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THE ACCESSIBILITY OF PRIMARY CARE AND PAEDIATRIC HOSPITALISATIONS FOR AMBULATORY CARE SENSITIVE CONDITIONS IN CZECHIA

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IES Working Paper 13/2024

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Bibliographic information:
Šlegerová L. (2024): "The Accessibility of Primary Care and Paediatric Hospitalisations for Ambulatory Care Sensitive Conditions in Czechia" IES Working Papers 13/2024. IES FSV. Charles University.

The Accessibility of Primary Care and Paediatric Hospitalisations for Ambulatory Care Sensitive Conditions in Czechia

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March 2024

Abstract:
This study evaluates the accessibility of primary care for children in Czechia in light of the declining numbers of general practitioners and the rising numbers of children without a practitioner. We show that children largely receive primary care outside their district of administrative residence, that the average number of children registered per practitioner is increasing, and that the share of children without a practitioner was over 6% in 2022. This study further challenges the use of hospital admissions for ambulatory care sensitive conditions as a measure of the accessibility and quality of primary care. We build a fixed-effects model for district-level data on paediatric hospital admissions and the utilisation of primary care between 2010 and 2019 in Czechia. Our focus is on the effect that the number of registered and treated children per primary-care physician has on the composition of paediatric hospital admissions. We find no significant relationship between the variables of our interest. Therefore, we suggest that hospital admissions for ambulatory care sensitive conditions are not a good measure of the accessibility and quality of primary care for the child population in Czechia, a country with compulsory health insurance and no gatekeeping of primary care.

JEL: I10, I11, I18
Keywords: accessibility of primary care, paediatric hospital admissions, ambulatory care sensitive conditions

Acknowledgement: The author would like to express her gratitude to Paola Bertoli for her valuable comments on this work. Moreover, the author would like to thank the Institute of Health Information and Statistics of the Czech Republic for providing all the datasets.

This publication was supported by grant project GAUK No. 1308220 of Charles University.

1 Introduction

This study explores the accessibility of primary care for children in Czechia and its effect on paediatric hospital admissions for ambulatory care sensitive conditions. The number of general practitioners who register and treat individuals aged 0-18 years ('children') is declining in Czechia (Bryndová et al., 2023). This endangers the accessibility of care, especially outside bigger cities where it is more difficult to replace retiring practitioners. Consequently, the average number of children registered per physician increases, with a potentially harmful effect on the number of preventive visits performed per child. Our study presents detailed unpublished data on the children registered across Czech districts and, importantly, on the distribution of children not registered with any primary-care physician in Czechia (approximately 145,000 children in 2022; 6.6% of the child population). We further bring evidence that children are, to a considerable extent, registered with a primary-care physician outside the district of their administrative residence, which is worth acknowledging when interpreting the differences in the number of inhabitants per physician across Czechia.

To evaluate the accessibility and quality of primary care and the effectiveness of policies targeting the system, the hospital admissions for ambulatory care sensitive conditions (ACSCs) are often used (Carneiro, 2018; Laberge et al., 2017; Rubinstein et al., 2014). ACSCs are conditions for which hospital admissions could potentially be prevented by primary-care interventions (Purdy et al., 2009). One advantage of using these hospitalisations is their independence from reporting by primary-care physicians. The literature focusing on the strength of the relationship between hospital admissions for ACSCs and indicators of primary-care accessibility suggests that it depends on the organisational structure of primary care. Strong primary care (adequate physician supply, long-term patient-physician relationships, gatekeeping) seems to reduce these hospitalisations (Van Loenen et al., 2014; Rosano et al., 2013b). We explore the strength of the relationship in Czechia, a country with compulsory health insurance and no formal gatekeeping role of primary care.

We build fixed effects models for panel data from 77 Czech districts (LAU-1 areas) between 2010 and 2019 to explain the variation in children's hospitalisations for nine diagnoses (dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, kidney/urinary infection, asthma, cellulitis, gastroenteritis, vaccine preventable conditions). This list was compiled by the author based on Freund et al. (2013); Jaeger et al. (2015); Purdy et al. (2009). We test the significance of several accessibility measures: the number of registered children per practitioner, the number of treated children per practitioner, and the number of patient contacts per practitioner. The models further control for the health-care network in the district, population and socio-economic characteristics, number of children in sports clubs, and hospitalisations of individuals aged 19 years and above ('adults').

Neither the number of registered children nor the number of treated patients or patient contacts per practitioner appears to be significant in our models for explaining the variation in the composition of paediatric hospitalisations, i.e. in the share of hospitalisations for the nine diagnoses in total children's hospitalisations. Hence, ACSC hospitalisations do not appear to be a good measure of the accessibility and quality of primary care for children in Czechia. This is in a disagreement with most of the papers collected in a systematic review by Rosano et al. (2013a), where the relationship between hospital admissions and indicators of primary care accessibility was found to be mostly significant and inverse. Nevertheless, the inverse relationship in studies on the statutory health insurance system (Bismark-based systems, such as the Czech one) was based on data on the overall population. None of these studies focused on vulnerable populations like children or the elderly. Most studies that met the inclusion criteria set by Rosano et al. (2013a) build on data from the US, where healthcare accessibility and affordability are a continual topic of discussion.

More details about paediatric primary care in Czechia are provided in the next section, followed by a description of the data and empirical approach chosen for this study.

1.1 Primary care for children in Czechia

Czechia's statutory health insurance system, with its virtually universal membership, guarantees a broad benefits package. The system's organisation is centralised and governed by the Ministry of Health. The reimbursement mechanisms are practically unified over the seven quasi-public health insurance funds that act as payers. Most of the services provided by general practitioners (GPs) are reimbursed through capitation fees. In 2019, capitation represented approximately two-thirds of their total revenue (63%), and the remaining part (37%) came through fee-for-service payments. Virtually all services are free for patients at the point of access. Cost-sharing applies for out-of-hours outpatient care (flat payment 90 Kč/under €4 per visit in 2024); other user fees were abolished by 2015.[1] Primary care in Czechia does not hold a gatekeeping role; patients are free to access higher-level care without a referral. Moreover, there are no catchment areas; patients can visit

[1] User fees were introduced in 2008. Since 2012, these were 30 Kč per outpatient visit, 100 Kč per hospital day, 30 Kč per prescription (Alexa et al., 2015).

providers located in any area (Bryndová et al., 2023).
GPs for children register and treat patients below 19 years of age. From the age of 14, patients can transfer to GPs for adults. Being registered with a GP is not obligatory per se, but those without obligatory vaccinations are subject to a fine, and unvaccinated children cannot easily register with a preschool care facility and participate in all school-related activities (Bryndová et al., 2023). The accessibility of GPs is defined in a government regulation by them being reachable within the travel time of 35 minutes. The health insurance funds are designed to secure this for all clients through contracting an adequate provider network. GPs may refuse to register more patients if a 'tolerable workload' has been exceeded. This remains at the physician's discretion; there is no threshold number of registered patients (Bryndová et al., 2023).
In recent years, Czechia has witnessed a steady decline in the number of GPs for children. Over a mere five years, between 2014 and 2019, the number fell by over 5%. But the number of children increased by almost 7% (ČSÚ, 2015, 2020; VZP, 2015, 2020). Naturally, these opposing trends had an impact on the number of registered children. The average number of individuals registered per GP for children has increased by 6%, reaching 991 in 2019. This helped to increase the total number of children registered with a GP for children by almost 6%. But still, this increase could not accommodate the demand of children who began to transfer to GPs for adults in greater numbers. An increase of 32% was seen in the number of individuals aged 14-18 registered with a GP for adults. As a result, 965 in 1,000 children were registered with a GP in Czechia in 2019. These values were computed based on data provided by the Institute of Health Information and Statistics of the Czech Republic (ÚZIS) from the National Registry of Reimbursed Health Services (NRHZS) and physicians' annual reports, and population statistics from the Czech Statistical Office (ČSÚ, 2020). With regard to more recent data, the number of registered children keeps decreasing. In 2022, there were only 934 children in 1,000 registered with a GP, based on the NRHZS data and the ČSÚ (2023).
Obviously, there are geographical differences across Czech districts in the accessibility of primary care, which this article discusses in greater detail. Inter-district commuting is relatively common in some areas, and it partially balances these differences. As regards the providers' network organisation, most primary care providers are independent solo practices, typically with one physician and a nurse. Around 95% of all individuals registered with a provider of primary care for children were registered in solo practices in 2020 (derived from ÚZIS (2021)). The rest were mainly group practices, health centres, polyclinics, and inpatient facilities.

2 Methods

2.1 Data

The following sections present data on the utilisation of paediatric primary care and hospitalisations for ambulatory care sensitive conditions in Czechia. This data was rendered to the author by ÚZIS. Most comes from the NRHZS and thus do not contain information about patients outside the statutory health insurance (part of foreigners and those paying care directly). The other part comes from physicians' annual reports, which, on the other hand, suffer from non-responsiveness. All datasets are available for the 77 Czech LAU-1 regions (hereafter 'districts'). District characteristics are depicted below as well. These are mostly available from the ČSÚ. The maps were created by the author using coordinate data from the Czech Geodetic and Cadastral Office (ČÚZK, 2024).

2.1.1 Hospitalisations for ambulatory care sensitive conditions

A list of nine ACSCs appropriate for the child population was identified based on the literature (Freund et al., 2013; Jaeger et al., 2015; Purdy et al., 2009). These diagnoses comprise dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, kidney or urinary infection, asthma, cellulitis, gastroenteritis, and vaccine-preventable conditions. The list for the adult population includes diabetes, congestive heart failure, bacterial pneumonia, dehydration, and epilepsy. All the related International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes are indicated in Table A.1.

The acquired data for the years 2010-2021 come from the NRHZS. Separately for children and adults, the datasets for each year consist of the total number of hospitalisations, the total number of hospitalised individuals, the number of hospitalisations for each of the listed conditions separately, and the number of individuals hospitalised with each of the listed conditions separately. The hospitalisations for specific conditions were retained from the primary inpatient diagnosis to avoid double counting. The hospitalisations were assigned to districts based on the administrative residence of the patient, not the hospital's address. Lastly, the dataset includes data on hospitalisations from acute appendicitis and intracranial injuries. These represent acute conditions that are not ambulatory care sensitive and serve for robustness checks.

2.1.2 Children registered with a GP

One needs to be careful when computing the share of children without a GP or the number of individuals per GP for children, because adolescents aged 14+ can transfer to GPs for adults and, conversely, some adults are still registered with a GP for children. Hence, to accurately map the situation across Czechia, we need several datasets: first, the number of children registered with any GP; second, the number of individuals aged 14-18 registered with a GP for adults; and third, the number of individuals of any age registered with a GP for children. ÚZIS provided these district-level datasets from the NRHZS for 2014-2019 (and part information up to 2022), valid on December 31 of each year. Older data are not available in the NRHZS. All datasets were provided separately based on the individuals' administrative residence and the GP's residence (workplace or physician identification number, IČP). We can derive the number of children registered with a GP for children from the first and the second datasets. Even though adults should not be registered with a GP for children, the data show that such cases exist.

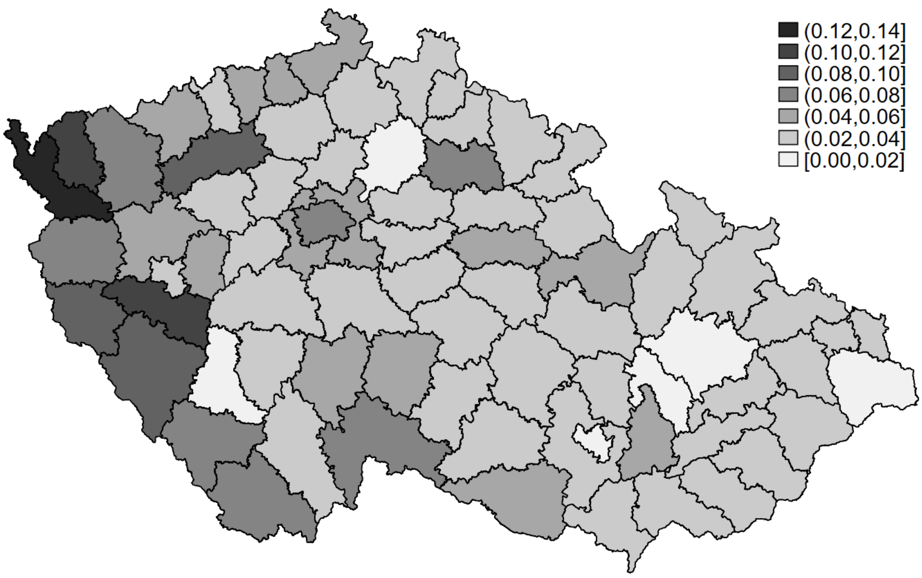

Figure 1: Share of children not registered with a GP in Czechia (2019)

Source: Own creation based on data provided by ÚZIS from the NRHZS and population data published by the ČSÚ (2020).
Notes: The number of registered individuals aged 0-18 according to their district of administrative residence was subtracted from the number of inhabitants aged 0-18 to derive the number of individuals aged 0-18 not registered with any GP in Czechia. All valid on December 31, 2019.

We show differences in the data across the districts in maps. The share of children who are not registered with any type of GP in Czechia is displayed in Figure 1. Basically, the opposite is shown in Figures A.1a and A.1b, which display the share of children registered with a GP for children and the share of children registered with a GP for adults, respectively. Figure 2 provides an estimate of inter-district commuting of children for primary healthcare. Assuming that children live in the district of their administrative residence, this is a lower bound estimate computed as a percentage difference between the number of children registered with a GP for children according to the GP's residence and according to the individual's administrative residence. Discussion of these maps is provided in the Results section.

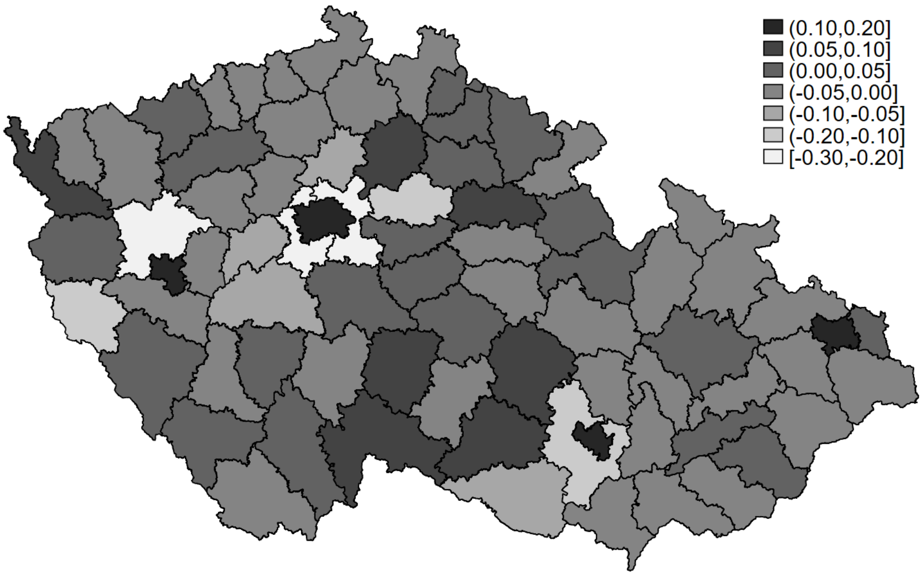

Figure 2: Estimate of inter-district commuting to a GP for children (2019)

Source: Own creation based on data provided by ÚZIS from the NRHZS.
Notes: Darker colours represent incoming regions. The measure was computed as the number of individuals aged 0-18 according to the district where they are registered with a GP for children minus the number of individuals aged 0-18 registered with a GP for children according to the individual's district of administrative residence, all divided by the second term. Assuming that the individuals live in the district of their administrative residence, this is a lower-bound estimate of inter-district commuting. All valid on December 31, 2019.

2.1.3 Care delivered by GPs for children

We are interested in the services provided by GPs for children. Hence, for each district, we acquired data on the number of registered individuals, then the annual number of treated patients, the total number of patient contacts, and the number of preventive contacts. The preventive contacts include regular check-ups and also visits for vaccination administration. The number of registered individuals and preventive visits is further divided in the data into age groups: 0-11 months, 1-4 years, 5-9 years, 10-14 years, 15+ years. The reported numbers were assigned to districts where the physicians' offices were located. To compute the average number of treated patients per physician and other measures, the dataset provided by ÚZIS also discloses the number of full-time equivalents (FTEs) of physicians that correspond to the reported patient numbers. All this data come from providers' annual reports but do not cover all practices of GPs for children. Even though it is compulsory to submit the annual report, some providers did not meet their obligations. Moreover, we only have data from independent solo practices. Hence, comparing the report and the NRHZS data, our dataset on services provided by GPs for children covers 86-96% of individuals registered with a GP for children between 2015 and 2019. In 2014, it was 77% due to a general drop in the submission rate of solo practices. The advantage of this annual report is its tradition; hence, we were able to acquire the dataset for the years 2010-2021. Figure 3 displays the average number of registered individuals per GP for children.

2.1.4 District characteristics

To further characterise Czech districts between 2010 and 2019, we use population statistics published by the ČSÚ. Each dataset consists of the number of women and men in every one-year age cohort, all at December 31 of each year (ČSÚ, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020). Other district characteristics were published by the ČSÚ (2022): the unemployment rate, number of divorces, and the total number of physicians per 1,000 inhabitants. To further describe the healthcare network, we acquired data from ÚZIS on the number of hospitals in each district. Lastly, we gathered the number of children in sports clubs from the public yearbooks of the Czech Union of Sport (ČUS, 2022). However, these have only been available since 2011.

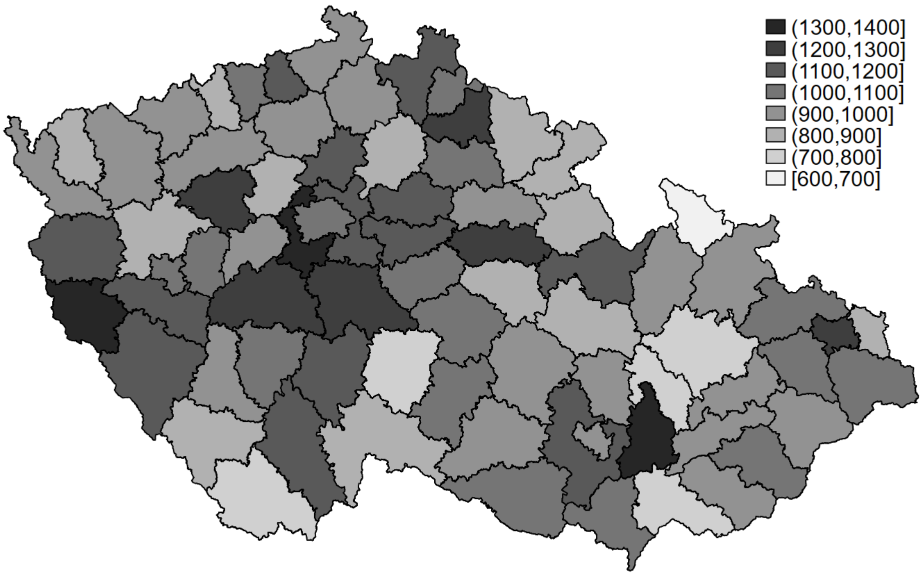

Figure 3: Average number of registered individuals per GP for children (2019)

Source: Own creation based on data provided by ÚZIS from annual reports of GPs for children in solo practices.
Notes: All individuals registered with a GP for children included irrespective of their age. This data covers 89% of individuals registered with a GP for children based on the NRHZS data. All valid on December 31, 2019.

2.2 Model and Estimation strategy

We use the fixed effects model with standard errors clustered over districts. The model examines the relationship between hospitalisations for ACSCs among children on the one hand and the accessibility measures quantifying the number of patients per GP for children on the other. The unit of analysis is a LAU-1 region (district), which leads to 77 cross-sectional observations. The observation period is from 2010 to 2019, i.e. 10 points in time with annual frequency. Even though we have data on hospitalisations for 2020 and 2021, these were distorted by the COVID-19 pandemic that hit Czechia in March 2020 (Figure A.2). The hospitalisations were influenced not only by the altered composition of diseases but also by the measures taken to cut non-acute care. Consequently, the total number of hospitalisations fell from 132 per 1,000 children in 2019 to 109 in 2020 (Figure A.2).
The dependent variable is constructed as the share from all child hospitalisations taken by hospitalisations for the nine ACSCs: dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, kidney or urinary infection, asthma, cellulitis, gastroenteritis, and vaccine-preventable conditions.

An alternative dependent variable relates the number of hospitalisations for the nine ACSCs to the number of children with administrative residence in the district. While the first dependent variable studies the composition of child hospitalisations, the second focuses on their number per 1,000 children. To adjust for the evolution in the total number of child hospitalisations, we control in the latter case for their number per 1,000 children (i.e. individuals aged 0-18 years).

The hospitalisations of adults serve as a regressor. It is constructed as a share of hospitalisations for dehydration, epilepsy, bacterial pneumonia, diabetes, and congestive heart failure from the total number of hospitalisations of adults. The model further controls for the healthcare network in the district (total number of physicians per 1,000 inhabitants and the number of hospitals per 1,000 inhabitants), population characteristics (share of girls in the child population, share of individuals aged 0-3 years among children, and the share of children in the population), and socio-economic characteristics (unemployment rate and the number of divorces in the adult population). The share of children enrolled in sports clubs is used as another predictor of child hospitalisations for ACSCs.

The variables of interest relate the number of GPs for children to the care provided. Thus, the models control for the number of registered individuals per FTE, the number of treated individuals per FTE, and the number of patient contacts per FTE. All measures were scaled by 1,000. A particular focus is placed on the relationship between the number of registered patients per FTE and the number of preventive visits per registered patient. Summary statistics for all the variables are displayed in Table A.2.

The panel of districts between 2010-2019 is balanced except for the share of children enrolled in sports clubs. As the share is available only for 2011-2019, we approximate the year 2010 by values from 2011. Hence, there are no missing data in the resulting dataset. However, there was an unknown district for some subjects in the ÚZIS data, and these observations had to be omitted. Nevertheless, the share of children with an unknown district of administrative residence registered with a GP for children did not exceed 0.6% of the child population between 2014 and 2019. And the share of nonassignable hospitalisations in the total number of child hospitalisations in Czechia did not exceed 0.5% between 2010 and 2019. Around 4.2% of the GPs did not fill in their district of residence in the annual reports between 2010 and 2013. From then on, the reports were complete.

3 Results

3.1 Trends in the number of registered children

We estimate that around 145,000 children in Czechia were not registered with a GP for children nor with a GP for adults in 2022 (6.6% of individuals aged 0-18), based on the NRHZS data and the ČSÚ (2023). Nevertheless, looking at the patterns around borders, we expect some of these children to have a GP abroad (Figure 1). Children who are only temporarily residing in Czechia are included in the ČSÚ population data together with Czech citizens and permanent residents. These temporary residents might not register with a GP in Czechia, in which case their status would not indicate a lack of capacity in Czech primary care. The wave of incoming refugees after the Russian invasion of Ukraine (February 2022) increased the demand for GPs in Czechia, as well as the number of children who are not registered with any GP. A year before, in 2021, there were around 107,000 (5.1%) children not registered with any GP, and in 2019, around 73,000 children (3.4%).

The studied data suggest the existence of inter-district commuting to GPs for children. We see a mismatch in the number of children residing in a district who are registered somewhere with a GP for children and the number of children registered with a GP for children in the given district (Figure 2). Even though this is only a lower-bound estimate of commuting, it exceeds 25% of child residents in two districts and 10% in another eight districts. It is thus important to acknowledge commuting when interpreting inequalities in the number of inhabitants per GP. For this reason, we prefer to report the number of registered children per GP over inhabitants. Nevertheless, commuting does not entirely erase the differences across districts. There are substantial inequalities even in the average number of registered individuals per FTE of a GP for children (Figure 3). Moreover, these inequalities seem to become more profound over time (Figure A.3).

The average number of individuals registered per GP for children increases over time. The average across the 77 districts oscillated between 950 and 960 individuals in the period 2010-2014 but surpassed 1,000 in 2019 and reached 1,050 in 2021 (based on the annual reports of GPs for children in solo practices). The higher number of individuals registered with GPs for children potentially has a negative impact on the number of preventive visits these GPs perform. The number of preventive visits per registered individual depends to a large extent on their age composition. Focusing on the youngest patients (0-11 months), the average number of preventive visits performed per registered child of this age varied significantly across districts in 2019 (Figure 4). The correlation with the number of registered individuals per FTE of a GP for children was -0.05 over the period 2010-2019. This suggests that more registered patients per GP leads to fewer preventive visits per registered child.

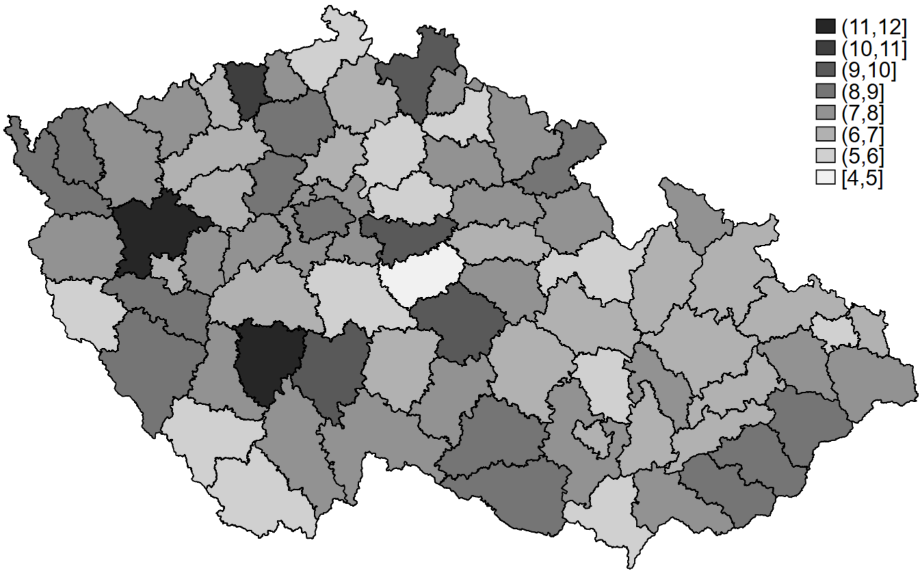

Figure 4: Average number of preventive visits per registered child aged 0-11 months (2019)

Source: Own creation based on data provided by ÚZIS from annual reports of GPs for children in solo practices.
Notes: The number of preventive visits of children aged 0-11 months divided by the number of registered children aged 0-11 months.

3.2 Hospitalisations for ambulatory care sensitive conditions

The composition of child hospitalisations varies substantially across districts. In 2019, the share of hospitalisations for ACSCs in all child hospitalisations ranged from 5.8% to 17.8% (Figure 5). Overall, in Czechia, 9.4% of all hospitalisations of children were for one of the nine listed ACSCs in 2019. This share peaked in 2015 at 10.5%, which was driven by hospitalisations for dehydration (Figure A.2), arguably due to the high temperatures recorded by the Czech Hydrometeorological Institute for that year (ČHMÚ, 2024). It seems the variation in the composition of child hospitalisations cannot be explained by the number of registered individuals per FTE of a GP for children, the number of treated individuals, or the number of contacts (Table

1). As expected, the ACSCs hospitalisations of adults are highly significant for explaining the variability, as well as the average unemployment rate in the district and the age and gender composition of children. There is also a significant inverse effect of the share of children enrolled in sports clubs.

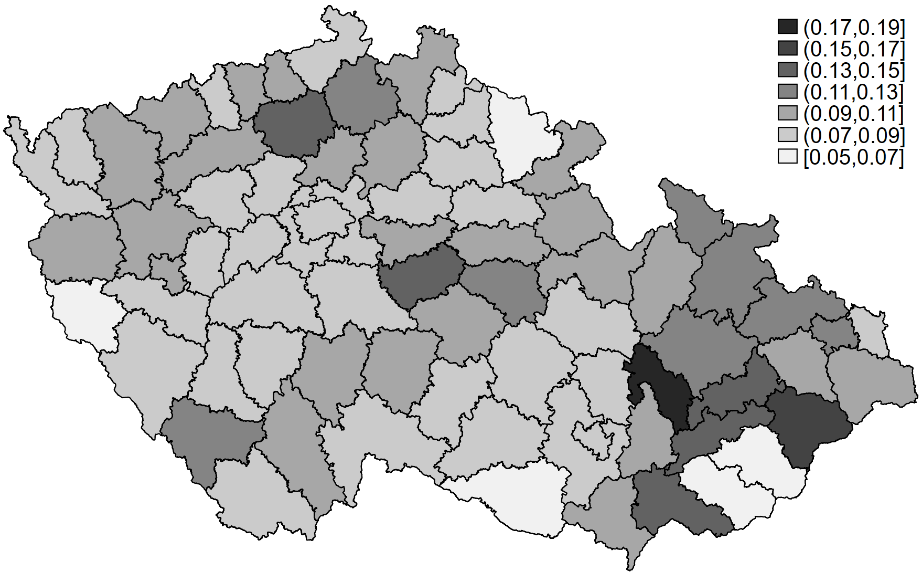

Figure 5: Share of hospitalisations for ambulatory care sensitive conditions in all hospitalisations of children (2019)

Source: Own creation based on data provided by ÚZIS from the NRHZS.
Notes: The share of hospitalisations for dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, kidney or urinary infection, asthma, cellulitis, gastroenteritis, and vaccine-preventable conditions in the total number of hospitalisations of individuals aged 0-18.

3.2.1 Robustness of the regression results

The regression results are reasonably robust to changes in the model specifications. Table 1 presented three choices for the regressor representing the utilisation and workload of GPs for children. Here, we offer three modified definitions of the dependent variable while keeping the regressors.
There is a gap in the frequency of hospitalisations for the listed ACSCs among children in Czechia, as depicted in Figure A.2. Five of the ACSCs are more frequent than the rest: dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, and kidney/urinary infection. We use these to construct an alternative dependent variable representing the share of hos-

Table 1: Fixed effects model on the share of ACSC hospitalisations in total hospitalisations of children

ACSC hospitalisations of children in total	(1)	(2)	(3)
registered individuals per physician	-0.010	.	.
	(0.006)	.	.
treated patients per physician	.	-0.002	.
	.	(0.002)	.
contacts per physician	.	.	-0.001
	.	.	(0.001)
ACSC hospitalisations of adults in total	0.497***	0.500***	0.492***
	(0.158)	(0.158)	(0.159)
children in sports clubs in all children	-0.065**	-0.066**	-0.064*
	(0.032)	(0.032)	(0.032)
girls in children	1.020**	1.007**	1.015**
	(0.480)	(0.476)	(0.479)
children aged 0-3 years in all children	-0.332***	-0.326***	-0.314***
	(0.089)	(0.093)	(0.090)
unemployment rate	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)
divorces in adult population	1.043	1.120	1.125
	(1.905)	(1.892)	(1.910)
physicians per population	0.004	0.004	0.004
	(0.004)	(0.004)	(0.004)
hospitals per population	0.094	0.093	0.092
	(0.074)	(0.074)	(0.075)
constant	-0.367	-0.372	-0.378
	(0.234)	(0.232)	(0.234)
N	770	770	770

* 0.10 ** 0.05 *** 0.01

Notes: Fixed effects model with standard errors clustered over 77 districts, years 2010-2019. The dependent variable is the share of hospitalisations for ambulatory care sensitive conditions (dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, and kidney/urinary infection, asthma, cellulitis, gastroenteritis, vaccine-preventable conditions) in the total number of hospitalisations of individuals aged 0-18.

pitalisations for these five ACSCs in all hospitalisations of children. The regression results remain practically the same as in the base models in terms of the statistical significance and coefficient sign and size (Table A.3).

The number of ACSC hospitalisations per child represents another alternative for the composition of hospitalisations used as a dependent variable in the base models. The variation of this variable across districts in 2019 is displayed in Figure A.4. Models in Table A.4 show that the number of registered individuals per physician remains insignificant for explaining its variation. Even though children in sports clubs and the share representing the youngest children lose their significance, the other control variables keep their statistical significance, as in the base model.

Importantly, none of the explanatory variables from the base model is statistically significant for explaining the variation in non-avoidable child hospitalisations for intracranial injuries and acute appendicitis. Only the non-avoidable hospitalisations of adults replacing the ACSC hospitalisations are significant (Table A.5).

4 Concluding remarks

The accessibility of primary care for children should not be measured by one metric. Multiple indicators are required to portray a picture that would not be misleading. Czechia has witnessed a steady decline in the number of GPs for children in recent years while the number of children has been growing. The rising demand of children for primary care has been accommodated by an increase in the average number of children registered per GP for children but also an increase in children transferring to GPs for adults. There has also been a growing number of children not registered with any GP in Czechia.

In 2022, 925 in 1,000 children were registered with a GP for children, and 9 children with a GP for adults. The remaining 66 children in 1,000 were not registered with any GP in Czechia (around 145,000 individuals aged 0-18). The reasons adolescents transfer to a GP for adults lie beyond the scope of this study; these may be individual preferences or may be attributed to the inaccessibility of GPs for children. With regard to the geographical differences, the highest share of the population of children not registered with a GP in Czechia can be seen near the borders. We can assume that at least some of these children receive primary care abroad.

A relatively large share of children consume primary care outside the district of their administrative residence, which is apparent especially around bigger cities. This puts preference on the number of registered individuals per GP over the number of inhabitants as an indicator to describe geographical differences in physicians' workloads. Nevertheless, even though the number of individuals registered per physician better accounts for commuting and living outside of the district of administrative residence, it fails to consider those who are not registered anywhere. For this, the share of children registered somewhere provides a better understanding of the situation.

We found no significant relationship between the number of registered or treated children per practitioner and their ambulatory care sensitive hospitalisations. Hence, these hospitalisations do not appear to be a good measure of the accessibility or quality of primary care for children in Czech conditions. The literature offers mixed results, though the relationship is mostly found to be significant and inverse (Rosano et al., 2013a). However, this stems mainly from the overall population, not children specifically. The absence of gatekeeping weakens Czech primary care, which might decrease its importance for hospital admissions (Van Loenen et al., 2014; Rosano et al., 2013b).

We found rather extensive variation in the number of preventive visits performed on the youngest children aged 0-11 months, varying between 4 and 12 per child on average in a district. The negative correlation with the number of registered individuals per GP for children suggests that more registered patients per GP leads to fewer preventive visits per registered child. Thus, the steadily decreasing number of GPs for children in Czechia might prevent the systematic observation of children's health from being conducted effectively.

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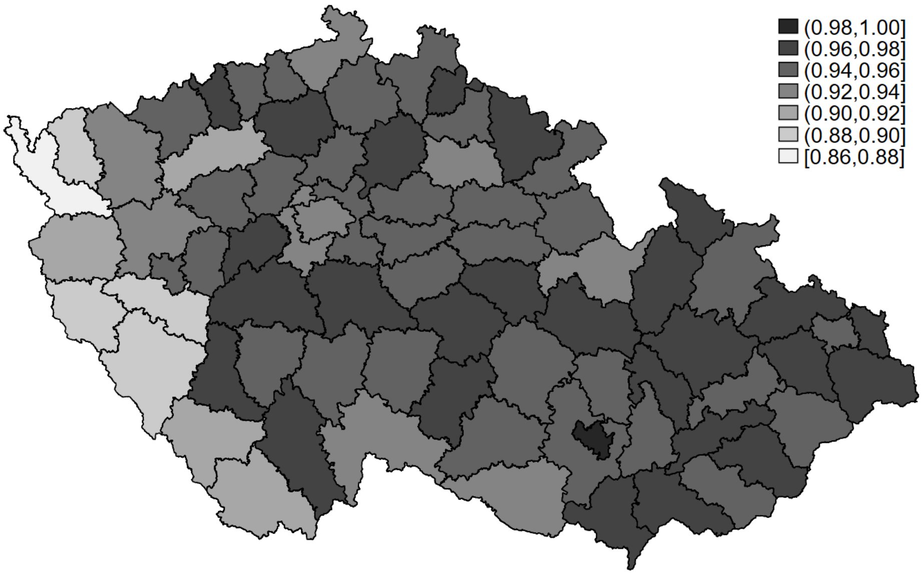
Appendices

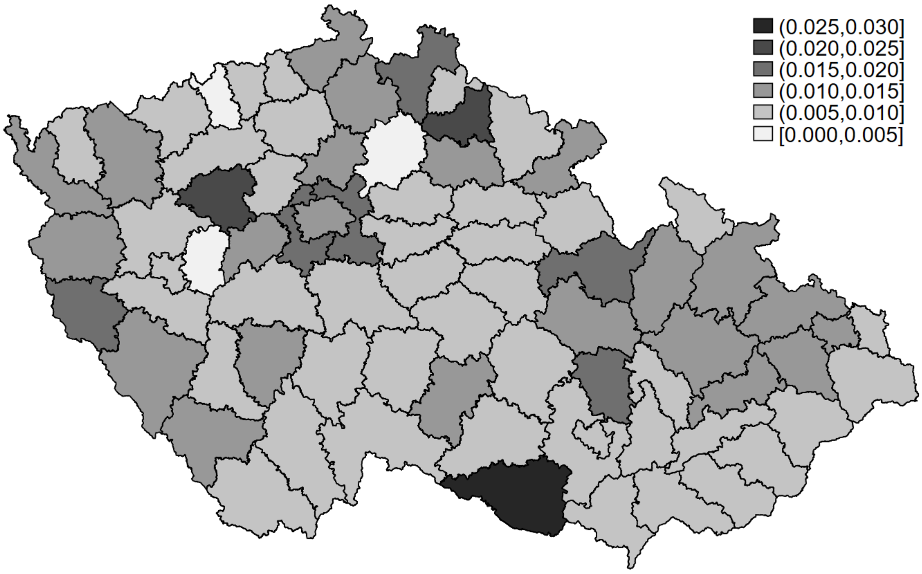
Table A.1: List of diagnoses based on the International Classification of Diseases (ICD-10) codes

ambulatory care sensitive conditions for children	
asthma	J45, J46
bacterial pneumonia	J13, J14, J15, J16, J18
cellulitis	L03, L04, L08.0, L08.8, L08.9, L88, L98.0
dehydration	E86
epilepsy	G40
gastroenteritis	K52.2, K52.8, K52.9
kidney/urinary infection	N10, N11, N12
severe ear-nose-throat infections	H66, J02, J03, J06, J31.2
vaccine-preventable conditions	A15, A35, A36, A37, A80, B05, B06, B16.1, B16.9, B18.0, B18.1, B26, G00.0
ambulatory care sensitive conditions for adults	
bacterial pneumonia	J13, J14, J15, J16, J18
congestive heart failure	I11.0, I50, J81.0
dehydration	E86
diabetes	E10, E11, E12, E13, E14
epilepsy	G40
acute conditions	
acute appendicitis	K35
intracranial injury	S06

Source: Author's compilation based on Freund et al. (2013); Jaeger et al. (2015); Purdy et al. (2009).
Notes: The vaccine-preventable conditions here consist of tuberculosis, tetanus, diphtheria, pertussis, acute poliomyelitis, measles, rubella, acute hepatitis B, chronic viral hepatitis, parotitis epidemica, and bacterial meningitis.



(a) Share of children registered with a GP for children (2019)



(b) Share of children registered with a GP for adults (2019)

Figure A.1: Share of children registered with a GP in Czechia (2019)

Source: Own creation based on data provided by ÚZIS from the NRHZS and population data published by the ČSÚ (2020).
Notes: The number of registered individuals aged 0-18 according to their district of administrative residence was divided by the number of inhabitants aged 0-18. All valid on December 31, 2019.

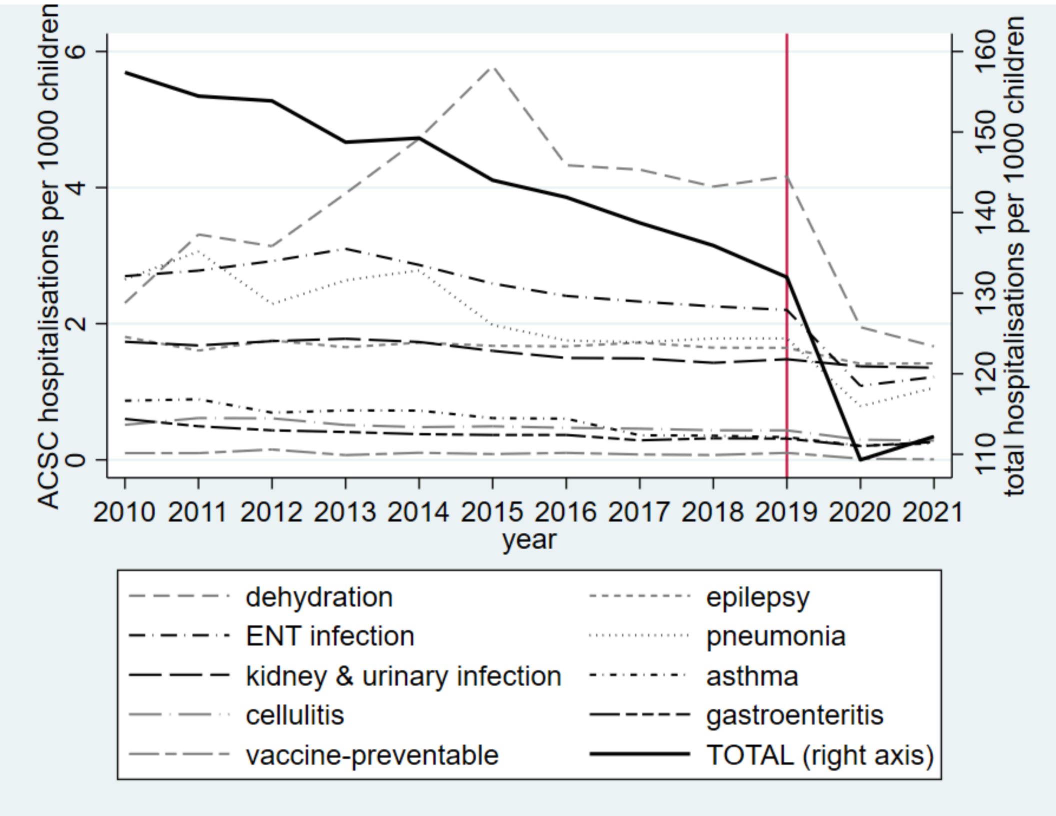


Figure A.2: Hospitalisations of children in Czechia in time

Source: Own creation based on data provided by ÚZIS from the NRHZS and population data published by the ČSÚ (2020).
Notes: Left axis: the number of hospitalisations of individuals aged 0-18 for the listed ambulatory care sensitive conditions (ACSCs) per 1,000 individuals aged 0-18, right axis: all hospitalisations of individuals aged 0-18 per 1,000 individuals aged 0-18. ENT = ear, nose, throat.

Table A.2: Summary statistics (2010-2019)

		Mean	Std. Dev.	Min	Max	$N/n/\overline{T}$
ACSC hospitalisations of children in total	overall	0.096	0.024	0.051	0.199	770
	between	.	0.019	0.062	0.154	77
	within	.	0.015	0.042	0.149	10
registered individuals per physician	overall	0.976	0.126	0.433	1.599	770
	between	.	0.092	0.761	1.184	77
	within	.	0.086	0.500	1.392	10
treated patients per physician	overall	1.060	0.296	0.312	2.784	770
	between	.	0.164	0.744	1.576	77
	within	.	0.247	0.430	2.493	10
contacts per physician	overall	5.566	0.904	2.052	12.638	770
	between	.	0.600	4.332	7.266	77
	within	.	0.679	3.006	11.571	10
preventive contacts per registered	overall	1.334	0.198	0.810	2.565	770
	between	.	0.137	1.101	1.749	77
	within	.	0.144	0.782	2.481	10
ACSC hospitalisations of adults in total	overall	0.067	0.011	0.034	0.114	770
	between	.	0.010	0.049	0.107	77
	within	.	0.006	0.046	0.093	10
children in sports clubs in all children	overall	0.187	0.051	0.044	0.375	770
	between	.	0.046	0.096	0.347	77
	within	.	0.024	0.113	0.279	10
girls in children	overall	0.487	0.003	0.477	0.498	770
	between	.	0.003	0.480	0.494	77
	within	.	0.002	0.478	0.494	10
children aged 0-3 years in all children	overall	0.221	0.015	0.192	0.288	770
	between	.	0.012	0.201	0.264	77
	within	.	0.010	0.180	0.263	10
unemployment rate	overall	5.914	2.558	1.117	13.474	770
	between	.	1.741	2.464	10.525	77
	within	.	1.883	0.508	9.668	10
divorces in adult population	overall	0.003	0.000	0.001	0.005	770
	between	.	0.000	0.002	0.004	77
	within	.	0.000	0.002	0.004	10
physicians per population	overall	3.827	1.425	1.290	10.297	770
	between	.	1.418	1.463	9.529	77
	within	.	0.204	3.048	4.772	10
hospitals per population	overall	0.023	0.018	0.000	0.162	770
	between	.	0.015	0.000	0.112	77
	within	.	0.009	-0.034	0.109	10

Source: Author's computation based on data from ÚZIS, population data from the ČSÚ, and ČSÚ (2022), ČUS (2022).

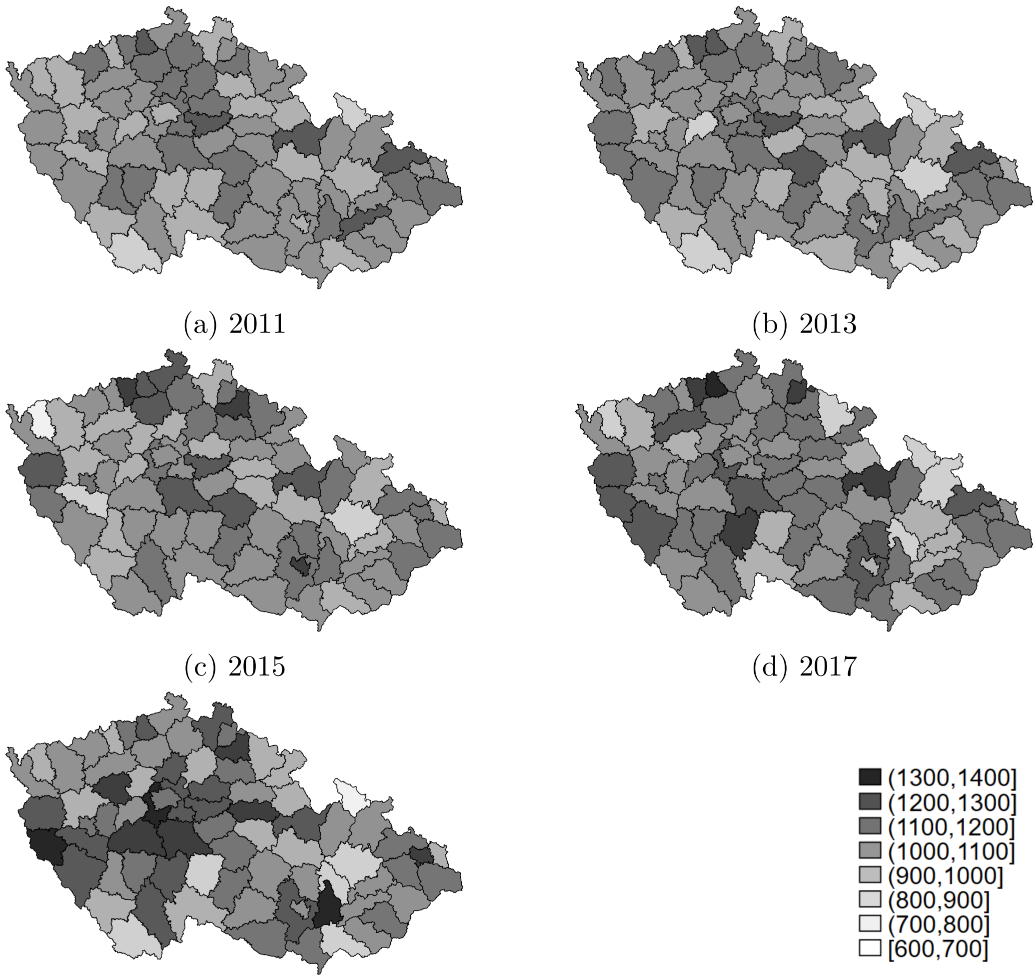


Figure A.3: Average number of registered individuals per GP for children in time

Source: Own creation based on data provided by ÚZIS from annual reports of GPs for children in solo practices.
Notes: All individuals registered with a GP for children included irrespective of their age. All valid on December 31.

Table A.3: Robustness check – hospitalisations for five ACSCs

ACSC hospitalisations of children in total	(1)	(2)	(3)
registered individuals per physician	-0.010*	.	.
	(0.005)	.	.
treated patients per physician	.	-0.001	.
	.	(0.002)	.
contacts per physician	.	.	-0.001
	.	.	(0.001)
ACSC hospitalisations of adults in total	0.566***	0.567***	0.561***
	(0.145)	(0.145)	(0.147)
children in sports clubs in all children	-0.060**	-0.060*	-0.059*
	(0.030)	(0.030)	(0.030)
girls in children	0.910**	0.901**	0.906**
	(0.444)	(0.440)	(0.443)
children aged 0-3 years in all children	-0.410***	-0.401***	-0.391***
	(0.082)	(0.088)	(0.087)
unemployment rate	0.001**	0.001**	0.001***
	(0.000)	(0.000)	(0.000)
divorces in adult population	0.447	0.530	0.534
	(1.831)	(1.821)	(1.837)
physicians per population	0.002	0.002	0.002
	(0.003)	(0.003)	(0.003)
hospitals per population	0.063	0.061	0.061
	(0.068)	(0.068)	(0.068)
constant	-0.301	-0.310	-0.313
	(0.218)	(0.215)	(0.218)
N	770	770	770

* 0.10 ** 0.05 *** 0.01

Notes: Fixed effects model with standard errors clustered over 77 districts, years 2010-2019. The dependent variable is the share of hospitalisations for dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, and kidney/urinary infection in the total number of hospitalisations of individuals aged 0-18.

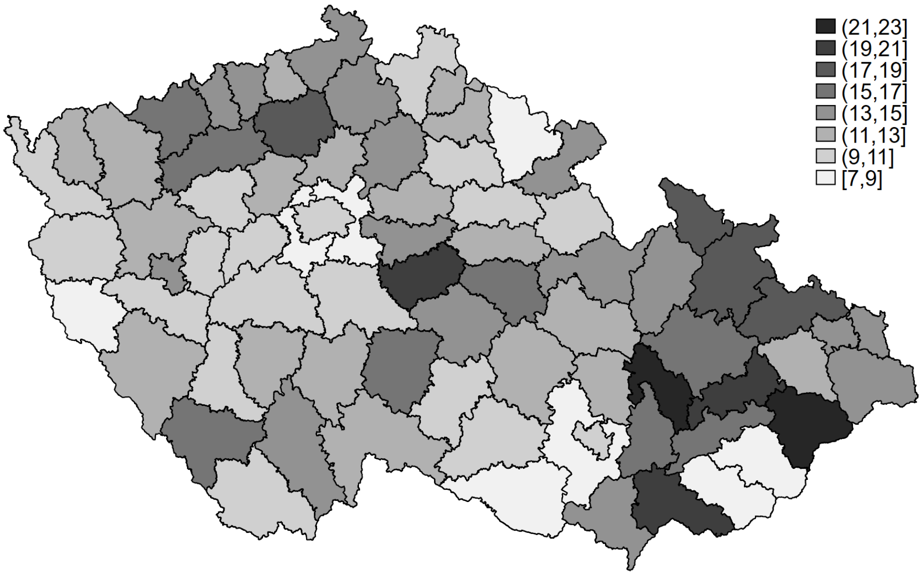


Figure A.4: Hospitalisations for ACSCs per 1,000 children (2019)

Source: Own creation based on data provided by ÚZIS from the NRHZS and population data published by the ČSÚ (2020).
Notes: The number of hospitalisations of individuals aged 0-18 for dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, kidney or urinary infection, asthma, cellulitis, gastroenteritis, and vaccine-preventable conditions per 1,000 individuals aged 0-18.

Table A.4: Robustness check – ACSC hospitalisations per child

ACSC hospitalisations of children per child	(1)	(2)
registered individuals per physician	-0.001	-0.001
	(0.001)	(0.001)
total hospitalisations of children per child	.	0.023
	.	(0.023)
ACSC hospitalisations of adults per adult	0.465***	0.447***
	(0.123)	(0.128)
children in sports clubs in all children	-0.007	-0.007
	(0.005)	(0.005)
girls in children	0.143**	0.145**
	(0.065)	(0.065)
children aged 0-3 years in all children	-0.011	-0.023
	(0.013)	(0.016)
unemployment rate	0.000***	0.000***
	(0.000)	(0.000)
divorces in adult population	0.092	0.112
	(0.258)	(0.259)
physicians per population	0.000	0.000
	(0.001)	(0.001)
hospitals per population	0.010	0.010
	(0.012)	(0.011)
constant	-0.061*	-0.062*
	(0.032)	(0.032)
N	770	770

* 0.10 ** 0.05 *** 0.01

Notes: Fixed effects model with standard errors clustered over 77 districts, years 2010-2019. The dependent variable is the share of hospitalisations for dehydration, epilepsy, severe ear-nose-throat infections, bacterial pneumonia, and kidney/urinary infection, asthma, cellulitis, gastroenteritis, vaccine-preventable conditions per individual aged 0-18.

Table A.5: Robustness check – non-avoidable hospitalisations

non-avoidable hospitalisations of children in total	(1)	(2)	(3)
registered individuals per physician	0.001	.	.
	(0.002)	.	.
treated patients per physician	.	-0.000	.
	.	(0.001)	.
contacts per physician	.	.	0.000
	.	.	(0.000)
non-avoidable hospitalisations of adults in total	0.304***	0.304***	0.306***
	(0.103)	(0.103)	(0.100)
children in sports clubs in all children	0.007	0.006	0.007
	(0.011)	(0.011)	(0.011)
girls in children	-0.031	-0.032	-0.030
	(0.120)	(0.123)	(0.120)
children aged 0-3 years in all children	-0.045	-0.048	-0.048
	(0.032)	(0.033)	(0.033)
unemployment rate	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
divorces in adult population	0.627	0.617	0.618
	(0.529)	(0.527)	(0.528)
physicians per population	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
hospitals per population	0.035*	0.036*	0.035*
	(0.019)	(0.019)	(0.019)
constant	0.052	0.055	0.053
	(0.060)	(0.062)	(0.060)
N	770	770	770

* 0.10 ** 0.05 *** 0.01

Notes: Fixed effects model with standard errors clustered over 77 districts, years 2010-2019. The dependent variable is the share of hospitalisations for intracranial injuries and appendicitis in the total number of hospitalisations of individuals aged 0-18. Similarly for the population aged 19+.

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