Covering letter

This page is only the covering letter part. The blinded manuscript is starting from the third page.

## Why the submission is appropriate for publication in Public Health?

This research concerns the political determinants of the excess deaths during COVID-19 pandemic. Thus, it is consistent with the scope of Public Health. For example, concerns listed fields such as “Applied epidemiology” or “Need or impact assessments”. From my brief study of previous papers published in the journal, it seems to fit the theme. Similar articles published are “Excess deaths from COVID-19 in Japan and 47 prefectures from January through June 2021” or “Excess mortality in Glasgow: further evidence of ‘political effects’ on population health”.

## what is known about the topic discussed?

There is a growing body of literature of relationship between right wing attitudes and excess mortality. Mostly based on the difference among mortality of conservatives in USA (e.g. [12] and [13]). None of literature concerns the far-right ideology though and very scarce literature concerns population outside USA.

Additionally, it is known that the studied subgroup (i.e. far-right voters) tend to be disobedient and non-compliant with respect to non-pharmaceutical interventions [2]. Moreover, according to recent article [16], the same subgroup that is analysed in my article is significantly more hesitant to vaccination (also studied on the same geographical level). These evidences supports the main conclusion of herein research. More on current status of literature as well as the references in the manuscript.

## what your study adds?

As stated above, the study synthesizes the evidence of non-compliance of far-right voters and their vaccination hesitancy with the estimates of the excess deaths in each of the subregion in Poland. I.e. answers the question of what are the actual consequences of this behaviour.

The paper was not published anywhere, nor is it under the review from any other journal than “Public Health”.

Far-right attitudes and excess mortality: a Bayesian study

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None to declare

Far-right attitudes and excess mortality: a Bayesian study

# Abstract

Objectives: Far-right views are known to be connected to non-compliance with public rules and anti-establishment beliefs. This link became especially apparent during COVID-19 pandemic, where far-right political parties exhibited their anti-lockdown inclinations. At the same time non-pharmaceutical interventions are crucial in limiting spread of the COVID-19 disease and thus, in saving affected population. This study aims at connecting these phenomena and examining the relationship between far-right political beliefs and excess mortality during COVID-19 pandemic.

Study design: Excess mortality estimation is model-implied counterfactual study, whereas estimating relationship between excess mortality and political beliefs is a cross-sectional study.

Methods: Univariate regression analysis was done to estimate the expected mortality during COVID-19 for each sub-region of Poland. The modelling of relationship between political beliefs and the estimated excess deaths was done with Bayesian generalized linear model with negative binomial link function.

Results: The 1 percentage point increase in far-right voters lead to 5.05% (95% CI: 2.05%; 8.12%) increase in total excess mortality during COVID-19 pandemic. This increase translates to roughly 8,473 excess deaths more.

Conclusions: Building on previous studies on high vaccinations hesitancy among the same studied group and evidence of higher anti-establishment and non-compliant behaviour among far-right voters, this paper shows, that this group is partially responsible for higher excess mortality during COVID-19 pandemic. Additionally, the control variables from analysis supports previous evidence of higher COVID-19 casualties among poorer and/or older subregions.

# Keywords

COVID-19, excess mortality, far-right ideology, Bayesian statistics.

# Introduction

COVID-19 pandemic (or severe acute respiratory syndrome coronavirus 2) imposed an extreme damage to the world population over the past two years, with only in United States, the amount of excess deaths from January 2020 through February 2021 is estimated to be around 646,514 [1]. The disease spread rapidly starting from China, with the first European registered case to be in Italy. Since the European emergence of the COVID-19 the governments started to impose restrictions with a varying degree of rigidity, in order to curb the transmission.

Despite these efforts, the COVID-19 hit every country in Europe. For policy makers, it’s one issue to impose an effective restrictions policy, but the other is to hope for the society to comply with them for the sake of public health. The biggest obstacles, besides the political will, for limiting transmission is disobedience of stay-at-home policy, usage of face mask and, during later part of the pandemic, the vaccine hesitancy. These issues in introducing the restrictions policies leads to higher COVID-19 incidence and ultimately excess deaths. Thus, it is of utter importance for governments to understand what determines the compliance with social distancing. One of the factors that emerge in literature, which potentially affect the social adherence are political beliefs. Namely, more conservative and far-leaning political beliefs are associated with lower social compliance to the anti-COVID-19 measures [2] and perception of transmission risk [3] [4].

These conclusions are especially relevant in Poland as the right leaning politicians from the ruling party has not made a clear stance on the importance of vaccinations [5]. Whereas the far-right parties were even openly sceptic towards vaccination and were criticizing the non-pharmaceutical interventions imposed by the government [6]. Those criticized policies were already much more liberal than in the other parts of Europe. The political party, whose electorate is a subject of herein study, officially named as “The Confederation Liberty and Independence” (henceforth called shortly as “Konfederacja”) is placed far-right on the political spectrum [7] [8]. The party have made a several populistic statements regarding the pandemic restrictions, among the others that they are “damaging the health, property and life of the Polish nation”[9] or comparing face-mask requirements to “how the Nazis forced Jews to wear armbands” [10]. During the 2020 presidential election, Konfederacja issued a candidacy of Krzysztof Bosak, whose opinion regarding non-pharmaceutical interventions are consistent with those of his party [11]. Because of the above, votes for him are assumed to be a good proxy of far-right ideology in this study.

With this openly vaccine-sceptic and anti-lockdown agenda, comes the question of what is the actual effect of these beliefs on COVID-19 transmission and, in effect, the excess mortality. Insofar, the literature on assessing the effects from right-wing political beliefs on COVID-19 induced damage is scarce. A recent study by J. Wallace [12] based on an individual level observation from USA, found an evidence for higher excess deaths during early stage of the pandemic among registered republicans. Similar research [13] found the same effect on county level observations based on a republican vote share. There are additionally numerous studies analysing the political affiliation of governments and the corresponding COVID-19 dynamics [14][15], reporting a negative effect of conservative governor’s policies. These studies however concern the response of the governors, whereas in polish political system, there is no heterogeneity among subregions with respect to the public policy. To the best knowledge of author, there is no research done exploiting differences in far-right vote share on excess mortality during public health emergencies.

This study synthesize the evidence of lower social compliance among far-right voters with the estimates on excess deaths for each of the subregions. Building on previous evidence of the lower vaccination uptake among the studied electorate group [16], this research shows the positive association between far-right beliefs and the excess mortality. The evidence is after controlling for the relevant socio-economic variables. Given the prior evidence, this paper conclude that the far-right beliefs play a key role as a proxy to social obedience, noncompliance and contrarianism which in effect lead to increased amount of excess deaths during COVID-19 pandemic.

# Materials and Methods

The observation are on a sub-region level (Polish: “powiat”), which is an administrative unit formerly classified in the European Union (EU) nomenclature as LAU-1 and NUTS-4. Poland is divided into 380 of these subregions, each of them being a single observation in herein study. The economic and demographic variables are sourced from Polish Statistics Office [17], whereas votes share of first round of 2020 presidential election are sourced from State Electoral Commission (“Państwowa Komisja Wyborcza”) [18]. Unlike the second round, the first round of elections is free from strategic voting behaviour.

The outcome variable of excess deaths from COVID-19 pandemic are estimated based on the annual sub-region all-cause mortality data from 2010 to 2022. The literature often analyse officially registered COVID-19 deaths, however there are several flaws of using this data. Namely, the registered deaths are underestimating the actual amount of deaths, given that the criteria for defining a death almost certainly depends on whether the death occurs in somebody who tested positive for OVID-19. Because of that, the registered deaths are usually a function of a testing coverage. This is especially relevant for Poland [19]. The excess deaths are thus often considered to be the more reliable alternative [20].

The procedure of estimating excess deaths is based on a simple model-implied counterfactual. That is, based on the historical demographic trends, the model projects the expected mortality that would have occurred, had the COVID-19 pandemic not started. First, for each of the sub-region (), in a period before COVID-19 pandemic (2010:2019), a linear-trend projection is estimated with OLS:

Where, is vector of total amount of deaths in for each of subregions , is a matrix of years and a column of values equal 1 for each , is a vector of estimated coefficients and are residuals of the projection. The decision of the model is a compromise between models employed in the literature, ranging from simple averages [12] to more advanced non-linear regressions [21]. Since the demographic trends are nonnegligible, it is appropriate to account for them with the trend. Next, the excess deaths are estimated as a difference of actual and expected deaths summed over two years of pandemic:

Map 1 shows the estimated excess deaths for each of the subregion. The single subregion (Powiat Wałbrzyski) is deleted from the dataset as its biggest city was excluded from the region artificially changing mortality time series. In total, the amount of excess deaths in Poland during 2020-2022 COVID-19 pandemic is approximately 167,658 (64,657 in 2020 and 103,001 in 2021), which is 17% more than expected 996,872. These results are consistent with previous studies estimating excess deaths in Poland [22].

Obraz zawierający mapa

Opis wygenerowany automatycznie

Fig. 1. Estimated excess deaths during COVID-19 pandemic in Poland.

The estimated excess deaths per 10,000 population is the outcome variable further in the modelling part. To control for socio-economic and demographic confounders, the dataset includes covariates presented in table 1, along with their descriptive statistics. These are population density, number of physicians per 10,000 population, percentage of population aged 65 or more, houses per 100 population, total population, registered unemployment as a percentage of population and percentage sewage accessibility, which serves as a proxy for low access to public services. After merging every covariate the final dataset had 371 observations.

Table 1. Model covariates and their descriptive statistics. (n = 371)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Minimum | 1st quantile | Median | Average | 3rd quantile | Maximum | Standard deviation |
| Excess deaths per 10,000 population | 9 | 37 | 45 | 46.7 | 55 | 124 | 14.9 |
| Population per 1 km square | 2.89 | 4.06 | 4.49 | 4.9 | 5.26 | 8.19 | 1.25 |
| Working physicians per 10,000 population | 0.8 | 9.5 | 12.9 | 17.5 | 19.6 | 81.7 | 14.2 |
| Higher educated per 1,000 population | 2.9 | 7.2 | 11.4 | 20.2 | 19 | 740 | 46.6 |
| Population aged 65 or above (%) | 12.1 | 17.2 | 18.8 | 18.8 | 20.5 | 28.5 | 2.4 |
| Votes for Konfederacja (%) | 4.35 | 5.93 | 6.51 | 6.73 | 7.46 | 10.7 | 1.18 |
| Access to airport (dummy) | 0 | - | - | 0.035 | - | 1 | - |
| Mean excess deaths per 10,000 among 4 neighbours | 22.8 | 40.9 | 46.6 | 47.7 | 52.5 | 113 | 11.2 |
| Households with access to sewage (%) | 14.3 | 53.7 | 67.4 | 66.8 | 81.1 | 107 | 19.3 |
| Unemployment rate (%) | 1.7 | 5.3 | 7.3 | 8.17 | 10.6 | 23.7 | 3.87 |

As one can see on the map 1 and as it usually is in cross-sectional settings with spatial dimension, there could be a potential spatial autocorrelation. To account for that, a new variable was introduced which is an average of estimated excess deaths per 10,000 population in 4 nearest neighbours of the subregion. The distance was calculated from the centroid of the subregion.

Since the outcome variable is integer only and has distribution with strictly positive support, the appropriate density function for modelling it is negative binomial. Indeed, it is popular in epidemiological literature to model either disease cases or death counts [23][24] also relative to the population [14]. That’s why the model employed for herein study is a Bayesian GLM with negative binomial link function:

With weakly informative priors:

Where are excess deaths per 10,000 population in a subregion , is mean parameter, is a reciprocal dispersion parameter. is a Gauss probability density function, is exponential distribution and is a negative binomial link function. The model parameters are estimated with a Markov Chain Monte Carlo simulation with 4 chains and 4,000 iterations. There are several advantages of using Bayesian approach rather than traditional econometrics in this study. Since the mortality is an estimate, it is not directly observable and thus, should be estimated probabilisticaly. Additionally, the parameters of interest are estimated with their own posterior distribution, so it’s easy to inspect not only point estimates but also the shape of the parameter posterior distribution. A sort of technical advantage is the robustness of bayesian models to the outliers [25].

Data preparation, graphs and modeling in the study was done with the R programming languge. The modeling was done with rstanarm [26] R package that uses STAN programming language as a backend for model estimation.

# Results

Table 2 presents the model coefficients along their 95% credibility intervals and Graph 2 shows posterior distribution of the coefficient of interest – share of the votes for representative of far-right Konfederacja and representing percentage of population aged 65 or above. The light blue area shows 95% credibility intervals, whereas solid blue lines are averages of the posterior distribution. The estimates of the far-right vote share are with 95% credibility between 0.0203 and 0.0781, with point estimate of 0.0493. Taking the exponent of the estimate, the model suggests that each increase by 1 percentage point in the popularity of far-right politician leads to 5.05% increase in the excess mortality. This translates to roughly another 8,473 excess deaths more. The units of observations are sub-regions, thus it cannot be concluded if the same group of far-right voters are subject of the excess mortality. However, since public health is everyone’s responsibility, the lack of compliance still have impact on the rest of population and the excess mortality. The size of the effect is indeed epidemiologically meaningful and comparable to the effect stemming from age structure of the population. The posterior distribution of age structure coefficient is with 95% credibility between 0.045 and 0.0590, with a point estimate of 0.0418. This suggests that each 1 percentage point increase in people aged 65 and more, increases number of excess deaths in the subregion by 4,26%.

The size of these effects is surprisingly comparable. However, prior studies showed that ideological views tend to be a stronger predictor of vaccine hesitancy than demographics [27]. This may suggest that even for the older subgroup of population, as long as they comply with restrictions and are willing to vaccinate, they may have better chance to avoid far-reaching COVID-19 consequences, than the younger, hesitant subgroup. Consequently, it is reasonable that the social behaviour may have apparently similar significance as age structure for the public health. Consistent with these estimates are previous studies showing that the same variable (vote share of the same far-right candidate in 2020 Polish election) had similar effect on vaccination hesitancy as age structure [16].

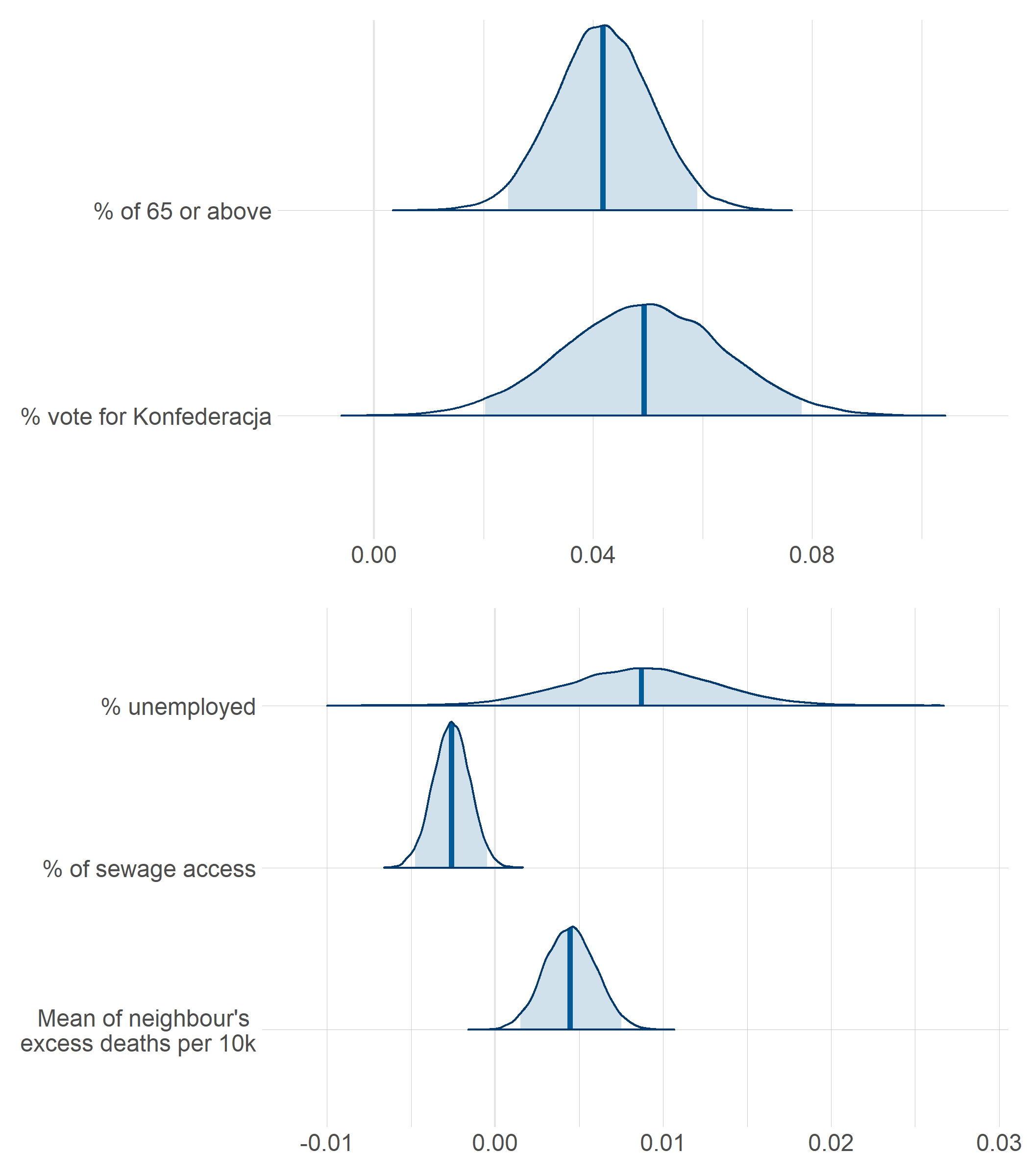


Fig. 2. Posterior distribution of statistically significant model coefficients

To better investigate the vaccine hesitancy channel of the studied effect, the model was also run separately for the period of vaccine availability – 2021, and before - 2020. Although the size of the effect is indeed higher for the 2021 data (0.0393 vs 0.049 point estimates), the study cannot conclude anything about the difference between those coefficients as the credibility intervals between them are too wide. This difference as well as previous research on the same subgroup may suggest that the vaccine uptake played an important role, however further research is necessary for any confident conclusion.

Table 2. Model coefficients and statistics. \* asterisk denotes statistically significant variables with 95% credibility.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Estimate | Std. error | Lower CI (95%) | Upper CI (95%) |
| Intercept\* | 2.63 | 0.226 | 2.19 | 3.07 |
| % votes for Konfederacja\* | 0.0493 | 0.0147 | 0.0203 | 0.0781 |
| % aged 65>\* | 0.0418 | 0.00877 | 0.0245 | 0.0590 |
| Mean excess deaths per 10,000 among 4 neighbours\* | 0.00448 | 0.00155 | 0.00151 | 0.00751 |
| Working physicians per 10,000 population | -0.000253 | 0.00202 | -0.00415 | 0.00375 |
| Access to airport (dummy) | 0.109 | 0.138 | -0.159 | 0.377 |
| Population per 1 km square | 0.0000266 | 0.0000437 | -0.0000602 | 0.000113 |
| Households with access to sewage (%)\* | -0.00259 | 0.00108 | -0.00477 | -0.000475 |
| Unemployment rate (%)\* | 0.00870 | 0.00429 | 0.000304 | 0.0171 |
| Higher educated per 1,000 population | -0.00178 | 0.000948 | -0.00363 | 0.0000538 |
|  | 0.183 | - | - | - |

Among control variables, there are additionally three variables from which it is possible to infer from, given the credibility intervals. Less expected variable, to have a significant effect, is share of population with access to sewage system. The estimated coefficient shows a slightly negative effect on excess deaths. The rationale behind this effect are twofold 1) Access to sewage improves the hygienics of the household, thus lowering transmission. 2) As mentioned before, it is a good proxy for access to public services, that can either prevent deaths or COVID-19 transmission.

A variable with estimates that are also consistent with literature findings, shows that economic factors also plays a role for the excess deaths from COVID-19. An unemployment rate, which serves in general as a poverty indicator, shows a positive and significant direction of effect. A study investigating the economic dimension of excess mortality, suggests that the poverty affects is mainly through: 1) a higher occupational exposure to the disease, that is, less paid occupations are usually also more exposed to the transmission risk and 2) high share of multigenerational households [28].

# Robustness check

Different model specifications were estimated in order to check for model robustness. The alternative specifications are presented in table 3. There is a new variable introduced as well, which is a percentage votes given to the Andrzej Duda, who was a candidate of currently ruling conservative party “Law and Justice” (PL: “Prawo I Sprawiedliwość”). He was a winner in 2020 elections.

Table 3. Alternative specifications of the model. \* asterisk denotes variables with 95% significance. Standard errors in brackets.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| % votes for K. Bosak | 0.0388\*  (0.0178) |  | 0.0521\*  (0.0139) | 0.0614\*  (0.0143) | 0.0596\*  (0.0144) | 0.0487\*  (0.0147) | 0.051\*  (0.0144) |
| % votes for A. Duda | 0.00236  (0.00234) | 0.00519\*  (0.00189) |  |  |  |  |  |
| % aged 65> | 0.0408\*  (0.00878) | 0.0332\*  (0.008) | 0.0424\*  (0.0072) | 0.0529\*  (0.00775) | 0.0514\*  (0.0078) | 0.0422\*  (0.00812) | 0.041\*  (0.008) |
| Population per 1 km square | 0.000028  (0.000042) | 0.0000393  (0.00004) |  | -0.00009\*  (0.000027) | -0.00007\*  (0.000032) | -0.00003  (0.000033) | -0.000025  (0.00003) |
| Higher educated per 1,000 population | -0.00166  (0.000945) | -0.00155  (0.00094) |  |  | -0.00039\*  (0.0004) | -0.00141\*  (0.0007) | -0.00113  (0.0007) |
| Mean excess deaths per 10,000 among 4 neighbours | 0.0043\*  (0.00155) | 0.00471\*  (0.0015) |  |  |  | 0.00522\*  (0.00151) | 0.00509\*  (0.0015) |
| Unemployment rate (%) | 0.00789  (0.00441) | 0.00646  (0.00421) |  |  |  |  | 0.0095\*  (0.0044) |
| Households with access to sewage (%) | -0.00177  (0.00137) | -0.00095  (0.00131) |  |  |  |  |  |
| Working physicians per 10,000 population | -0.00029  (0.00204) | 0.00028  (0.002) |  |  |  |  |  |
| Access to airport (dummy) | 0.133  (0.136) | 0.103  (0.139) |  |  |  |  |  |
|  | 0.196 | 0.181 | 0.105 | 0.118 | 0.131 | 0.153 | 0.152 |

As it is apparent from the table, the coefficient for far-right voters is significant in several specifications. This means that the main contribution of this research is robust with respect to different choices of included variables and so, it’s a supporting evidence of structural validity. The model with lowest effect size of the far-right voters is the one with included vote share for conservative candidate. This is reasonable as the characteristics of right-wing conservatives are often overlapping with far-right ideology.

The additional model, with vote share for currently serving president of Poland – Andrzej Duda, whose candidacy was issued by the ruling conservative party, shows a significantly positive effect. Although, the size of the effect is much smaller than that of the far-right vote share. The effect suggests a 0.52% increase of excess deaths for each percentage point of votes in a given subregion. It’s approximately 10 times smaller than the effect of the main variable of concern in this study and smaller than reported by studies analysing mortality of foreign right-wing subgroups (e.g. Wallace 2022 [12]). The smaller size of the effect than in similar studies may be explained by the fact that, the ruling party imposed lockdown and in consequence, encouraged population to comply with them. It was not the case for example in study by Wallace J. where republicans were not compliant with non-pharmaceutical interventions imposed mostly by representatives of Democratic Party (J. Biden began his service in January 2021). However, this is only one of possible reasons for the difference.

# Limitations

Despite the robustness of the analysis, this study could be a subject of an ecological fallacy, that is perhaps aggregation of data may results in the loss or concealment of certain details of information. Thus, it is important to not generalize with an absolute certainty the result on individuals. However, the individual-based studies are also not flawless when it comes to the causal inference. Because health consequence for self-directed action lies partly outside the self, the studies with spatial unit of observations are better at capturing the externality of individual’s misbehaviour. In studies with microdata, often those that are incompliant, are transmitting disease to those more vulnerable, yet compliant. Thus, there is a trade-off between individual and region based studies.

Additionally, since there is a common opinion, that polish political scene lacks good alternative, often the votes are made for the lesser bad. This could mean that votes for Konfederacja are merely reflecting the voters shared opinion with candidate, that is not necessarily related to the COVID-19 policy.

Despite the access to the vaccination rate data for each of the analysed subregion, the modelling of the vaccination on excess deaths and especially identification its causality with this research design is highly challenging task. This is mostly because the vaccination rates are highly endogenous to the vaccination campaign development. That is, the agents are making the choice based on their risk of getting infected. Thus, this research have to assume the effect and its strength from individual-based studies. [29]

# Discussion

This study sheds a new light on the political radicalization during major public health emergencies. The main result of herein research is the positive effect of far-right political beliefs on the excess deaths during COVID-19 pandemic. The effect controls for various socio-economical confounders. To the author’s best knowledge, there has not been a similar research done linking these phenomena.

The mechanism of the effect, as backed by the contributions of scientific literature, is mostly through the vaccination hesitancy, government mistrust and non-compliance with non-pharmaceutical interventions implemented to mitigate the impact of the COVID-19. These results are consistent with the previous study [11] providing evidence of higher anti-vaccine hesitancy (and more likely general incompliance with COVID restrictions) among the same population group during pandemic period in Poland. Additional studies on far-right groups provides supporting evidence of their opposition to non-pharmaceutical interventions during COVID-19 pandemic. This suggests that the far-right views, through their incorporated conspiratorial beliefs, contrarianism and tendency to disobey, lead to increased mortality in the region during COVID-19 pandemic.

The contribution of this study mainly lies in understanding the link between COVID-19 health damage and far-right ideology. However, the underlying research design additionally adds to the growing body of literature that analyse determinants of the excess mortality during health crises. The additional factors that plays a role in strengthening the pandemic severity are also unemployment and lack of access to public services. Although, given the complexity of these aspects further research is necessary in order to investigate it in depth.

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