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SOCIAL CAPITAL AND SPREAD OF COVID-19 IN POLAND – DO MEMBERSHIP, TRUST, NORMS AND VALUES OR SHARED NARRATIVES MATTER?

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ABSTRACT. The experience of the SARS-CoV-19 pandemic can be a source of valuable information for public health authorities. As we have seen, the incidence is not evenly distributed in space, and the factors influencing it are not fully understood. Aspects of biological, demographic, economic, environmental, and political nature are considered, but it is believed that the social factor may be of critical importance. The density and intensity of social relations, general trust and trust in the authorities, norms and values – i.e., social capital – may have a key impact on the scale of infections. The research conducted so far on this subject does not provide clear conclusions, and the post-communist society, inferior in social capital, has hardly been analyzed. Using data for 73 subregions of Poland and performing regression analysis, we investigate how social capital explains the level of infection rate in the first three waves of the epidemic. The analysis results have shown that the factor of "political leaning" was strongly and negatively related to the infection rate in Poland. The research results indicate that, contrary to the previous studies, structural capital has the same positive effect on reducing the epidemic. However, relational social capital promotes more significant morbidity.

JEL Classification: C21, C5, E7, I12

Keywords: social capital, trust, Poland, spatial econometrics, post-communist countries, norms, membership, pandemic, political orientation.

Introduction

The SARS-CoV-19 pandemic has become a part of everyday life worldwide, an urgent and vital subject of numerous studies. It is still unclear why the effects of this epidemic are unevenly distributed across space. Understanding the causes of the unequal development of an epidemic is key to reducing it. These reasons may be biological, genetic, demographic, environmental, political, or economic, but they may also be related to the nature of social contacts and the community's system of norms and values. The last of the mentioned factors can be described as social capital. The analysis of this factor is crucial because human

behaviour is the critical factor that can contain the spread of a pandemic in the absence of reasonable medical solutions and as supplement to them. Hence, social capital is a significant factor worth examining. As Makradis and Wu (2020) emphasized, there is a growing consensus that social capital can serve as one of the most critical tools in carrying out essential tasks during crises (Aldrich & Meyer, 2015; Dynes, 2021). Experience with recent epidemics - SARS in 2003, Ebola in 2014 and Zika one year later - also suggests that epidemics are better dealt with in places with high social capital (Blair, Morse, & Tsai, 2017; Brayne, 2017; Koh and Cadigan, 2008; Kruk, Myers, Varpilah, and Dahn, 2015; Trapido, 2019).

The role of social capital seems to be complex. On the one hand, higher social capital may suggest more significant personal interaction and the risk of infection. On the other hand, greater trust and social norms resulting in more profound care for others should lead to responsible behaviour, more hygienic practices, social distancing, and vaccination, limiting the epidemic's size. This work's novelty lies in researching a new object - the post-communist economy of Central and Eastern Europe, which has not yet been the subject of exhaustive analyses.

Social capital is a broad, multidimensional, multilevel theoretical construct that describes shared social resources. There are many definitions of social capital, and there is no consensus on its essence, but most definitions emphasise three elements: networks and relationships, norms and values, and trust. Network means social ties through group membership and social participation that benefit individuals and social groups (Bourdieu, 1986; N. Lin, 2001). Norms are the rules, beliefs, mores and habits which regulate behaviour (Spellerberg, 2001); social norms are socially enforceable expectations about what constitutes normal and appropriate action in a particular context (Bendor and Swistak, 2001), trust according to Sztompka (2007) – it is a bet on the uncertain future activities of other people. Trust refers to one's faith in other people and confidence in institutions.

Social capital is a concept developed for over 100 years. One of the classic works on this subject are works by Bourdieu (1986), Coleman (1988), Fukuyama (1997), Putnam (1993), Woolcock (1998), Burt (1992), Portes (1998), Westlund (2007), Glaeser (2001), Lin (2001) or Grootaert (1998). The literature indicates different types of capital. This study distinguishes between social capital's structural, relational, and cognitive dimensions (Nahapiet and Ghoshal, 1998).

Structural social capital is a dimension of social capital that relates to the social system's properties and the network of relations (Claridge, 2004; Davenport and Daellenbach, 2011; Nahapiet and Ghoshal, 1998). Relational social capital is a dimension of social capital that relates to the characteristics and qualities of personal relationships such as trust, obligations, respect and even friendship. (Gooderham, 2007; Nahapiet and Ghoshal, 1998). Cognitive social capital is shared values or paradigms that allow a shared understanding of appropriate ways of acting. It is a common language, goals, values or narratives. Thus, cognitive social capital provides a set of norms of acceptable behaviour (Anderson and Jack, 2002). Shared understanding is related to social identity and belonging, solidarity, trust and participation in society (Fuller and Tian, 2006). Shared goals are a force that brings people together and allows actors to coordinate their efforts and work together for mutual benefit. When they exist - people are more likely to put the group's needs over their own (Chamlee-Wright and Storr, 2011; Gray et al., 2007; Subramaniam et al., 2013). The three dimensions of social capital are interconnected and do not work independently: social structures create opportunities, the relational dimension helps create motivation, and a common language enables the creation and use of social capital.

Studies on social capital often indicate the positive effects of this capital, including its impact on health or the response to epidemics, as exemplified by studies on the outbreaks of

SARS, Ebola and Zika, and various strains of HN influenza (Asri, Nuntaboot, and Festi Wiliyanarti, 2017; Chuang and Chuang, 2008; House, Landis, and Umberson, 1988; Kawachi, Subramanian, and Kim, 2008; Pretty, 2003). Research indicates that better social capital resources have generally been associated with more positive responses to the COVID-19 pandemic, fewer confirmed cases, and a slower growth rate of infection over time.

To date, a dozen or so publications have been published on the relationship between social capital and the spread of the epidemic, measured by the scale of deaths (Borgonovi, Andrieu, and Subramanian, 2021a; Elgar, Stefaniak, and Wohl, 2020a; Murayama, Nakamoto, and Tabuchi, 2021; Yanagisawa, Kawachi, Scannell, Oronce, and Tsugawa, 2021), excess deaths (Bartscher et al., 2020), the scale of infections (Fraser and Aldrich, 2020; Kokubun and Yamakawa, 2021; Kuchler, Russel, and Stroebel, 2020; Makridis and Wu, 2020; Varshney, Socher, and Research, 2020; Yanagisawa et al., 2021), hospitalisation (Borgonovi et al., 2021a) or testing rates (Wu, Wilkes, Fairbrother, & Giordano, 2020). There have also been works analysing changes in people's behaviour due to an epidemic, e.g. reduced mobility (Bai, Du, Jin, and Wan, 2020a; Barrios et al., 2020b; Borgonovi and Andrieu, 2020a).

Results of many studies indicate a positive impact of this capital on social reactions to COVID, which is also reflected in deaths and infection statistics. Research conducted in the USA showed that individuals who lived in counties with high levels of social capital reduced mobility faster than individuals living in counties with low levels of social capital (Borgonovi and Andrieu, 2020a); social capital is associated with a reduced growth rate of COVID-19 cases (Varshney et al., 2020), communities with higher levels of relational and cognitive social capital were particularly successful in lowering COVID-19 deaths and hospitalisations than communities with lower social capital (Borgonovi, Andrieu, and Subramanian, 2021b), an area with more social capital tend to have a higher testing rate (C Wu et al., 2020), more engagement in social distancing (Ding, Levine, Lin, and Xie, 2020), as well as fewer, confirmed cases and slower infection growth rates (Makridis and Wu, 2020). Research on Japan has shown that social capital is negatively correlated with infection rates (Kokubun and Yamakawa, 2021); more significant norms of reciprocity and government trust were associated with fewer COVID-19 deaths during the first and second 3-month periods of observation (Murayama et al., 2021). Research for several European countries indicated that high-social-capital areas exhibit lower excess mortality and a decline in mobility (Bartscher et al., 2020). For US individuals, US counties, and European regions, voluntary social distancing was higher when individuals exhibited a more heightened civic duty (Barrios et al., 2020a).

However, there are also reports of the negative relationship between social capital and the course of the epidemic. Results of research by Elgar et al. (2020) carried out internationally indicate that two dimensions of social capital: civic engagement and confidence in state institutions, related to less mortality, but social trust and belonging to groups were associated with more deaths. Similarly, multidirectional relationships have been shown by studies Borgonovi et al. (2021) – between late March and early April, communities with higher levels of relational and cognitive social capital were especially successful in lowering COVID-19 deaths and hospitalisations, but from late June-early July onwards the number of new deaths recorded as being due to COVID-19 was higher in communities with higher levels of cognitive social capital. Other studies suggest that the association between social capital and COVID-19 deaths may vary according to the dimension of social capital and time (Bai et al., 2020; Murayama et al., 2021; Yanagisawa et al. 2021). It should also be added that some of the studies indicate the deficiencies of social capital relationships in the development of the epidemic (Murayama et al., 2021; Yanagisawa et al., 2021).

There is mounting evidence that social capital remains vital in determining disease spread and mortality. However, the conclusions of the research remain mixed. It results from

various methodological approaches and social, economic, and political conditions. The studies mainly analyse the USA, China, Japan and selected European countries, less often the international dimension. To the best of the authors' knowledge, studies covering the societies of Central and Eastern Europe are very scarce (Kravchenko and Ivanova, 2021). Socio-cultural, historical, and political differences create conditions for the belief that the existing arrangements of relations between social capital and Covid-19 for other societies cannot be generalised and applied in Central and Eastern Europe. Our study concerns one of the post-communist economies – Poland. The post-communist past is one of the factors determining the current ties, relations, social norms and respecting the law, which also affects the observance of restrictions related to the epidemic and voluntary refraining from risky social contacts.

Poland is a country where the epidemic has reached a considerable size (Figure 1). During the first three waves (from March 4, 2020, to September 27, 2021), 2,842,578 cases of infection and 75,372 deaths were recorded (74.29 and 1.97 per 1,000 inhabitants, respectively).

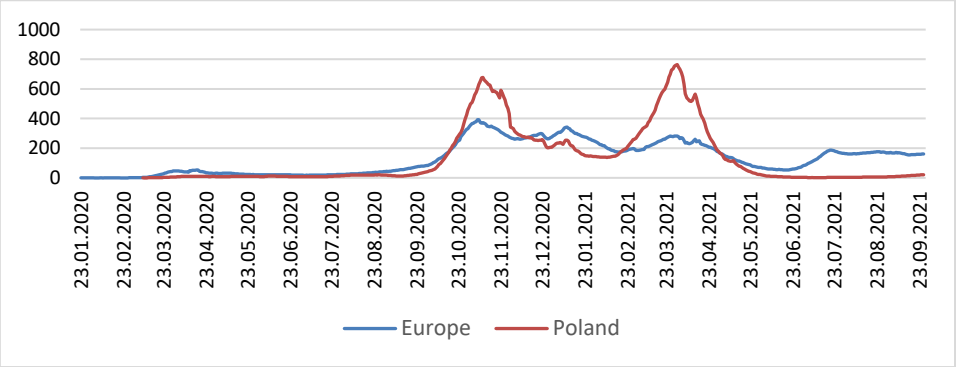


Figure 1. Daily new confirmed Covid-19 cases per million people in Poland and Europe from 23.01.2020 to 27.09.2021 (7-day rolling average).

Source: Our World Data, https://ourworldindata.org/covid-cases, accessed on 05.01.2022

In the first period of the epidemic, heavy restrictions were applied in Poland and sanctions for non-compliance with them. The first wave was very gentle. Two more – in the fall of 2020 and the spring of 2021 – had a dramatic course (Figure 1). There were also many protests and violations of legal and social rules. The policy of fighting the epidemic has been criticised for inconsistency and the lack of some politicians in respecting the restrictions. It could also have contributed to discouraging compliance with the restrictions introduced. Like other societies of Central and Eastern Europe, the Polish community is also not very eager to vaccinate. On September 27, 2021, 51% of the population was fully vaccinated.

The work has an exploratory nature. Analyses are conducted to find answers to three questions: (1) whether social capital in Poland is related to the size of the epidemic during the first three waves, and if so, (2) what is the nature of these relationships and (3) what are the similarities and differences with other countries in this matter.

To answer the questions posed, we use the regression method, taking the control variables and spatial dependencies into account. We investigate whether structural, cognitive and relational social capital is associated with infection rate. We use the data for subregions on infections between 04. March 2020 and 27. September 2021 that is, during the first three waves of the epidemic. The analysed period is when vaccination has not yet played a significant role in the course of the epidemic. In Poland, vaccinations began to be widely available in May 2021, when the number of infections declined.

The structure of the paper proceeds as follows. Section 2 discusses the data and methods used, section 3 presents the empirical findings and section 4 discusses the results, study limitations and future research directions. Section 5 presents final conclusions.

1. Methodological approach

1.1. Data

The research concerns the associations between various factors reflecting the state of the social capital in 73 Polish subregions (NUTS nomenclature) and the COVID-19 cases confirmed in these areas. The analyses are based on secondary data coming from various sources: official governmental information on COVID-19 confirmed cases, Michał Rogalski's and Piotr Tarnowski's databases (2021), official data from public statistics (Statistics Poland), namely Local Data Bank (2021), National Electoral Commission (2020), data from a nationwide survey entitled "Social Diagnosis. Objective and Subjective Quality of Life in Poland" (Rada Monitoringu Społecznego, 2015). The scope of the data and the data sources are presented in Table 1.

Table 1. Variables considered in the study.

Variable	Characteristics	Source
COVID-19 cases	Total number of infections (cumulative) as of 27/09/2021 (assumed before the 4th wave of the epidemic) per 1000 inhabitants	Ministry of Health in Poland and data from M.Rogalski's database
Sport_members	The number of members of sports clubs per 10 000 inhabitants (2020)	Statistics Poland, Local Data Bank
Religious_participation	Belonging to and participating in religious organisations (4-step measurement scale) (2015)	Social Diagnosis
Culture_group_members	The number of members of artistic groups, circles, clubs and sections in centres, houses and cultural centres per 10 000 inhabitants (2020)	Statistics Poland, Local Data Bank
Cognitive_SC	Aggregate measure - an unweighted average of the normalised variables: – electoral turnout in the first round of the 2020 presidential elections, – the average number of hours spent by respondents reading the press (2015), – tendency to sign petitions (4-step measurement scale) (2015), – the percentage of people who care if someone avoids paying for the use of public transport (2015), – the percentage of people who care if someone pays the taxes less than they should (2015)	National Electoral Commission Social Diagnosis
Norms_sanctions	Aggregate measure (unweighted average): – number of crimes per 10 000 inhabitants (transformed into stimuli) (2020) – Crime detection (2020)	Statistics Poland, Local Data Bank
Trust	Percentage of people answering "Most people can be trusted" to the question: Overall, do you think you can trust most people?" (2015)	Social Diagnosis
Population_density	Population per 1 km^2 (2020)	Statistics Poland, Local Data Bank
Age65+	Percentage of the population over the age of 65 (2020)	Statistics Poland, Local Data Bank
GDP	GDP per capita (2018)	Statistics Poland, Local Data Bank
Political	Percentage of votes cast for Andrzej Duda (the winner) in the first round of presidential elections in 2020	National Electoral Commission

Source: own study

It is worth emphasising that the variables come from different sources and represent various aspects of the complex phenomenon, which the social capital is. The authors made every effort to use the most recent data but encountered certain limitations. Although official statistical data are up-to-date in most cases, the detailed data relating to the social capital are obtained from surveys, which are not often carried out. Hence, some of the data included in the analysis come from 2015. The others are the last accessible through official sources (2020 and 2018).

Social capital is analysed in three dimensions: structural, cognitive and relational. Structural social capital was included in the analyses in three separate variables: membership in sports clubs (*Sport_members*), participation in religious organisations (*Religious_participation*) and participation in cultural organisations (*Culture_group_members*).[1] Relational social capital was represented by two variables - generalised trust (*Trust)* and norms and sanctions (*Norms_sanctions*). Cognitive social capital was included as an aggregate measure (*Cognitive_SC*), which considers aspects of involvement in civic activities and approach towards the free-rider attitude. The "*Political*" variable was taken as the control variable. Indirectly it is a measure of the manifestation of social capital in its relational and cognitive dimensions: it is a measure of trust in the current power (relational social capital) and an expression of common beliefs, goals and interpretations of reality (cognitive social capital).

Other control variables were also included in the analysis - population density, percentage of the population over 65 and GDP per capita.

1.2. Statistical methods

A preliminary statistical analysis of the collected research material was carried out in the first stage. Descriptive statistics were used for the assessment, allowing for a concise characteristics of the variables. Due to the nature of the COVID-19 cases, an evaluation of spatial relationships for subregions was carried out. The levels of COVID-19 indicator in subregions were presented on the choropleth map, and the occurrence of spatial autocorrelation for this variable was tested. Moran I statistic (Moran, 1950) was applied as a global measure of spatial autocorrelation. For this purpose, the spatial weight matrix according to first-order rook contiguity was calculated and normalised by rows (Fotheringham and Rogerson, 2009). Additionally, Moran scatter plot was used to analyse dependencies between values and spatially lagged values (Anselin, 1996). Pseudo-p-values for Moran's I were estimated to test the hypothesis concerning spatial autocorrelation.

To directly answer the research questions, statistical methods were used to assess the dependence of phenomena. The dependent variable was COVID-19 cases, and the other variables (log-transformed if applicable) listed in Table 1 were treated as possible explanatory variables. Linear regression models were chosen to identify the relationships. Backward elimination procedure was used to identify the final version of the models with all structural parameters statistically significant. The procedure was based on F test and information criteria were used to evaluate the legitimacy of subsequent steps. The models were verified

[1] For the Polish conditions, Janc (Janc, 2009) treats the occurrence of artistic circles and treats interests as a measure of the ability to associate to achieve specific goals. Działek (Działek, 2011) adopted a different assumption (artistic groups as a type of bridging social capital), however, the results of his research also led him to believe that the circles of interest and artistic groups are rather a manifestation of binding social capital. Bartkowski (Bartkowski, 2005) considers that both hobby organizations and cultural associations should be treated as bridging associations. However, he recognized that traditional local associations promoting local culture should be treated as bonding associations. Unlike religious and cultural organizations, sports clubs are perceived as bridging and not bonding capital.

concerning the fit to data, normality of the residuals distribution, heteroscedasticity, and significance of coefficients. For the previously mentioned reasons, the spatial aspect was also taken into account in the regression analysis – Lagrange Multiplier tests were used to assess the validity of using spatial regression models, i.e., the spatial error model or the spatial lag model (Anselin, 2005). This type of association suggests the construction and evaluation of an additional model containing an element reflecting the spatial processes (Plant, 2018).

Guided by the merits, we consider two models:

- Model 1 makes COVID-19 cases dependent on the variables chosen during elimination procedure from those listed in Table 1, except for the *Political* variable. In this model, attempts were made to determine the impact of various factors, excluding the political aspect.
- Model 2 makes COVID-19 cases dependent on all the variables chosen during elimination procedure from all variables presented in Table 1, thus containing the political aspect.

2. Conducting research and results

2.1. Preliminary statistical analysis

The descriptive statistical measures of the analysed variables are presented in Table 2. The values of COVID-19 cases per 1000 inhabitants in subregions range from 46.118 to 111.073. The distribution of this variable is close to symmetrical and is characterised by high variability. The coefficients of variation (CV) indicate that all explanatory variables are characterised by significant variability. Exceptionally high variability was noted for the variables *Population_density*, *Culture_group_members*, *Trust*, and *GDP*.

There is a substantial positive distribution asymmetry in the case of *GDP*, *Population_density*, and *Cognitive_SC* variables, which is confirmed by skewness coefficients and histograms. Due to the high skewness, natural logarithms of the aforementioned variables were taken.

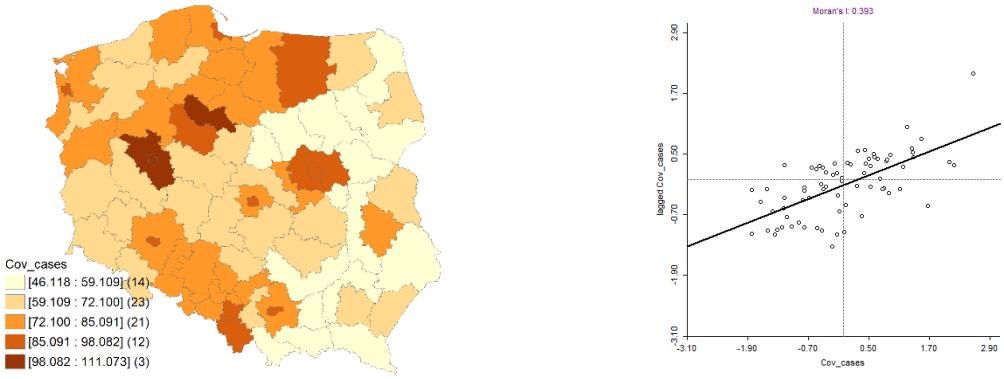
Table 2. Descriptive statistics of variables

Variable	Mean	SD	CV	Median	Min	Max	Skew
COVID-19 cases	72.975	14.800	0,203	71.779	46.118	111.073	0.279
Sport_members	259.321	57.915	0,223	255.359	126.218	398.500	0.199
Religious_participation	0.414	0.062	0,150	0.403	0.266	0.592	0.429
Culture_group_members	0.308	0.135	0,438	0.294	0.000	0.683	0.325
Cognitive_SC	0.451	0.163	0,361	0.424	0.148	0.935	0.804
Norms_sanctions	0.674	0.146	0,216	0.706	0.205	0.894	-1.023
Trust	0.149	0.064	0,432	0.129	0.038	0.291	0.660
Population_density	358.507	677.324	1,889	102.000	41.000	3469.000	2.841
Age65+	18.396	1.944	0,106	18.308	13.460	24.529	0.308
GDP	49769.384	21319.275	0,428	42768.000	28359.000	163372.000	2.725
Political	45.468	10.805	0,238	44.346	22.982	66.070	0.075

Source: own computations

The calculations and visualisation were made using the R programme or GeoDa software. The spread of epidemics is usually a phenomenon characterised by geographic determinants. Therefore, the spatial aspect of the COVID-19 variable is considered. Figure 2 (a) presents a choropleth map of COVID-19 cases per 1000 inhabitants by subregions. The equal intervals approach was used to determine the scale. The configuration indicates the

existence of spatial regularities. In the subregions located in the northwest area, more cases were recorded than in the southeast part. High values were also recorded in the Warsaw capital city, its vicinity, and other large cities constituting separate statistical units. The calculated Moran global statistic is 0.393 (pseudo-p-value 0.001), and the Moran plot is shown in Figure 2 (b).



a b

Figure 2. Spatial aspects of COVID-19 cases per 1000 inhabitants in subregions in Poland: (a) choropleth map; (b) Moran scatter plot.
Source: own research

Very low level of pseudo p-value (0.001) and the sign of Moran global statistic lead to the conclusion that there is the positive and significant relationship between the observed values of the COVID-19 cases variable and its spatial lagged values (i.e., noted in surrounding locations). It is confirmed by the arrangement of points on the Moran scatter plot, which are concentrated in the lower left and upper right quadrants corresponding to low-low and high-high spatial associations (Anselin, 1996).

2.2. Regression analysis

In both regression models, the dependent variable was COVID-19 cases. The models' parameters were estimated by OLS with elimination procedure, and the estimation results are presented in Table 3. The measure of goodness of fit and the results of testing the assumptions are included in Table 4.

Model 1 shows a moderate fit to the data ($R^2 = 0.518$). The Jarque-Bera test gives no evidence for the non-normality of the distribution of errors. Breusch-Pagan and White tests opt for homoscedasticity of errors. In Model 1, the parameters for the variables *Sport_members*, *Religious_participation*, *Culture_group_members* and *Ln_GDP* are significant ($p < 0.05$, $p < 0.05$, $p < 0.01$ and $p < 0.01$, respectively). Lagrange Multiplier tests were used to verify spatial dependences. Neither Lagrange Multiplier lag test nor the Lagrange Multiplier error test finds evidence for rejection. Hence, according to Anselin (2005) there is no reason for usage of spatial regression models.

Table 3. Results of regression modelling (dependent variable: COVID-19 cases) - coefficients and standard errors

Variable	Model 1	Model 2
Constant	-86.538 (51.912)	84.577***(12.224)
Sport_members	0,067* (0.0256)	-
Religious_participation	-51,356* (20.961)	-
Culture_group_members	-31.014** (10,639)	-
Norms_sanctions	-	26.567* (11.106)
Ln_Population_density	-	4.438***(1.282)
Ln_GDP	16.088** (4.851)	-
Political	not considered	-1.140***(0.117)

* p < 0.05, ** p < 0.01, *** p < 0.001
Source: own computations

Table 4. Model 1 and Model 2 – the goodness of fit and statistical inference for Model 1 and Model 2

Measure/Statistic		Model 1	Model 2
Goodness-of-fit (R^2)		0.518	0.731
Jarque-Bera test	statistic	0.443	1.555
	p-value	0.801	0.460
Breusch-Pagan test	statistic	5.362	5.906
	p-value	0.252	0.116
White test	statistic	15.594	11.262
	p-value	0.339	0.258
Lagrange Multiplier (lag) test	statistic	3.550	0.035
	p-value	0.060	0.851
Robust LM (lag) test	statistic	5.874	0.358
	p-value	0.015*	0.549
Lagrange Multiplier (error) test	statistic	0.513	0.103
	p-value	0.474	0.748
Robust LM (error) test	statistic	2.837	0.426
	p-value	0.092	0.514

* p < 0.05
Source: own computations

Model 2, taking into account the political factor, is characterised by a better fit to the data (R^2=0.731) than Model 1. Again, the Jarque-Bera test gives no evidence for non-normality of the distribution of errors, and Breusch-Pagan and White tests opt for homoscedasticity of errors. The parameters by following variables are significant: *Political* (p <0.001), *Norms_sanctions* (p <0.05), and *Ln_Population_density* (p <0.001). All Lagrange Multiplier tests show that no spatial regression specification is needed.

3. Discussion

The conducted research is exploratory, and its purpose is to analyse and evaluate the relationship between social capital and the pandemic scale. Answers were sought to whether social capital in Poland is related to the size of the epidemic during the first three waves, and if so, what is the nature of these relationships. Moreover, similarities and differences to relationships observed in other countries were searched for.

Regression analysis performed for the lowest possible level of data aggregation (NUTS 3), taking into account the control variables and spatial dependencies, showed that structural and relational social capital is essential. The study also attempts to verify the impact of spatial aspects on the analysis results. Statistical tests showed that the spatial lag model was appropriate and considered as Model 3. Our findings point to both favourable and unfavourable community characteristics to the COVID -19 infection rate.

First -. Structural social capital is related in a variety of ways with infection rate. This impact depends on the type of social capital. Communities rich in bonding social (*Religious_participation*, *Culture_group_members*) capital have a lover infection rate, but these abundant in bridging social capital (*Sport_members*) – higher infection rate.

Involvement in religious organizations is favourably related to reducing the scale of infections. It can be assumed that the norms and values shared by the organisation's participants could contribute to responsible behaviour, taking into account safety and protecting other people. Research shows that people who often participate in religious practices trust public institutions more (Omyła-Rudzka, 2020), declare that they must be sensitive to the needs of others and that by cooperating with others, one can help others or solve common problems (Boguszewski, 2016). They are much more involved in social work within civic organisations (Bożewicz, 2020). Stillman and Tonin reached similar conclusions when researching the South Tyrolean community. They found that more religious communities have higher testing rates (Stillman and Tonin, 2022).

Membership in cultural organisations also favorably impacted the infection level, but this factor – same as membership in religious organization – became irrelevant after considering the political aspect. Meetings within cultural organisations in the analysed period were limited due to epidemic restrictions, which could also positively affect the scale of infections. When it comes to the characteristics of this type of organisation, similar to religious organisations, cultural organisations can be perceived as bonding types (Działek, 2011; Janc, 2009). Presumably, relative "closing" of interactions with other groups also limits the spread of infection.

Relationship between membership in sports clubs and the development of the epidemic is different. This membership is a factor that is adversely related to the size of the epidemic. It can be explained by the nature of the physical interactions that result in infection, the relatively low degree of restrictions for sports clubs, and the character of the relationship. Unlike religious and cultural organizations, sports clubs are perceived as bridging and not bonding capital. While bonding social capital creates solid in-group loyalty and may create strong out-group antagonism, so much bridging social capital is a capital derived from relationships between different people due to sociodemographic characteristics bound by union ties. Bonding social capital comes from close relations and, cements only homogenous groups, whereas bridging, in addition to the horizontal relationship, also includes the vertical ties between communities (Aldridge, Halpern, and Fitzpatrick, 2002). This difference could cause an unfavourable relationship with the scale of infections. According to Putnam (Putnam, 2001), relationships and trust built up by participation in sport facilitate the creation of new social networks and the maintenance of existing ones. According to Perks (Perks, 2007), they also foster involvement in community activities outside sport. In Poland indeed, according to Biernat et al. (Biernat, Nałęcz, Skrok, and Majcherek, 2020), the number of social associations and organisations increases with the number of people exercising.

Secondly, as the model shows, when other independent variables are considered, communities with higher relational social capital resources - show higher morbidity. This result is inconsistent with our expectations, therefore further in-depth research is recommended. Perhaps a higher crime detection rate somehow correlates with a higher detection rate of infections as well, and lower crime rates favour more open relationships

based on trust? As with many studies, a low trust may prove to be a factor in limiting the spread of disease (Elgar et al., 2020b; Maj and Skarżyńska, 2020). Greater openness to strangers and a more significant number of direct contacts may negatively impact an epidemic. Distrust can help contain an outbreak. At the same time, generalised trust turned out to be an insignificant factor in the development of the epidemic in our research. The issue is complex and the data available does not allow for obtaining binding.

Thirdly, communities with a higher population density have a higher incidence rate. Irrelevant - according to the model's result, it turns out to be the level of affluence or the demographic structure. Population density, as expected, is positively combined with the level of infections.

Fourth - areas with higher GDP per capita have a higher infection rate. This is in line with our expectations - higher GDP is associated with denser, more frequent economic and social relations, greater mobility of people, greater professional activity, which translates into the density of interpersonal contacts, resulting in more infections.

Fifth and last but not least: the political factor is most strongly associated with the level of recorded infection rate - the support of Andrzej Duda, a representative of the ruling right-wing party in the presidential elections, is negatively related to the level of infections. Such dependence may probably be explained by trust in the government and thus compliance with restrictions and more responsible behaviour. In 2020, in Poland, the highest public trust was shown by people representing right-wing views (Omyła-Rudzka, 2020); About 90% of supporters of the current ruling party have a good opinion of the government's actions aimed at combating the coronavirus epidemic in Poland (25-35% of supporters of other parties have a favourable view of these actions) (Umańska, 2021). Research also shows that the reality of the threat of an epidemic is least often doubted by people declaring their willingness to vote for PiS; 76% of the electorate of this party believe that the epidemic is a real danger, only 19% of them doubt it (Cybulska and Pankowski, 2020), PiS supporters are no more opposed to compulsory vaccination than others (Omyła-Rudzka, 2021). It, therefore, seems that the authoritarianism characteristic of PiS supporters may have a beneficial effect on the attitudes of the epidemic, unlike in studies Prichard and Christman (2020), where authoritarianism predicted less concern about the impact of the virus on health. According to the research by Skarżyńska and Maj (2020), PiS supporters are also characterised by the highest distrust of people, which may mean limited contact during the pandemic.

Common political orientation can be treated as one of the components of social capital - cognitive capital. A community in which a significant percentage of voters choose the same candidate (in this case, Andrzej Duda, associated with PiS) is a community that shares common values, common goals and a shared narrative of reality. In 25 out of 73 surveyed subregions, A. Duda was chosen by more than 50% of those eligible to vote in the first round of presidential elections. Hardly any other candidate concentrated such many votes in the subregion (only R. Trzaskowski (the opposition candidate) obtained over 50% of the votes cast in one subregion). In a way, shared political views testify to shared values and goals and express a shared narrative. In this case, this shared narrative of a sense of the threat of the virus and trust in the authorities to fight this threat may explain the lower number of infections. However, we should also bear in mind that the coexistence of lower infection rates and a shared political orientation (with current right-wing governments) may be merely symptomatic, and another undiagnosed factor may influence infection levels.

Research on the relationship between social capital and the size of the epidemic should be continued for further periods. As shown by the results of other studies, the described relationships are changeable over time (Bartscher et al., 2020; Fraser and Aldrich, 2020). It can be expected that the positive influence of the "political" factor, which took place in the first three waves, does not have to be unconditional and constant in time. Apart from the

shared goals, narrative and trust in public authorities, the substantive value of shared norms and views represented in the government's policy is also essential. Still, government policy has changed quite radically in the fourth wave of the epidemic. Many restrictions were lifted.

Moreover, despite the government's official stance on the need for vaccination, many events surrounding politicians in the ruling party cast doubt on this stance. Government policy has often been opposed to science, as reflected in the resignation of the majority of the members of the Medical Council (the prime minister's auxiliary body composed of medical experts) from their position in January 2022. These events could have influenced the behaviour of individuals and the community, expressing themselves in the course of the epidemic.

Effectively comparing with earlier results is difficult because they are varied and carried out according to different methods, definitions, and measures of social capital. Nevertheless, one can say that generally, the research results are concurrent with research findings from other parts of the world. As indicated in the introduction, many studies on the USA, Japan and several European countries show the positive role of social capital. (Elgar, Stefaniak, and Wohl, 2020a).

As in many studies to date, also in Poland, trust in the government (treating the variable "*Political*" as a proxy for "trust in political authority") is beneficial for reducing the epidemic. The research by Elgar et al. (2020) is indirectly confirmed, in which trust in state institutions is related to less mortality. Studies by Murayama et al. (2021) have also confirmed that greater government trust was associated with fewer COVID-19 deaths. Wu (2021) finds that political trust plays a more significant role in authoritarian China than social trust in slowing the community spread of COVID-19.

Our research results differ from previous findings on two main issues. First, unlike most studies, structural social capital to a certain extent positively reduces the number of infections. The earlier findings for structural capital (carried out in the USA, Japan and internationally), often indicated the negative impact of the network on the development of the epidemic (Bai et al., 2020; Ding et al., 2020; Elgar, Stefaniak, and Michael J. A. Wohl 2020; Kuchler et al. 2020; Wu 2021). However, it should be noted that in Poland, the positive impact of structural social capital concerns organisations of a bonding nature. Participation in bridging-type networks favors an increase in the infection rate. Recent studies conducted for European countries by Alfano (2022) confirm this observation. The second point concerns the political factor. The situation in Poland seems to be different than in the USA, where the factor of "political orientation" (the percentage of voters for Trump) was also analysed. In the United States, counties leaning toward Trump are less adhering to epidemic recommendations and are more mobile. In Poland, supporters of right-wing governments follow these recommendations more (Allcott et al., 2020; Barrios and Hochberg, 2020; Borgonovi and Andrieu, 2020b).

Nevertheless, it turns out that it is vital to trust those in power, and similar conclusions come from other countries. Apart from those quoted above (Elgar et al., 2020b; Murayama et al., 2021), Pitas and Ehmer (2020) also stress the importance of trust in institutions. Similarly, Bargain and Aminjonov (2020), using mobility data at the regional level in Europe, show that higher political trust is associated with a more considerable reduction in non-essential mobility following the implementation of containment policies in March 2020. Similar conclusions can be drawn from the other studies (Cairney and Wellstead, 2021; Mazey and Richardson, 2020). Outbreak management relies heavily on trust management. Thus, it cannot be a temporary policy but a long-term policy and should consider that trust is a fragile resource that arises in the long term and is easily destroyed.

The research carried out has important implications for public policy and knowledge about social capital. Once again, various effects of social capital, both positive and negative,

were indicated. The conducted research shows that taking into account the concept of social capital in public management may bring potential benefits.

There are, of course, some limitations of our study that merit discussion. It is difficult to demonstrate a causal effect of social capital or to rule out an inverse causal relationship between social capital and the size of an epidemic. Further research, based on later information on inverse relationships and time lags, is desirable, especially as social capital is very sensitive to various shocks. Another limitation is the reliability of the data on which the research is based. There are opinions that the number of registered infections in Poland is highly underestimated, and the data on them are not entirely reliable. However, the official measurement method was the same across the whole country, so even if the results are biased, one may expect that it similarly refers to all statistical units. Because in spatial terms, the share of positive tests in the total tests remains stable (approx. 15%), it was considered underestimated at a similar level in all subregions inside the country. Nevertheless, further research using other sources and data to verify these findings is also advisable.

Conclusions

Certain features of societies – which we can consider using the concept of social capital – allow more effectively limit the development of a pandemic. In our work, we analysed the dependence of COVID-19 cases on variables representing social capital and other control variables. And although we cannot draw detailed conclusions about the effects of social capital, the results of the analysis of the available data at the NUTS 3 level indicate that in Poland, during the first three waves of the pandemic, social capital could have been no less important than the population density, level of development or age structure. The relationships of the analysed dimensions of social capital were multidirectional within individual components.

The "political" factor has the strongest, favourable relationship with the level of infections in Poland. It can be explained by trust in public authorities, coexisting with cognitive capital and authoritarian attitudes expressed by the variable "political". Structural capital also seems to limit - to some extent - the size of the epidemic, which is somewhat surprising compared to the previous results. Importantly, however, only the structural capital of the bonding type shows such a beneficial relationship.

These studies are partially consistent with the results of studies conducted for other countries (especially for trust in institutions or authoritarian attitudes), although the political orientation had the opposite impact in the USA than in Poland.

Our research was the first astute study – to our knowledge – to cover a post-communist country. Although more than a dozen essential studies on the relationship between social capital and the size of the COVID-19 epidemic have already been prepared, none of them concerned a society with such a relatively poor social capital. We believe our work fills the empirical and contextual gap. A novelty in our research is also the use of spatial modelling methods. Spatial relationships became apparent in the case of Polish subregions and were statistically significant.

Our research contributes to recognizing the relationship of social capital with the size of infections in Poland and indicates the needs and directions of future research. It would be interesting to analyse these relationships in subsequent periods, with the changing government policy regarding the epidemic, explore the relationship with vaccination, analyse the cause-effect relationships in both directions, and conduct in-depth research using individual data that can confirm the initial suggestions posed in this paper.

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