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NEW CORONAVIRUS DISEASE – DATA FROM THE REGIONS OF THE CZECH REPUBLIC

Nový koronavirus – data z krajů České republiky

JANA ROZMARINOVÁ

Katedra veřejné ekonomie | *Department of Public Economics*
Ekonomicko-správní fakulta | *Faculty of Economics and Administration*
Masarykova univerzita | *Masaryk University*
✉ Lipová 41a, 602 00 Brno, Czech Republic
E-mail: 450924@econ.muni.cz

Annotation
A new coronavirus disease (COVID-19) spread across the world from Wuhan (China) in the first quarter of 2020. The goal of our research in this paper is to map the extension of coronavirus cases across the regions of the Czech Republic and to describe the trends in dissemination within the regions. The results of a descriptive analysis of cases in the regions of the Czech Republic are reported. The survey was based on the reports by the Regional Hygiene Station of the Czech Republic The number of days to reach 100 cases in the regions, the average age of patients in the region and the median age of the population in individual regions were calculated. The number of days to reach 100 cases in a region shows in the speed of the spread of the virus in the region. The regions with the most aggressive beginning of the infection are not those currently reporting the highest numbers of infection. Concerning the division of cases into individual regions, the Prague region is the leader in absolute numbers. The Karlovarský region, together with Prague, is the most affected if taking into account the size of the population.

Key words
regions of the Czech Republic, coronavirus

Anotace
Zcela nové onemocnění koronaviru (COVID-19) se rozšířilo z počátkem roku 2020 z Wuchanu (z Číny) a dostalo se mu nadnárodního významu v prvním čtvrletí roku 2020. Cílem příspěvku bylo zmapování rozšíření COVID 19 v rámci krajů České republiky. V našem příspěvku uvádíme výsledky základní deskriptivní statistiky případů COVID-19 v krajích České republiky. Náš průzkum byl založen na datech krajských hygienických stanic, která jsou v agregované podobě veřejně dostupná. Počítali jsme následující indikátory: Počet dní pro dosažení 100 případů v regionu, průměrný věk pacientů v daném regionu a střední věk, počet případů na 100 000 obyvatel. Počet dní k dosažení 100 případů v regionu ukazuje na rychlost šíření viru v kraji v prvních týdnech nákazy. Bylo zjištěno, že regiony s nejagresivnějším začátkem infekce nejsou těmi, které nyní hlásí nejvyšší počet nakažených. Co se týče počtu případů v jednotlivých krajích, je Praha v absolutních počtech lídrem. Karlovarský kraj spolu s Prahou jsou nejvíce zasaženy, pokud data očistíme od počtu obyvatel jednotlivých krajů, který se významně liší.

Klíčová slova
kraje České republiky, koronavirus

JEL classification: I14

1. Introduction

The general view of health conditions and disease environments is as first-order direct determinants of economic development (Acemoglu, Johnson, Robinson, 2003). The effect of health on economic development and growth is much debated in large amounts of national and international literature and as recently summarised by Acemoglu and Johnson (2007), suggests that mortal diseases and pandemics have a serious economic impact. The negative impact is that these diseases and pandemics reduce the labour supply while the positive impact is that they later increase real wages and improve living conditions. The economic impacts of the disease can be classified as direct and indirect costs. The direct costs include hospital costs, lost working days and the costs of medication (Meltzer et al.1999). The indirect costs tend to be more significant and include the economic multiplier effects of the direct costs, plus the results of shifts in the structural parameters governing such fundamental economic behaviour as

consumption (Meltzer et al.1999). A pandemic can also play an important indirect role in shaping economic development when it affects institutional choices (Acemoglu, Johnson, Robinson, 2003).

Pandemics have accompanied the pattern of human evolution from antiquity until modern civilization and some, e.g. the Spanish flu pandemic (which was probably the most dramatic in terms of loss of human lives) have dramatically changed the fortunes of cities and nations (Percoco, 2016). The epidemiologic practice makes a significant contribution to emerging population-based health management frameworks (Timmreck, 2002).

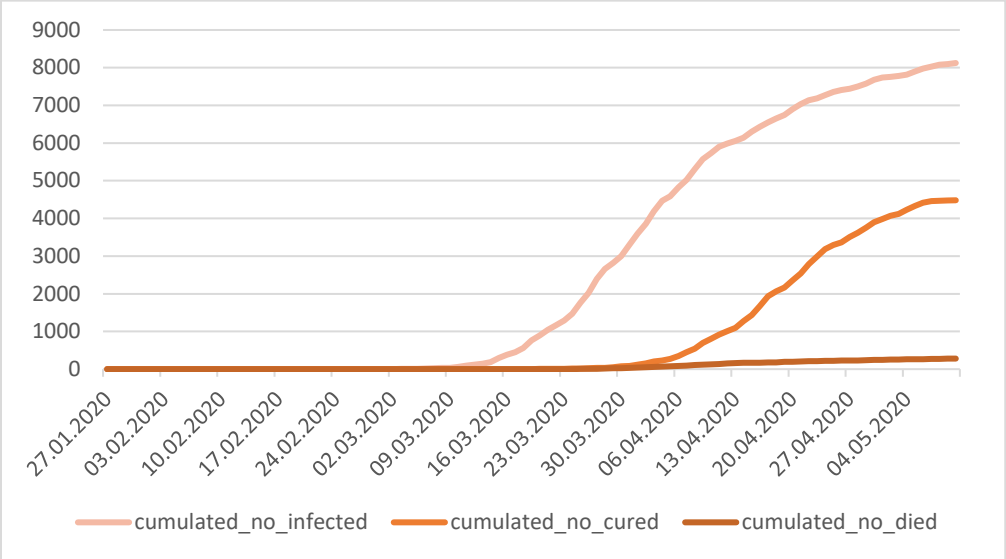
A new coronavirus (2019-nCoV) occurred in Wuhan in the Hubei Province in China in December 2019 and within a short time quickly spread across the world (Sohrabi et al., 2020; Li et al., 2020). The Czech Republic was no exception and reported its first case on 1.3.2020.

Scientific literature aimed at coronavirus disease has since rapidly appeared with many authors proposing solutions to how to proceed in this unprecedented situation. Remuzzi and Remuzzi (2020) studied the coronavirus outbreak in Italy while Legido et al. (2020) addressed government coordination of the diverse regions of Spain. Luchini et al. (2020) contributed to improving the quality of health decision-making by providing an acceleration/deceleration comparison of confirmed cases over the health policy responses across various countries. Ferguson et al. (2020) showed how epidemiological modelling can inform policymaking.

This paper uses descriptive statistics to map and discuss regional disparities in the individual regions of the Czech Republic. As of 11th May 2020, the virus has infected thousands of people. The Government of the Czech Republic declared a state of emergency on 12th March 2020 and extensive measures to reduce person-to-person transmission of COVID-19 have been implemented to control the outbreak.

As of 11th May 2020, the number of confirmed cases in the Czech Republic has reached 8,136 while 4,602 patients have recovered and 284 have died. The number of people tested now (11th May) exceeds 306,000. The Czech Republic has managed the epidemic without exceeding the capacity of its hospitals and the collapse of the healthcare system. In contrast, countries such as Italy have been severely affected. There was serious concern regarding the capacity of the Italian national health system to effectively respond to the needs of infected patients and those who require intensive care for SARS-CoV-2 pneumonia (Remuzzi, Remuzzi, 2020).

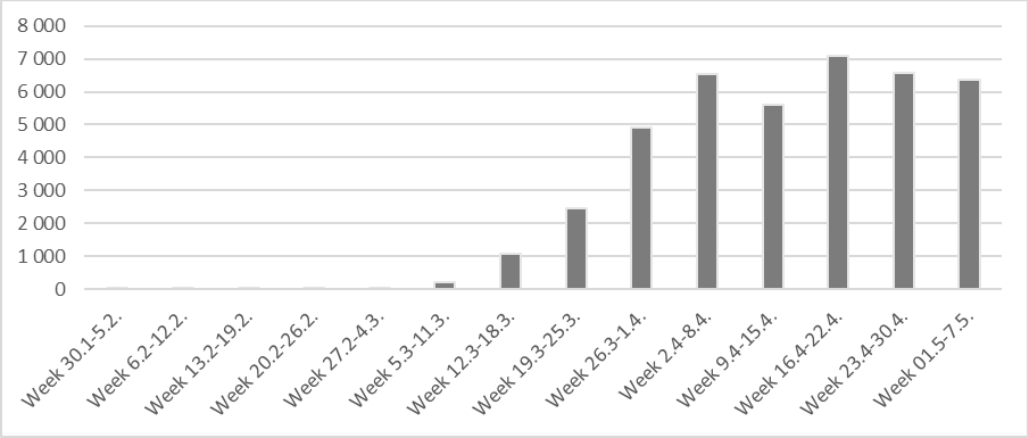
Fig. 1: Numbers of people infected, recovered and died



Source: based on the data of the Ministry of Health of the CR

Testing is essential when managing the course of an epidemic (Sharfstein et al. , 2020). In the Czech Republic, the course of testing is shown in Fig. 2. The table shows that the average number of tests increased until the second week of May. So that the trend can be described more accurately, the number of tests in the Czech Republic are presented as number for individual weeks (for individual weeks from the week in January) to avoid fluctuations caused by weekends and public holidays. The number of tests had increased to over 7,000 per week by the third weekend in April, then slightly decreased to between 6,000 and 7,000 per week.

Fig. 2: Number of tests (average per week)



Source: Based on the data of the Ministry of Health of the CR

The Czech Republic has introduced a number of measures that are among the strictest in the EU countries and probably led to a milder course of the epidemic outbreak.

2. Methodology

The main goal of the research in this paper is to map the extension of coronavirus cases across the regions of the Czech Republic and to describe dissemination trends in the regions. The nature of the study takes the form of an epidemiological study. This paper provides an empirical basis for further scientific study and research work in this field.

The data required for mapping the spread of COVID-19 in the conditions of the Czech Republic was obtained from the website of the Ministry of Health of the Czech Republic from the reports from the Regional Hygiene Station of the Czech Republic. The data was available as aggregated open datasets for download in the CVS format. Every positive person is represented (date, age, gender, and the region code is assigned to individuals) and the data is fully anonymised. The sample structure is shown in Tab. 1. The data was ranked according to the accessories for individual regions and also ranked by date. In this way, the prepared file could already be processed regarding the aim of this article.

Simple descriptive statistics were used with formulas for the average, median, absolute frequency and relative frequency. In addition, the necessary dates were selected as the first case in the region. Particular indicators were also calculated: the number of days to reach 100 cases in the regions; the average age of patients in the region and the median share of the patients with COVID-19 in the regions belonging to group 75+, these calculations were based on the data as of 11th May. New cases in the week 18-24th May were added while preparing the final paper after the first stage of the review process to show the current activity of the virus in the regions. All the data was processed in the Excel editor.

Tab. 1: A Sample

Date	Age	Gender	Reg. code	Infected out of CR	Country code
07.03.2020	3	M	CZ010	1	IT
08.03.2020	62	M	CZ010	1	IT
08.03.2020	62	Z	CZ010		

Source: Based on the data of the Ministry of Health of the CR

3. Results

The results are summarised in Tab. 2.

3.1 First reported case

The first reported cases in the regions of the Czech Republic were in Prague and the Ústecký region (date 29.2.2020). Eight days later, new cases appeared in the Středočeský region. Following these, COVID-19 was positively tested in all regions of the Czech Republic until 12.3.2020.

Tab. 2: COVID-19 in the regions of the Czech Republic

Region	First reported case	Country	Days reaching 100	No of cases.	No of cases 100 thousand	Average age	Median age	New cases week 18 - 24 May
Praha	29.02.2020	IT	15	1842	140.7	46.5	42	63
Středočeský	08.03.2020	NA	12	946	69.1	44.6	42	27
Jihočeský	11.03.2020	DE	21	179	27,9	47.1	44	1
Plzeňský	11.03.2020	IT	19	632	108.0	46.9	47	8
Karlovarský	11.03.2020	IT	20	427	144.7	44.9	45	17
Ústecký	29.02.2020	IT	29	503	61.4	49.3	47	6
Liberecký	12.03.2020	IT	20	197	44.6	48.5	49	1
Královéhradecký	09.03.2020	NA	23	189	34.5	43.1	47	1
Pardubický	11.03.2020	AT	20	278	53.3	45.5	45	5
Vysočina	10.03.2020	IT	21	178	35.0	41.4	46	6
Jihomoravský	11.03.2020	IT	14	493	40.9	45.9	45	13
Olomoucký	10.03.2020	DE	14	699	112.8	42.8	43	5
Zlínský	09.03.2020	IT	18	337	57.5	42.1	44	14
Moravskoslezský	12.03.2020	IT	22	1128	95,3	47.4	47	224

Note: Number of cases as of 11th May
Source: Based on the data of the Ministry of Health of the CR

In the case of nine regions, the first infected persons in the region became infected with the virus in Italy, two firs cases in Jihočeský and Olomoucký were reported as infected from Germany, and one case from Austria, where the first person from the Pardubický region was infected. The reason that Italy prevailed in terms of infection is that the period at the end of March in the Czech Republic is connected with the spring holidays of primary and secondary schools and families often spend these holidays skiing in the Alps in Italy.

There are two further cases where this information was not available (Středočeský and Královéhradecký regions). Due to the closing of the borders shortly after the initial spread of the virus in the Czech Republic, then according to the dataset from the hygiene stations, the virus spread without the contribution of foreign trips during April. In the case of the Prague region, there were 77 infected people in Prague as of 15th March of which 33 were infected in Italy (55%); the share infected abroad decreased to 0% during April.

3.2 Number of days to reach 100 infected people

The number of days in individual regions until the virus infected 100 people were calculated. The number of days to reach 100 infections indicates the rate of the spread of the virus in the first days and the base from which the virus further spread. This indicator is also related to the total relative number of people infected in the region in Figure 3. The number of days in which the virus spread to 100 cases ranged from 12 days (Středočeský); 14 days (Jihomoravský, Olomoucký); 15, 18, 19 days (Praha, Zlínský, Plzeňský); 20 days (both for Karlovarský and Liberecký, Pardubický); 21 days (Jihočeský, Vysočina); 22, 23 days (Moravskoslezský, Královéhradecký); 29 days (Ústecký).

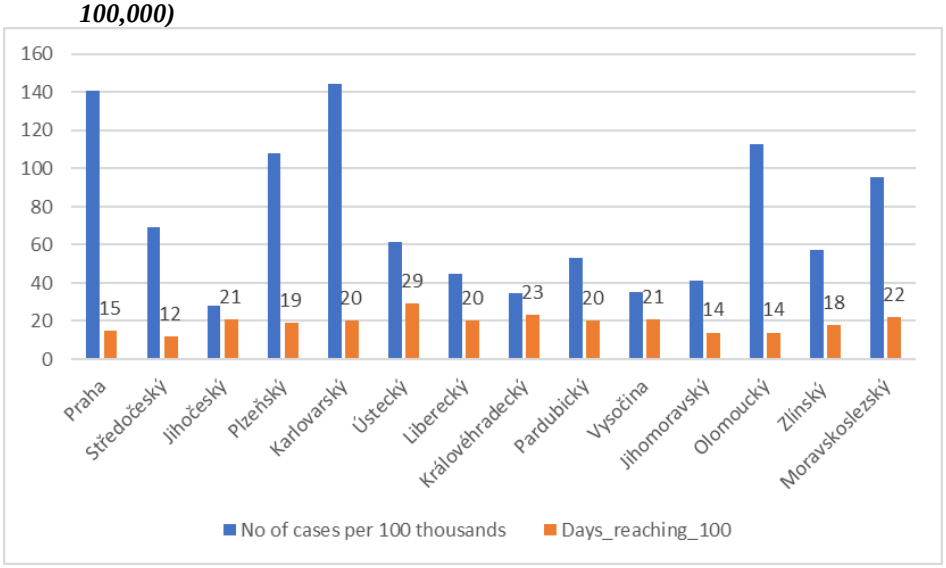
3.3 Absolute and relative numbers of cases on 11th May

The number of cases of people infected in the regions in absolute and relative numbers is reported here. Concerning absolute numbers, the Prague region is the highest (1842) followed by Středočeský (946), then Plzeňský (632) and Jihočeský (179) as the most infected regions. However, the numbers were then recalculated relatively (number infected per 100,000 people) due to the differently populated regions. The regions could then be ranked (relatively per 100,000) as follows: Karlovarský (144.7), Praha (140.7), Olomoucký (112.8) and Plzeňský 108.0. The least affected were Jihočeský (27.7), Královéhradecký (34.5) and Vysočina (35).

3.4 Spread from the initial outbreak and the prospective course

Our premise was that the number of days to reach 100 cases in the regions shows in the speed of the spread of the virus in the region for the whole period to 11th May (a larger base of infected people would initially mean a worse course of the COVID-19 epidemic). The data does not confirm this relation. To show the regions where this relation held then the Olomoucký region and Prague are examples where the expansion to 100 infected people was relatively quick compared to other regions and are currently among the most affected regions (relatively). However, the Středočeský and Jihomoravský regions had a rapid onset followed by a more favourable course, see Fig. 3.

Fig. 3: Number of days to reach 100 infected people; Number of people infected in the region (recalculated to 100,000)



Source: Based on the data of the Ministry of Health of the CR

3.5 Average and Median age, accessories for the risk group

The probability of complications due to Covid-19 varies widely across the age of the patients. The empiric results approximately showed that these rates of complications caused hospitalisation (Table 3). Based on the data from the regions of the Czech Republic, the average age of patients in individual regions is from 41.4 (Vysočina) to 49.3 (Ústecký), and a median age from 42 (Středočeský) to 49 (Liberecký). The share of infected patients in individual age groups is a more convenient indicator. The share of patients belonging to the high risk group 75+ were calculated as follows (regions sorted from the highest ratio):

Tab. 3: Rate of hospitalisation COVID-19 increase by age

Age group (years)	0-4	5-17	18-49	50-64	65-74	75-84	>84
Hospitalization rate	0.3	0.1	2.5	7.4	12.2	15.8	17.2

Source: Garg (2009)

Jihočeský (15%), Praha (13,7 %), Ústecký (13%), Moravskoslezský (12%), Vysočina (11%), Pardubický (10%), Olomoucký (9,7%), Jihomoravskýk (9%), Plzeňský (8,8%), Středočeský (6,7%). Liberecký (6,6 %), Královéhradecký (5,2%), Zlínský (4,7%), Karlovarský (4,6%). The proportion of people with COVID-19 who belong to risk groups is very diverse in the regions. One comment is important here, the Karlovy Vary region is the most affected region concerning relatively. The calculation of shares of patients in the individual age categories show that on the other hand the Karlovarský region has the most advantageous proportion of people with COVID-19 (in terms of possible complications rates which we know from the previous empirical research Garg (2009).

3.6 Current activity of the virus in the regions

Data on how many people are acutely treated with COVID-19 in the regions cannot be obtained at present. CSV files with specific numbers of cured and acute cases are not shown in the available data. However, the number of new infections in the last week may show on the current level of the spread of COVID-19, and this is shown in Tab. 2., in the column “New cases week 18-24 May”. In many regions, new data indicates that the virus is spreading only minimally: Jihočeský, Liberecký, Královéhradecký (1 case in a week), Pardubický, Olomoucký (5

cases in a week), Ústecký, Vysočina (6 cases in a week), Plzeňský (8 new cases in a week), Jihomoravský (13), Zlínský (14), Karlovarský (17), Středočeský (27), Praha (63), Moravskoslezský (227). The Moravskoslezský Region recorded a significant increase in the number of new cases during the week 18th to 24th May, due to the spread of the virus in the Darkov coal mine. In other regions, the rate of spread is proportional to the size of the region and the number of cases infected so far.

4. Conclusion

The contribution of this paper is primary information about the current level of the spread of COVID-19 in the regions of the Czech Republic. Through the analysis, we identified the regions with a higher relative infection with coronavirus, while the differences among individual regions of the Czech Republic are not negligible. Concerning absolute numbers, the Prague region is the highest (1842 infected as of 11.5.2020) followed by Středočeský (946 infected as of 11.5.2020). The relative numbers (number infected per 100,000 people) show that the Karlovarský region and Prague are the most affected by COVID-19. The date of processing dates back to 11th May. The regional situation has now changed significantly due to the high number of infections in the Darkov mine. This paper examined if the higher number of days to reach 100 infected people was followed by a burdensome course of the epidemic in the region, but this relation has not been confirmed.

With the analysis, knowledge is acquired that fulfils the scientific goal of the paper, which is to present data on the epidemic situation among the regions of the Czech Republic. Further research in the area of the COVID-19 epidemic is accordingly called for and researchers still have much to do. It will be an effort to arrive at a more balanced assessment of the real impact of the epidemic (see the discussion on the direct and indirect cost in the theoretic part of the paper). Such an assessment of the real impact of COVID-19 epidemic should be a challenge and cannot be counted only by the number of people who died.

The survey shows a high variability among the regions of the Czech Republic. My recommendation for managing the epidemic, while maintaining the most favourable conditions for the economy and the development of individual regions, would be to set measures according to the epidemiological situation in the individual regions of the Czech Republic even if the situation can rapidly change (for example, recent events in the Darkov mine.). This focus on individual outbreaks of the epidemic would bring more favourable conditions for the development of the regions (in the situation when some of them have, for example, one new case of COVID-19 in one week). In the situation of such significant variability of infection among the regions, the path of universal measures set out for the territory of the whole Czech Republic is not desirable (the indirect costs exceed direct costs).

This paper particularly traces the challenge of epidemic mapping of the virus among the regions. It will be an endeavour to arrive at a balanced assessment of the impact of the epidemic COVID-19 epidemic. The scope of the survey introduced in the paper could be a suitable basis and a starting point for further scientific activities in the field of COVID-19 and its impact on regional development.

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