across regions, as the impact of these factors appears relevant for health decisions and behaviours. The example of CEE countries, which are particularly reluctant towards vaccines, indicates that, when designing their vaccination campaigns, authorities should identify their target groups taking into account that vaccination willingness constitutes a complex interplay of factors, including within-country differences and personality traits.

It is important to acknowledge that this study's focus on willingness to vaccinate, as opposed to hesitation or reluctance, may not fully reflect the nuanced nature of vaccine decision-making. Several authors differentiate between those who are willing to vaccinate, those who are hesitant but not entirely opposed, and those who outright refuse vaccination, using multinomial regression (Halstead et al., 2022; Baker & Merkley, 2023). A handful of studies even focus on vaccine hesitancy (Halstead e tal., 2022; Howard, 2022; Nanteer-Oteng et al., 2022; Reagu et al., 2023)(*Note* 1). In our analysis, multinomial regressions were only additional.

One potential caveat is related to the type of short Big-5 personality trait measurement used in our study, which included only ten items. In the SHARE data, a large panel study, the short version was the only available measure, making it the most suitable option for assessing personality traits. However, in the literature, the number of questionnaire items used to assess Big-5 personality traits of individuals was often larger. Several studies used different types of items provided by a shorter type of the Big Five Inventory (including from 10 to 30 items), whereas other studies were based on an even larger set of items, such as HEXACO-60 Inventory (dedicating 50 questions to Big-5 personality dimensions) (Webster et al., 2023) or the 61-item Gosling–Potter Internet Personality Project (Ngo et al., 2023).

Since most of the data on personality traits come from different Waves of the SHARE database than the information on vaccination willingness, another limitation might be linked to potential variability in personality trajectories influenced by such factors as gender, age-graded life events, and social climate. While the early literature claimed that changes in personality are largely limited to young adulthood (McCrae et al., 1999), later studies have shown that personality traits can fluctuate even among adults aged 50 or older (e.g., Small et al., 2003). Nevertheless, the majority of personality trait changes take place between the ages of 20 and 40 (Roberts & Mroczek, 2009).

It should also be noted that certain potential factors influencing individual vaccination attitudes, and their regional variation were not considered in this study. Among other factors, anti-vaccine conspiracy theories can be mentioned here, as such beliefs usually emerge during crisis situations, characterized with increased collective uncertainty and threat, as a response to the psychological needs of imbuing these situations with meaning (Douglas & Leite, 2017; Douglas et al., 2019). The literature confirms the increase in conspiracy beliefs observed during the Spanish flu, H1N1 flu and the COVID-19 pandemic (Lindholt et al., 2021; Freeman et al., 2022; Ripp & Röer, 2022; Roy et al., 2022).

Note: 1. Other articles on vaccination decision-making used alternative dependent variable measures, such as the full-vaccination rate (Webster et al., 2023), vaccination readiness based on the 7C model (Kalebić Maglica & Šincek, 2022) or the 12-item Vaccine Attitudes Examination Scale (Nanteer-Oteng et al., 2022).

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