

Accessibility of kindergartens and identification of childcare deserts in urban environment: A case study from Bratislava, Slovakia

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Abstract

Access to early childhood education is a key component of educational justice, especially in cities undergoing rapid socio-spatial transformation. This paper investigates the spatial accessibility of kindergartens in Bratislava, Slovakia, and introduces a methodology for identifying “childcare deserts”- urban areas with inadequate access to preschool education. Using the balanced two-step floating catchment area (B2SFCA) method on a 100x100 m grid and walking as the primary transport mode, we model kindergarten accessibility concerning local demographic and housing market data. Results show that nearly a quarter of preschool-aged children reside in areas with poor accessibility despite sufficient citywide capacity. A substantial subset of these children lives in socio-economically disadvantaged neighbourhoods, qualifying as “real” childcare deserts. The findings highlight spatial injustice in the distribution of educational infrastructure and offer a replicable approach to identifying vulnerable areas. This study contributes to theoretical and policy debates on education and spatial justice in urban contexts, where historical legacies and current demographic pressures intersect. Policy implications include the need for spatially targeted interventions, planning reforms, and better integration of social equity into education infrastructure provision.

Key words:

*childcare deserts,
kindergartens, B2SFCA,
spatiotemporal analysis,
geography
of education, Slovakia*

1 INTRODUCTION

Providing (pre)primary education services is essential for the upbringing of children and an important part of supporting parents' employment. Moreover, in many countries (Slovakia being one example), pre-primary education is compulsory for children from the age of five. However, the situation is unfair, as the distribution of kindergartens tends to be concentrated. That creates areas with poor access to (pre)school facilities and limits children (and their parents) in their daily commutes to compulsory education. Therefore, ensuring the accessibility of kindergartens should be a priority for planners and local authorities.

Childcare supply differs by geography (Blumenberg et al., 2023), eventually leading to childcare oases and, on the other hand, childcare deserts. Childcare is an essential service, and its provision improves quality of life. Early childhood education and care distinguish between (child)care in facilities for children under 3 years of age (in Slovakia, these are usually nurseries) or in facilities for children aged 3 to 6 years, which kindergartens in Slovakia mainly provide. The subject of this analysis is the second case, i.e., the analysis of the spatial distribution and (in)accessibility of kindergartens. A childcare desert is a geographical location with insufficient (transport) accessibility to preschool childcare facilities. This

approach is based on the broader concept of transit (access) deserts (Guo & Brakewood, 2024), including food, healthcare, and education deserts. Research on education deserts (Hillman, 2016) highlights that insufficient access to schooling is not only a logistical problem but also reproduces socio-economic disadvantage, particularly in rural or marginalised regions. Similarly, Alexander and Massaro (2020) show how school closures and uneven distribution of educational facilities create “school deserts” that exacerbate segregation and disadvantage urban populations. Guo and Brakewood (2024) found a relationship between the different types of access deserts; this means that households occupying areas with reduced access to childcare are likely to have limited access to other essential services (healthcare, food, or schools). However, an important factor (context) of the research is the fact that Guo and Brakewood (2024) studied an area strongly linked to car use (Nashville, Tennessee). In this sense, this study differs mainly in the transport modes used for commuting to kindergarten in Slovakia (Križan et al., 2025). In addition, the urban development and historical contexts of the studied area are also different. Bratislava, a subject of this research, is the capital of Slovakia, which operated a centrally planned socialist economy in the second half of the

20th century. Today, we can say that Bratislava has largely gone through a phase of post-socialist transition. Despite the current city government's declared efforts, it is still largely a monocentric city. Nevertheless, compared to Nashville, it has a high-quality (albeit still relatively sparse) transport network and relatively well-functioning public transport, which reduces the need for individual car transport (Mazúr et al., 2022).

The accessibility of affordable, high-quality early childcare and education programming is critical to parents' labour force participation and promoting children's educational and other outcomes (Pelletier et al., 2025). At the same time, according to Guo and Brakewood (2024), the higher inaccessibility of essential social services is associated with locations inhabited to a greater extent by populations affected by poverty or social exclusion. In addition, these population groups are more often dependent on cheaper transport modes (walking, public transport) due to their lower income, which is slower and less flexible. In Slovakia, the most vulnerable groups include marginalised Roma concentrations, older people (Voľanská et al., 2021), people with lower levels of education (Rajčáková & Švecová, 2018) or income levels (Míchálek, 2023), as well as single mothers (Rišová, 2025). In general, these are people with lower incomes, and therefore, we associate their spatial distribution with locations with lower housing prices (Šveda & Výboštok, 2020).

This article aims to identify childcare deserts in the urban environment. Specific objectives in a narrow context include analysing the accessibility of kindergartens for different social strata and a geospatial analysis of intra-urban economic inequalities in the context of kindergarten accessibility. In a broader context, the aim is to propose a methodology for identifying and delimiting childcare deserts at the intra-urban level and to discuss the geographical approach to such research. In this context, the aim is to find answers to the following research questions:

- RQ1: What spatial patterns does the accessibility of kindergartens create at the intra-urban level?
- RQ2: Do areas with below-median socio-economic conditions generate childcare deserts?
- RQ3: How many children live in childcare deserts in Bratislava?

2 THEORETICAL BACKGROUND

Childcare deserts

Education plays a vital role in the reproduction of cultural and economic capital. Differential access to education and geographical variations in educational attainment have thus been important themes (Holloway et al., 2010, p. 587). As Butler and Hamnett (2007) noted, education is at or near the heart of policies for fostering greater social integration, social mobility and national competitiveness and reducing social exclusion. Recently, a growing institutionalisation of geographic research into education has been observed (Kučerová et al., 2020). Current research topics also include research on childcare deserts. In recent decades, the concept of 'geographical deserts' has developed in socio-economic research to address many societal problems. Examples include food deserts (Wrigley, 2002; Shaw, 2006), transport deserts (Aman & Smith-Colin, 2020; Hornák et al., 2023), pharmacy deserts (Wisseh et al., 2021; Ying et al., 2022), healthcare deserts (Statz & Evers, 2020; Rosik et al., 2021) and education deserts¹ (Alexander & Massaro, 2020; Young et al., 2020). Spatial

accessibility is key in all deserts, often called "access deserts". Access deserts are a powerful lens to consider a community's spatial justice regarding access to needed services (Alexander & Massaro, 2020, p. 791). While groceries and healthcare are generally crucial in people's lives, education and childcare services receive relatively little attention in the literature (Guo & Brakewood, 2024). One of the crucial services in a developed society is providing education. In creating a just society, it is essential to consider the spatial justice of (pre-primary) educational facilities. It should be noted that education is a mandatory part of the daily routine. With a few exceptions, it is not a matter of choice, but an obligation to attend school regardless of its accessibility or the socio-economic characteristics of the children (parents). Ultimately, parents often face difficulties in securing compulsory pre-school childcare for their children (Prusinski et al., 2023), potentially leading to alternative employment (e.g., part-time work) or increased financial costs for their care (e.g., purchasing and operating a car).

Previous research on accessibility has focused on family child care decisions, utilisation, enrollment, and how early childcare and education selections intersect with household demographic characteristics and parental preferences (Stephens et al., 2024). In addition, living in a childcare desert is connected with negative effects on mental health. Research in Canada (Young et al., 2020) has shown increased psychological distress among fathers living in childcare deserts who also spent a substantial amount of time at work. In the context of changing gender roles in households concerning childcare, this is a consequence of the combination of higher demands on fathers to spend time with their children and the inaccessibility of kindergartens. Conversely, the accessibility of a high-quality early childhood education and care network, among other things, supports community life, increases opportunities for parents to participate in working life, and has a positive impact on children's cognitive abilities and social-emotional skills (Sipple et al., 2020; Prusinski et al., 2023). The spatial imagery of school deserts makes it easier to understand which communities benefit from vibrant schools and which do not, and to grasp the entrenched history of residential segregation and the link between property values and school quality (Alexander & Massaro, 2020, p. 798).

Research in New York (Sipple et al., 2020) suggests that when it comes to the accessibility of childcare for children under the age of three, there are not only spatial differences but also differences in demographic factors. Non-urban (rural and suburban) and high-poverty-level communities have less capacity for infants and toddlers. Similar patterns have already been outlined in research on Slovak regions, with low-income and rural regions in particular seeing a decline in the number and capacity of kindergartens over the last 30 years (Švecová & Tolmáči, 2025). Conversely, suburbs of larger cities have seen an increase in capacity, which has significantly improved their accessibility.

Measuring the accessibility of public service facilities: background

Accessibility represents a fundamental concept in spatial sciences, with a long-standing historical trajectory and wide-ranging applications (Ingram, 1971; Handy & Niemeier, 1997; Geurs & van Wee, 2004; El-Geneidy & Levinson, 2007). Its theoretical foundation closely aligns with Tobler's (1970) First Law of Geography. The scholarly literature offers a broad spectrum of methodological approaches for

measuring access to public (social) services, including healthcare facilities (e.g., Luo & Wang, 2003; Páez et al., 2019), food retail outlets (Bilková et al., 2017b), public transport stops (Daniels & Mulley, 2013; Vecchio et al., 2022), and educational institutions (Martínez-Jiménez & Salinas-Pérez, 2019; Krížan et al., 2021; Hu et al., 2024). These methods range from simple distance-based measures and gravity models to more advanced techniques such as floating catchment area models and utility-based approaches.

Distance-based and gravity models augmented by demand-side variables (i.e., population size) offer the advantage of minimal data requirements, as they do not rely on detailed information about service supply (i.e., provider capacity) or more complex behavioural data (e.g., actual flow volumes, commuting trajectories, or target population characteristics). However, these simpler models often produce results that lack robustness and analytical precision. In contrast, more comprehensive datasets are increasingly available, including information on service capacities (regardless of their quality), travel flows (e.g., number of doctor visits, residential addresses of children attending schools or preschools), and relevant demographic variables. This growing data availability enables the use of more refined and empirically grounded accessibility measures.

3 STUDY AREA CONTEXT

Bratislava is the capital of Slovakia, inhabited by 479,000 people (as of 31 Dec 2024). In 2023, 211 operating kindergartens were unevenly distributed across the city (Fig. 1) and attended by 18,738 children. According to data from the most recent population census (SO SR, 2023), 20,963 preschool children lived in Bratislava in 2021.

The socio-demographic structure of Bratislava is extremely complex and diverse, reflecting the city's urban morphology (Šveda & Boris, 2021).

The economic structure of Bratislava differs significantly from that of Slovakia. In 2023, the average monthly wage for employees in Slovakia was €1,637, while in Bratislava it was €2,162, i.e. 32% higher (SO SR, 2025). However, it should be noted that the cost of living in the capital is higher than the Slovak average, mainly due to higher housing prices (Šveda et al., 2021). In the case of housing prices (real estate prices), the differences are even more pronounced. In 2024, Slovakia's median residential real estate price was €2,019 per square metre (United Classifieds, 2025). In Bratislava, prices were almost 70% higher (€3,396/sq m) during the same period.

The median equivalised monthly household income according to the EU-SILC methodology reached €1,544 in Bratislava in 2021, i.e., 11.5% more than the Slovak average (€1,385). This figure includes the tax and social security burden on households, other household income and housing expenditures. Applying the EU-SILC poverty threshold methodology (60% of median equivalised income), the monthly poverty threshold (for all households) is €831. In Slovakia, the at-risk-of-poverty rate reached 17.6% in 2021, while in Bratislava it was 12.6%. However, these figures do not take into account the size of the household. As the size of the household increases, so do its monthly costs. While it also increases incomes, this is only partially the case for economically inactive household members. For households with children aged 3–6, the poverty threshold shifts to €934.

Regarding household structure, Bratislava households with at least one child aged 3–6 are

relatively well off economically. Only 4.1% of these households were at risk of poverty in 2021 (SO SR, 2024); this is eight percentage points less than the national average (12.1%) for households with pre-school age children. The difference is even greater compared to other households in Bratislava (13.8%) and the rest of Slovakia (17.9%).

4 DATA AND METHODS

Kindergartens and schoolchildren

In this study, the spatial accessibility of childcare facilities (for children aged 3–6) in Slovakia is examined (Fig. 1). Using selected statistical and geostatistical techniques, we analyse the spatial accessibility of kindergartens at the intra-urban level and identify childcare deserts using selected demographic and socio-economic indicators.

The analysis is based on kindergarten capacity data and the number of preschool-age children. Kindergarten capacity (CVTI, 2023) is determined for each school year by decision of the regional public health authority (in this case, the 2023/2024 school year data are used). The list of kindergartens is derived from the schools and educational facilities register and does not include any unregistered childcare facilities, which compensate for the lack of capacity in areas with increased demand (Sládeková Madajová et al., 2021). The number of children of preschool age is based on census data (SO SR, 2023) and represents the number of all children born between 1 Sep. 2014 and 31 Aug. 2017, i.e. those who could have started kindergarten in the 2020/2021 school year. This approach has been chosen due to the unavailability of up-to-date age-structure data in monthly granularity.

Accessibility measurement

Current research into the accessibility of social services facilities uses a wide range of methodological

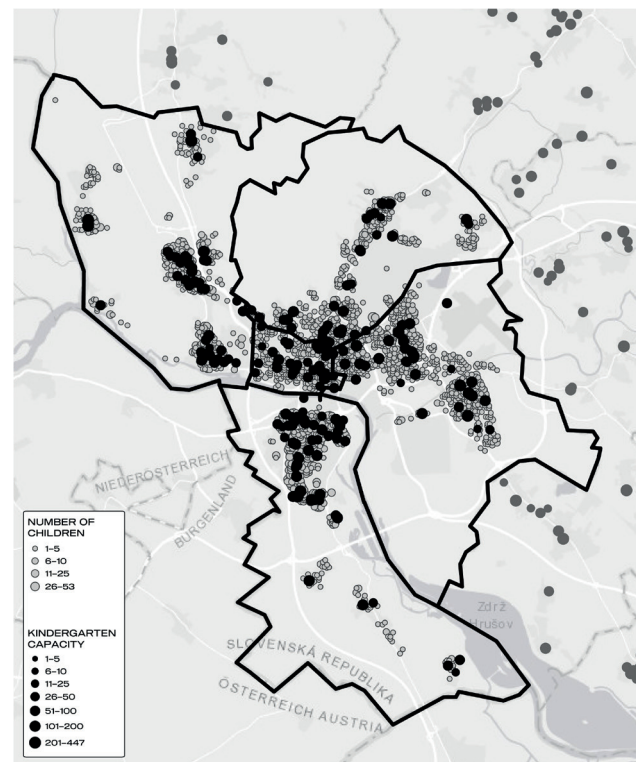


Fig. 1. Spatial distribution of kindergarten capacities and potential demand across Bratislava

Data source: CVTI (2023), SO SR (2023), authors' elaboration

approaches, including floating catchment area (FCA) methods. One of the first such methods was the Two-Step Floating Catchment Area (2SFCA) method (Luo & Wang, 2023). Unlike simple interaction models, FCA methods take into account not only distance (or temporal accessibility) but also the supply of selected services (kindergarten capacity) and demand (in this case, the number of children aged 3–6). The calculation of individual FCA methods thus applies the provider-to-population ratio (PPR) indicator, which compares the aforementioned demand and supply variables. Another option for analysing the accessibility of kindergartens is to use a utility-based method using multinomial logistic regression (MNL). Demitry et al. (2022) compared selected FCA and MNL methods. The results indicate relatively small differences in the final results. The disadvantage of the MNL method proposed by the authors is the excessive emphasis on detailed (and often sensitive) data. On the other hand, the advantage of the FCA approach is its simplicity and, ultimately, the relatively high quality of the results achieved.

In this research, the B2SFCA (Balanced Two-Step Floating Catchment Area; see Páez et al., 2019) method was used to measure the accessibility of kindergartens for individual cells in a 100x100 metre GRID. The chosen method is suitable for analysing a single transport mode (in this case, walking), as shown by the results of Benhlila et al. (2024), who investigated the accessibility of hospitals using multiple transport modes. Several models from the FCA family have also been applied in research on kindergartens' accessibility (Azuma et al., 2023; DeBaryshe et al., 2024; Pennerstorfer & Pennerstorfer, 2021), which is the main argument for the chosen approach. In addition, while the simplest 2SFCA method divides the catchment area dichotomously into accessible and inaccessible, B2SFCA's distance between supply and demand is weighted using a distance decay function (Delamater, 2013). The distance from the centres (centroids) of individual spatial units (cells in a 100x100 metre GRID) to kindergartens was weighted using an exponential distance decay function (1):

$$y = e^{-\beta x}; \beta = 0.0025 \quad (1)$$

The distance threshold beyond which the model considers a kindergarten to be completely inaccessible is 800 metres, which we consider to be the walking equivalent of a 20-minute commute with a preschool-aged child (this value is based on a representative survey; only 2.9% of parents in cities with more than 50,000 inhabitants reported walking to kindergarten for more than 20 minutes). The distance matrix of individual combinations of GRID centroids (origins) and kindergartens (destinations) was calculated using the Open Source Routing Machine (OSRM) tool, and the profile was "auto".

In the first step of B2SFCA, the row-standardised weights using formula (2) are calculated. By substituting into the formula (3), the provider-to-population ratio for each school j is calculated. The same procedure can also be found in the 3SFCA method (cf. Delamater et al., 2019).

$$W_{ij}^i = \frac{W_{ij}}{\sum_j W_{ij}} \quad (2)$$

$$R_j = \frac{S_j}{\sum_i P_i W_{ij}^i} \quad (3)$$

In the second step, the resulting accessibility value is weighted for each territorial unit (GRID cell) i once

again (5), however, this time using col-standardised weights, which are calculated using formula (4). Unlike 3SFCA, this value is weighted only once. That prevents the minimisation of the distance effect in the calculation.

$$W_{ij}^i = \frac{W_{ij}}{\sum_i W_{ij}} \quad (4)$$

$$A_i = \sum_j R_j W_{ij}^i \quad (5)$$

Socio-economic situation

The delimitation of geographical deserts as spatial units depends on measuring the accessibility of the facilities under investigation. However, their identification as a social problem depends on the characteristics of these spatial units. That is, due to the function of the socio-economic indicators of the inhabitants living in the given territories. If only the accessibility of the facility under investigation is taken into account, Bilková et al. (2017a) suggest discussing "potential deserts"; if socio-economic (or demographic and other) factors are taken into account, they suggest discussing "real deserts". Such an approach is applied in this study to identify childcare deserts in Bratislava.

Data on real estate prices are used to assess the socioeconomic status of people living in potential deserts. This approach is applied partly because of the data availability and its spatial granularity at the address point level, and partly because it is a suitable, albeit indirect, indicator of the socio-economic situation. It is important to recognise the limitations of this approach, as the value of real estate itself is not directly dependent on the socio-economic (income) situation of households. Premium locations in Bratislava are predominantly occupied by highly educated and well-earning populations (see Ondoš & Korec, 2006; Rochovská et al., 2013; Malý et al., 2020). However, income distribution in Bratislava's Old Town (SIA SR, 2019), a city district with the highest average income, is quite heterogeneous, highlighting intra-urban income inequalities. However, it is hypothesised that it mostly applies to the autochthonous population, whose demographic structure may differ significantly from households with preschool-aged children. It is assumed that a large proportion of families with children aged 3–6 are allochthonous and therefore had to find and finance the dwellings in the given location on their own, and did so in the recent past (roughly in the last 10 years). The exceptions are mainly heirs and families living in multi-generational houses. In addition, different migration periods may also be reflected in changes in real estate prices in some locations. Still, it is believed that over the last 10 years, the urban-morphological structure of Bratislava has not changed to such an extent that it would have a significant impact on geospatial differences in housing prices.

The real estate price data used comes from the trhovereporty.sk database (United Classifieds, 2025) and represents asking prices. Only data with accurate geographical information (address point) is used for this analysis. These data were then assigned to 100x100 metre GRID cells. The time frame of housing price data is relatively vast (Jan 1, 2020, until Dec 31, 2024) to capture the highest possible number of GRID cells with at least one child of preschool age. After cleaning the data of duplicate and outlying advertisements, and of unrealistic GRID cells using address point data (MVS SR, 2025), the data covered the

territory inhabited by 16,100 children (76.8%) living in Bratislava during the last census (SO SR, 2023). For time harmonisation, prices were indexed according to the monthly inflation rate in the housing category (SO SR, 2025). The resulting value for each GRID cell is the median of the prices from the advertisements.

Identification and visualisation of childcare deserts

A two-step approach was applied to identify and delimit childcare deserts. The first step was to measure the accessibility of the nearest facility (cf. Bilková et al., 2017b), in this case, a kindergarten. Areas more than 10 minutes walking distance to the nearest kindergarten (or 400 m, see Abulibdeh et al., 2024) were considered “potential” childcare deserts. Considering the capacity of kindergartens, they were classified into two types. Type A represents potential childcare deserts where no kindergarten is available within a defined distance. These are areas where no kindergarten is accessible to any child. Type B represents potential childcare deserts where there is a kindergarten, but it does not have the capacity for all children in the area (buffer 400 m). These are areas where a kindergarten is only available to some children. The literature sets the capacity limit at less than 0.333 places per child (Hurley et al., 2022).

The second step was to analyse the below-average socio-economic data (Q1 and Q2 in property prices). Based on this, “real” childcare deserts were identified, i.e., areas with poor access to kindergartens and an unfavourable socioeconomic situation. Eventually, real childcare deserts were classified into two subtypes. The “mild” one is based on “softer” criteria of the socioeconomic situation. This subtype also includes areas where real estate prices fall into Q1 and Q2. The second, stricter, subtype, also labelled “hard”, only includes areas with the cheapest housing prices (Q1), and, therefore, it is more likely to be inhabited by less affluent residents.

Next, the results were cartographically visualised using R (tmap library). Identified potential and real childcare deserts are qualitatively (by colour) distinguished from areas with accessible kindergartens, also known as childcare oases (Hurley et al., 2022).

5 RESULTS

Association between kindergarten accessibility and housing prices

The analysis results confirm spatial heterogeneity in the kindergartens’ accessibility on the one hand (Fig. 2a), and a different spatial pattern of housing prices on the other (Fig. 2b). The results indicate a relatively unfavourable situation for Bratislava, regardless of socio-economic conditions (Tab. 1). The largest group (quartile) consists of locations with the least favourable kindergartens accessibility (35.2% of locations), which are also inhabited by the largest number of children (30.7%). In the case of areas with lower property prices, in terms of the child population, locations with more favourable access

to kindergartens predominate (648 out of 1,202 locations), in which 4,910 children live (i.e., 58.5% of children living in areas with lower housing prices); this can generally be considered a positive finding. It means that the network of kindergartens responds relatively well to the demand for kindergartens for the population in the lower strata of social stratification. However, for 2,049 children living in areas with lower property prices, the accessibility of kindergartens is less favourable. This group of children is potentially most at risk from limited access to pre-primary education.

The opposite trend is evident in areas with the highest property prices (Q3 and Q4). A higher proportion of children live in areas with poor access to kindergartens; this suggests that proximity to kindergartens is neither a priority nor an obstacle for these locations. Parents in these locations can likely compensate for poor access to kindergartens with more mobile transport modes (mainly cars).

The lower concentration of the child population in the highest quartile of accessibility may be linked, on the one hand, to an increase in capacity in some locations to meet the needs of children of commuting parents. Still, on the other hand, it indicates capacity limits in some densely populated locations in moderately accessible locations (Q2 and Q3), where the situation is reversed. The concentration of the child population is significantly higher.

Subsequent statistical tests confirmed significant differences in accessibility across property price quartiles (Kruskal-Wallis chi-squared = 11.262, df = 3, p-value = .010; ANOVA F(3, 2393) = 4.384, p = 0.004). Pairwise comparisons using the Wilcoxon rank sum test with continuity correction (with p-value adjustment) show statistically significant differences in kindergarten accessibility between areas with below-average (Q2) and above-average property prices (Q3) at a 99% confidence level. However, there are no statistically significant differences (at 95% confidence) in accessibility between housing price categories (Tab. 2). That follows the assumption of the existing heterogeneous socio-economic structure of Bratislava in terms of spatial distribution.

Tab. 2. Post-hoc Wilcoxon rank sum test results (p-values adjusted by Holm-Bonferroni method)

	Q2	Q3	Q4
Q1	.090	.299	.958
Q2		.005	.102
Q3			.299

Data source: authors’ elaboration

Childcare deserts and oases

To identify childcare deserts, the results of an analysis of kindergarten accessibility were used; it creates a typical spatial pattern (Fig. 3a). A total of 4,119 children live in potential childcare deserts (type A), representing 19.6% of the 20,963 children in Bratislava. Another 744 children live in potential childcare deserts (type B). Potential childcare

Tab. 1. Association between kindergarten accessibility (using B2SFCA) and housing prices

		Q1		Q2		Q3		Q4	
		cells	kids	cells	kids	cells	kids	cells	kids
Property price quartile	Q1	204	1,066	80	594	201	1,584	117	730
	Q2	171	983	99	838	164	1,35	166	1,246
	Q3	236	1,542	88	671	132	957	141	999
	Q4	233	1,345	88	671	102	643	175	869

Data source: CVTI (2023), SO SR (2023), authors’ elaboration

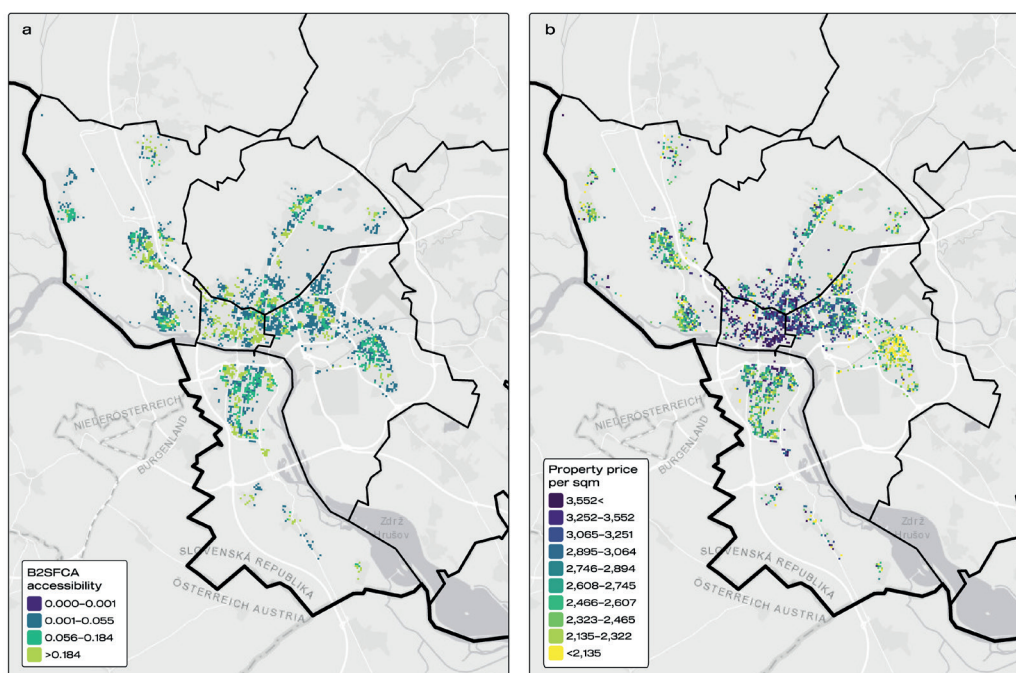


Fig. 2. Intra-urban differences in the availability of kindergartens identified by the B2SFCA method (a) and property prices in 2020–2024 (b) in the 100x100 metres GRID in Bratislava
Data source: United Classifieds (2025), CVTI (2023), authors' elaboration

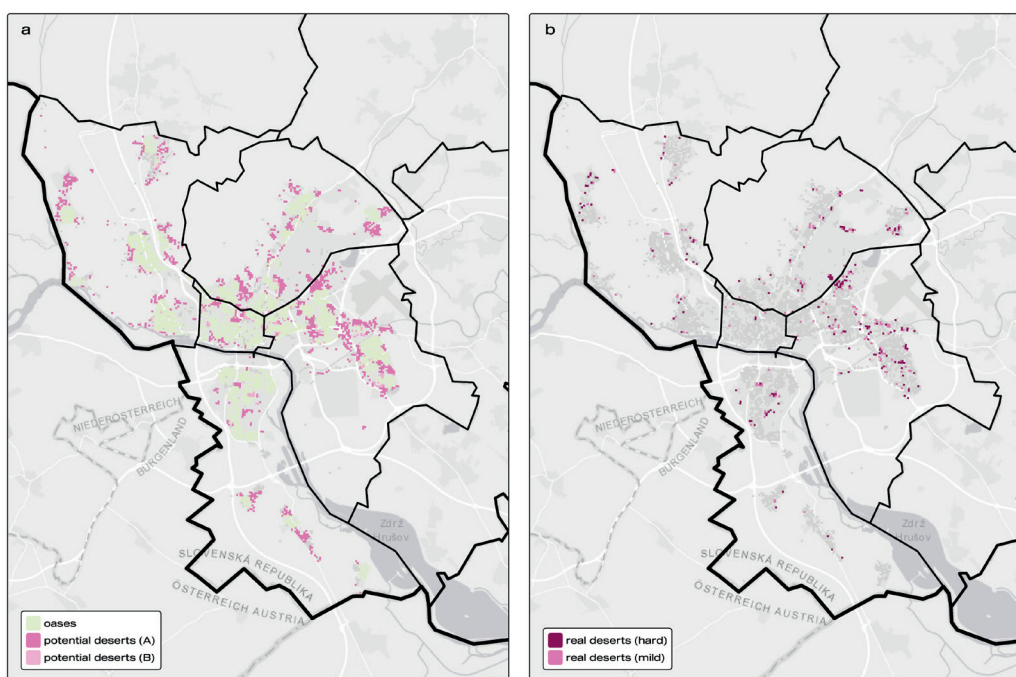


Fig. 3. Potential (a) and real (b) childcare deserts in Bratislava
Data source: CVTI (2023), SO SR (2023), United Classifieds (2025), authors' elaboration.

deserts are home to almost a quarter (23.2%) or 4,863 children in Bratislava. Looking at Figure 3a, contrasting spatial patterns emerge. Kindergartens are concentrated mainly in more densely populated areas, with their number decreasing in the outlying areas of individual city districts; this is most evident in city districts with visible signs of suburbanisation processes (e.g., Záhorská Bystrica, Vajnory, Jarovce, Rusovce). At the same time, potential childcare deserts are also concentrated in areas where newer developments predominate. To a certain extent, however, this confirms the assumption that the network of kindergartens does

not adequately reflect the increased demand in some areas.

Considering socio-economic indicators based on housing prices, areas where residents (children) have less access to facilities and are also socio-economically disadvantaged were identified. These areas are referred to as “real” childcare deserts, and, in Bratislava, they are concentrated not only in the city's peripheral zones. A total of 1,612 (7.7%) children live in these areas. Seven hundred ninety-two children live in the “hard” subtype, i.e., in areas with the least favourable socio-economic situation or housing prices (Fig. 3b).

6 DISCUSSION

Access to preschool institutions is limited for various reasons, including geography and kindergarten distribution (Köse et al., 2021). As Alexander and Massaro (2020, p. 792) note, identifying access deserts geographically does not equate to simple solutions. The solutions will be complex and multifaceted, but mapping and analysing geographic access to good schools offers a starting point to consider spatial justice in educational policy. Several studies have shown how childcare provision varies across communities depending on community characteristics (Davis et al., 2019). The accessibility of preschool facilities can be particularly important for low-income families, as the associated costs are linked to complex commuting. Spatial variability in preschool education and care can affect parents' economic opportunities (Pelletier et al., 2025).

The relationship between supply and demand for preschool education using the capacity of kindergartens was analysed. The capacity of kindergartens does not necessarily correspond to the spatial distribution of preschool-age children, as exemplified by Bratislava; this is why the term "potential childcare deserts" is proposed in connection with the limited accessibility of kindergartens and their limited capacity. This research showed a heterogeneous spatial distribution of kindergartens in the city of Bratislava and heterogeneous patterns of their accessibility (RQ1). In general, the supply of preschool facilities is intertwined with demand. Even though the capacity of Bratislava's kindergartens exceeds their actual occupancy, locations with limited accessibility to kindergartens have been identified within the city. A similar pattern of the least accessible preschool facilities concentrated in the outskirts of cities, peripheries, and areas with rapid population growth without an adequate infrastructure response is also characteristic of other cities (Hurley et al., 2022; Hu et al., 2024). Inner-city locations are often better covered by services, including educational facilities, giving the local population a better chance of a place in a kindergarten compared to remote areas. At the intra-urban level, this also applies to newly urbanised areas, often in spatially separated territories, without sufficient connection to urban infrastructure. Analyses show that spatial patterns can also be influenced by regional specifics such as population density, development characteristics and volume, and transport mode (Hurley et al., 2022). For almost a quarter of children in Bratislava, there is no kindergarten within 400 meters or a 10-minute walk. This distance is considered to be critical in defining childcare deserts.

Taking into account the unfavourable combination of limited spatial accessibility and the socioeconomic situation of parents, real childcare deserts have been identified. Previous research indicates that childcare deserts often arise in less developed, marginalised, and socioeconomically disadvantaged areas (RQ2). In addition to unfavourable accessibility, these are often areas with limited kindergarten capacity (Hurley et al., 2022). Areas with a high concentration of lower socioeconomic groups suffer from a lack of capacities, lower-quality facilities, and a lower likelihood of children entering preschool education (Hermes et al., 2025). These findings are in line with the study by Pelletier et al. (2025), according to which disadvantaged communities have poorer access to preschool education programs or services. While it is not true that areas with below-average socioeconomic conditions automatically generate childcare deserts, they do create an essential prerequisite for their emergence.

These research results indicate a problem with preschool attendance for a quarter of children in Bratislava (RQ3). International studies show that in similar metropolitan areas, 25–45% of urban children of preschool age may live in childcare deserts, with even higher rates in areas with a high proportion of low-income households (Hurley et al., 2022). The capital of Slovakia also mirrors the structure of cities with a high proportion of children living in childcare deserts.

Childcare deserts are not only a problem in selected cities currently undergoing or having undergone long-term transformation of services (e.g., Bratislava), but they are an integral part of urban space regardless of urban planning tradition. An example of this is the experience of New York, where more than half of New Yorkers live in childcare deserts (Malik, 2017). Similar values are also characteristic of rural or suburban regions (Griffin, 2022). In a global context, Rodriguez-Segura and Kim (2021) demonstrate how education deserts manifest in developing countries through a lack of basic school infrastructure, illustrating that education deserts are a universal issue transcending income levels and geographies. This international evidence strengthens the argument that childcare deserts should be analysed not only as local planning issues but as part of a broader framework of spatial justice in education.

Possible solutions to the issue of childcare deserts are often time-consuming and financially demanding. The problematic remains to be the changing demographic situation on the one hand and the building of preschool capacities on the other (Sládeková Madajová et al., 2021), i.e., addressing the relationship between supply and demand. One solution could be a more effective management of catchment areas (Griffin, 2022), the introduction of various support mechanisms for parents (Prentice & White, 2019), e.g. in the form of vouchers (Gallagher, 2022) or the provision of childcare at the workplace and employer support (Friedman, 2001), etc. Although the demographic demand for preschool care is predictable, local authorities cannot always respond dynamically to these challenges, for example, by building new facilities. Since the construction of kindergartens is a lengthy and costly process, a partial solution, typical for rural regions, is the construction of container kindergartens, which compensate for the temporary increased demand for pre-primary education. Another solution is external funding for building increased kindergarten capacity using EU sources. However, such a solution is not always appropriate in Slovakia (Švecová & Križan, 2023); this is why solving the problem of childcare deserts requires systemic steps not only at the level of local authorities but also at the level of education policy makers.

Experience from abroad suggests that locations identified as childcare deserts show a high spatial correlation with other access deserts, specifically food and healthcare deserts. At the same time, they have a lower correlation with park deserts (Guo & Brakewood, 2024). Thus, residents living in such areas (access deserts) may be multiply disadvantaged, which puts pressure on local authorities to set priorities and spatially target interventions for a more equitable management of society; this is one of the reasons why the concept of "essential service deserts", i.e., areas with limited access to different essential services (Guo & Brakewood, 2024), using the example of a post-socialist city, represents a topic for future research, which may also include focused groups of residents

with special needs. In further research, it is necessary to examine the actual commuting flows of children to schools, as the accessibility of a facility may contrast with its capacity. Furthermore, although accessibility is a key factor in choosing a preschool facility (Križan et al., 2025), it is certainly not the only one; this is why parents likely place their children in kindergartens other than the most accessible ones. As a result, they often have to travel longer distances to reach suitable or desired preschool facilities, creating a spatial mismatch between supply and demand for childcare and generating excess commuting with diverse impacts on families and urban planning (Hu et al., 2024).

7 STUDY LIMITATIONS

The concept of access is complex, and there is no commonly accepted definition or measure of access in the literature on early care and education (Davis et al., 2019). It differs not only between countries, but also between rural and urban areas. For this reason, spatial analyses have various recommendations for delimitating geographical deserts (e.g., Apparicio et al., 2008; Walker et al., 2010; DeBaryshe et al., 2024). The selected zone of 10 minutes (400 m) is based on empirical research experience on the accessibility of facilities and geographical (food) deserts at the intra-urban level of Bratislava (e.g., Križan et al., 2015). However, in many countries, the primary transport mode is the car (even in cities), which provides parents with flexibility in caring for their children and household (Blumenberg et al., 2024). This study used housing prices as a socio-economic indicator for identifying childcare deserts. However, a set of other social and economic indicators provides more detailed information. The limitation, however, is the availability of such data in the required granularity in Slovakia.

To make this research reproducible, a layer of residential buildings from the ZBGIS database (codes: 16, 17, 359) was used (GKÚ, 2019); this is the only available high-resolution database with geodetic accuracy that contains highly granular data on the functional use of buildings and their actual height. Although OpenStreetMap is a regularly updated and open database, in the case of Bratislava, many attributes of functional use and building height are missing. The height of buildings could be calculated from the point cloud of available LiDAR data, but this would still not solve the absence of functional (i.e., residential) use of buildings. However, the last update took place in 2017, meaning that some newer residential complexes are missing from the analysis (Slnečnice in Petržalka, Bory bývanie and Čerešne near Dúbravka, Steinerka in the Staré Mesto, Urban Residence and the Pri mýte residence in Nové Mesto, Sky Park and other projects in the Nivy area, etc.).

Another limitation is the lack of real data on children's kindergarten attendance. Studies often assume that children attend the nearest kindergarten. Although in Slovakia, the accessibility of a kindergarten is an essential factor in choosing a facility (Križan et al., 2025), children do not necessarily attend the nearest one. An example is selecting a kindergarten near the parents' workplace rather than their home. This combines the childcare deserts and excess commuting topics (Cheng & Chen, 2024).

8 CONCLUSIONS

This paper reflects the current legislative changes in education policy and the idea of reasonable

(travelling) accessibility as an essential component of childcare deserts. Using a geographical approach, it examines the interpretation of distance at the intra-urban level in the context of school policy-making and in the urgent context of the need for local authorities to ensure compulsory pre-school attendance.

The research has shown that the spatial accessibility of kindergartens in Bratislava is uneven. The capacity of kindergartens often does not correspond to the actual distribution of children, and some areas, especially the outskirts of the city and newly urbanised areas with rapid population growth, face limited accessibility to preschool facilities. Distance is a critical issue—for about a quarter of children, the nearest kindergarten is more than 400 meters away, which makes it difficult to fulfil compulsory preschool attendance. Research suggests that socioeconomic factors increase the risk of childcare deserts. Disadvantaged and marginalised areas often have less favourable access to kindergartens and lower capacity and quality of kindergartens, and children from these areas have fewer opportunities for preschool education. While the socioeconomic situation does not automatically generate childcare deserts, it creates a significant prerequisite for their emergence.

A significant proportion of children live in areas with limited access to kindergartens. In addition, compulsory preschool attendance for children living in childcare deserts is limited regarding spatial accessibility and social justice. Living in such areas, places increased demands on the parents of these children to fulfil their legal obligations. In Bratislava, approximately a quarter of children face problems with kindergarten attendance, comparable to Western metropolises, where 25-45% of urban children in preschool age live in childcare deserts, especially in areas with a higher proportion of low-income households. In conclusion, childcare deserts have clear spatial and socio-economic dimensions and require comprehensive solutions in infrastructure planning and social policy.

Although the definition of “childcare deserts” may be ambiguous, the issue must be urgently addressed locally. Information from research on the accessibility of kindergartens can help provide a rich, multidimensional picture of the local education market, and policymakers and local authorities can use it to determine where to support the expansion of supply and adopt mechanisms such as subsidies or scholarships to improve access to (quality) early childcare and education for all children. Therefore, the discussion about the current situation regarding the accessibility of facilities for children and how to improve it, especially for vulnerable population groups (and their children), is an important part of the context of this research. Future research should consider studying preschool facilities and their accessibility based on other indicators (in addition to accessibility) not examined in this study (e.g., affordability, quality, parental needs, special care, etc.).

Footnotes

¹ In this paper, we equate the term “education deserts” with the term “childcare deserts”. Given the focus of the research on pre-primary education, we consider childcare deserts to be more appropriate when researching the accessibility of kindergartens. For research on the accessibility of primary or secondary schools, it would be more appropriate to use the term education or school deserts.

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REFERENCES

- Abulibdeh, A., Al-Ali, M., Al-Quraishi, D., Al-Suwaidi, W., Al-Yafei, B., & Al-Mazawdah, S. (2024). Assessing the spatial distribution and accessibility of public and private schools in Qatar: A GIS-based analysis. *Geomatica*, 76(2), 100015. <https://doi.org/10.1016/j.geomat.2024.100015>
- Alexander, M., & Massaro, V. A. (2020). School deserts: Visualizing the death of the neighborhood school. *Policy Futures in Education*, 18(6), 787–805. <https://doi.org/10.1177/1478210320951063>
- Aman, J. J. C., & Smith-Colin, J. (2020). Transit Deserts: Equity analysis of public transit accessibility. *Journal of Transport Geography*, 89, 102869. <https://doi.org/10.1016/j.jtrangeo.2020.102869>
- Apparicio, P., Abdelmajid, M., Riva, M., & Shearmur, R. (2008). Comparing alternative approaches to measuring the geographical accessibility of urban health services: Distance types and aggregation-error issues. *International Journal of Health Geographics*, 7(1), 7. <https://doi.org/10.1186/1476-072X-7-7>
- Azuma, J. T., DeBaryshe, B. D., Gauci, K. T., & Stern, I. R. (2023). Mapping access to affordable early childhood education and care: Methodology and application to community advocacy. *International Journal of Community Well-Being*, 6(2), 169–186. <https://doi.org/10.1007/s42413-020-00096-1>
- Benhlila, O., Riane, F., Puchinger, J., & Bahi, H. (2024). Development of a Variable Multimodal Balanced Floating Catchment Area Approach for Spatial Accessibility Assessment. *Geographical Analysis*, 56(4), 678–699. <https://doi.org/10.1111/gean.12398>
- Bilková, K., Križan, F., Barlik, P., Horňák, M., Zeman, M., & Zubriczký, G. (2017a). Za nákupom ďaleko: rurálne potravínové púšte na Gemeri. *Geografický časopis*, 69(1), 3–20.
- Bilková, K., Križan, F., Horňák, M., Barlik, P., & Kita, P. (2017b). Comparing two distance measures in the spatial mapping of food deserts: The case of Petržalka, Slovakia. *Moravian Geographical Reports*, 25(2), 95–103. <https://doi.org/10.1515/mgr-2017-0009>
- Blumenberg, E., Wander, M., & Yao, Z. (2024). Decisions & distance: The relationship between child care access and child care travel. *Journal of Transport Geography*, 114, 103756. <https://doi.org/10.1016/j.jtrangeo.2023.103756>
- Blumenberg, E., Yao, Z., & Wander, M. (2023). Variation in child care access across neighborhood types: A two-step floating catchment area (2SFCA) approach. *Applied Geography*, 158, 103054. <https://doi.org/10.1016/j.apgeog.2023.103054>
- Butler, T., & Hamnett, C. (2007). The geography of education: Introduction. *Urban Studies*, 44(7), 1161–1174. <https://doi.org/10.1080/00420980701329174>
- Cheng, L., & Chen, C. (2024). Is school travel excessive? Empirical evidence from Xi'an, China. *Journal of Transport Geography*, 117, 103895. <https://doi.org/10.1016/j.jtrangeo.2024.103895>
- CVTI (2023). Kindergartens - capacity, total number of children, by age and pending applications (applications not granted due to lack of space). Centrum vedecko-technických informácií SR /Slovak Centre of Scientific and Technical Information.
- Daniels, R., & Mulley, C. (2013). Explaining walking distance to public transport: The dominance of public transport supply. *The Journal of Transport and Land Use*, 6(2), 5–20. <https://doi.org/10.5198/jtlu.v6i2.308>
- Davis, E. E., Lee, W. F., & Sojourner, A. (2019). Family-centered measures of access to early care and education. *Early Childhood Research Quarterly*, 47, 472–486. <https://doi.org/10.1016/j.ecresq.2018.08.001>
- DeBaryshe, B. D., Im, S., Azuma, J., Stern, I., Nguyen, M., & Chen, Q. (2024). Close to home: Family-centered spatial analysis of access to early care and education. *Early Childhood Research Quarterly*, 68, 123–134. <https://doi.org/10.1016/j.ecresq.2024.04.003>
- Delamater, P. J. (2013). Spatial accessibility in suboptimally configured health care systems: A modified two-step floating catchment area (M2SFCA) metric. *Health & Place*, 24, 30–43. <https://doi.org/10.1016/j.healthplace.2013.07.012>
- Delamater, P. J., Shortridge, A. M., & Kilcoyne, R. C. (2019). Using floating catchment area (FCA) metrics to predict health care utilization patterns. *BMC Health Services Research*, 19, 144. <https://doi.org/10.1186/s12913-019-3969-5>
- Demitiry, M., Higgins, C. D., Páez, A., & Miller, E. J. (2022). Accessibility to primary care physicians: Comparing floating catchments with a utility-based approach. *Journal of Transport Geography*, 101, 103356. <https://doi.org/10.1016/j.jtrangeo.2022.103356>
- El-Geneidy, A., & Levinson, D. (2007). Mapping accessibility over time. *Journal of Maps*, 3(1), 76–87. <https://doi.org/10.1080/jom.2007.9710829>
- Friedman, D. E. (2001). Employer supports for parents with young children. *The Future of Children*, 11(1), 63–77. <https://doi.org/10.2307/1602810>
- Gallagher, A. (2022). *Childcare provision in neoliberal times: The marketization of care*. Bristol University Press.
- Geurs, K. T., & Van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies: review and research directions. *Journal of Transport Geography*, 12(2), 127–140. <https://doi.org/10.1016/j.jtrangeo.2003.10.005>
- GKÚ (2019). ZBGIS [Data set]. Geodetic and Cartographic Institute Bratislava.
- Griffin, K. M. (2022). It's 3:00 p.m., do you know where your children are? New York's inadequate use of federal funds that have led to the continuance of childcare deserts. *Family Court Review*, 60(2), 322–336. <https://doi.org/10.1111/fcre.12644>
- Guo, J., & Brakewood, C. (2024). Analysis of spatiotemporal transit accessibility and transit inequity of essential services in low-density cities, a case study of Nashville, TN. *Transportation Research Part A: Policy and Practice*, 179, 103931. <https://doi.org/10.1016/j.tra.2023.103931>
- Handy, S. L., & Niemeier, D. A. (1997). Measuring accessibility: an exploration of issues and alternatives. *Environment and Planning A: Economy and Space*, 29(7), 1175–1194. <https://doi.org/10.1068/a291175>

- Hermes, H., Lergetporer, P., Peter, F., & Wiederhold, S. (2025). Application barriers and the socioeconomic gap in child care enrollment. *Journal of the European Economic Association*, 23(3), 1133–1172. <https://doi.org/10.1093/jeea/jvae054>
- Hillman, N. W. (2016). Geography of college opportunity: The case of education deserts. *American Educational Research Journal*, 53(4), 987–1021. <https://doi.org/10.3102/0002831216653204>
- Holloway, S. L., Hubbard, P., Jöns, H., & Pimlott-Wilson, H. (2010). Geographies of education and the significance of children, youth and families. *Progress in Human Geography*, 34(5), 583–600. <https://doi.org/10.1177/0309132510362601>
- Hornák, M., Hluško, R., Rochovská, A., & Lelkesová, V. (2023). Public transport accessibility and spatial exclusion in Roma settlements: A case study of three regions in Eastern Slovakia. *Moravian Geographical Reports*, 31(1), 27–38. <https://doi.org/10.2478/mgr-2023-0003>
- Hu, Y., Sherlock, P., Huang, J., Knopf, H. T., & Hall, J. M. (2024). Unveiling spatial mismatch in childcare supply and demand: An excess commuting analysis of home-to-childcare distance in subsidized families. *Journal of Transport Geography*, 116, 103829. <https://doi.org/10.1016/j.jtrangeo.2024.103829>
- Hurley, P., Matthews, H., & Pennicuik, S. (2022). Deserts and oases: How accessible is childcare? Victoria University.
- Ingram, D. R. (1971). The concept of accessibility: A search for an operational form. *Regional Studies*, 5(2), 101–107. <https://doi.org/10.1080/09595237100185131>
- Köse, M., Koçyigit, M., Erdem, C., & Jega, I. M. (2021). An evaluation of accessibility to preschool education institutions using geographic information systems. *Education and Information Technologies*, 26(4), 4307–4328. <https://doi.org/10.1007/s10639-021-10482-7>
- Križan, F., Bilková, K., Kita, P., & Hornák, M. (2015). Potential food deserts and food oases in a post-communist city: Access, quality, variability and price of food in Bratislava-Petržalka. *Applied Geography*, 62, 8–18. <https://doi.org/10.1016/j.apgeog.2015.04.003>
- Križan, F., Sládeková Madajová, M., Rišová, K., Švecová, A., & Chorvát, I. (2025). Preferencie rodičov pri výbere predškolského zariadenia: výsledky reprezentatívneho prieskumu na Slovensku. *Sociológia - Slovak Sociological Review*, 57(1), 25–53. <https://doi.org/10.31577/sociologia.2025.57.1.2>
- Križan, F., Šveda, M., Tarčáková, S., Bilková, K., & Hencelová, P. (2021). Kam do školy? Transformácia a priestorové rozmiestnenie základného školstva v zázemí Bratislavy. In M. Šveda & P. Šuška (Eds.), *Suburbanizácia 2: sondy do premien zázemia Bratislavy*. (pp. 171–188). Geografický ústav SAV.
- Kučerová, S. R., Holloway, S. L., & Jahnke, H. (2020). The institutionalization of the geography of education: An international perspective. *Journal of Pedagogy*, 11(1), 13–34. <https://doi.org/10.2478/jped-2020-0002>
- Luo, W., & Wang, F. (2003). Measures of spatial accessibility to health care in a GIS environment: synthesis and a case study in the Chicago region. *Environment and Planning B: Planning and Design*, 30(6), 865–884. <https://doi.org/10.1068/b29120>
- Malik, R., & Hamm, K. (2017). Mapping America's Childcare Deserts. <https://www.americanprogress.org/article/mapping-americas-child-care-deserts/>
- Malý, J., Dvořák, P., & Šuška, P. (2020). Multiple transformations of post-socialist cities: Multiple outcomes? *Cities*, 107, 102901. <https://doi.org/10.1016/j.cities.2020.102901>
- Martínez-Jiménez, E., & Salinas-Pérez, J. A. (2019). Accessibility to culture and education. Educative city of Córdoba (Spain). *Journal of Maps*, 15(1), 39–45. <https://doi.org/10.1080/17445647.2019.1575776>
- Mazúr, J., Brunovský, J., Círanová, L., Čupková, Z., Hurný, J., Sidorová, M., & Žurkinová, Z. (Eds.), (2022). Bratislava 2030: Program rozvoja mesta 2022 – 2030. Metropolitný inštitút Bratislavy.
- Michálek, A. (2023). Vývoj miezd v regiónoch Slovenska počas pandémie COVID-19. *Geografický časopis*, 75(1), 27–46. <https://doi.org/10.31577/geogrcas.2023.75.1.02>
- MVSR (2025). Adresy podľa krajov. [Data set]. Ministry of the Interior of the Slovak Republic. <https://data.slovensko.sk/datasety/b27f57f1-7e76-45e0-8968-631f9176b2e9> [accessed 17 July 2025]
- Ondoš, S., & Korec, P. (2006). Súčasná dimenzia sociálno-demografickej priestorovej štruktúry Bratislavy. *Sociológia - Slovak Sociological Review*, 38(1), 49–82.
- Páez, A., Higgins, C. D., & Vivona, S. F. (2019). Demand and level of service inflation in Floating Catchment Area (FCA) methods. *PLoS One*, 14(6), e0218773. <https://doi.org/10.1371/journal.pone.0218773>
- Pelletier, E., Allard, S. W., Karon, J., & Morrissey, T. W. (2025). The spatial inequality of early care and education centers. *Early Childhood Research Quarterly*, 70, 120–132. <https://doi.org/10.1016/j.ecresq.2024.09.006>
- Pennerstorfer, A., & Pennerstorfer, D. (2021). Inequalities in spatial accessibility of childcare: The role of non-profit providers. *Journal of Social Policy*, 50(1), 122–147. <https://doi.org/10.1017/S0047279419000990>
- Prentice, S., & White, L. A. (2019). Childcare deserts and distributional disadvantages: The legacies of split childcare policies and programmes in Canada. *Journal of International and Comparative Social Policy*, 35(1), 59–74. <https://doi.org/10.1080/21699763.2018.1526700>
- Prusinski, E., Mahler, P. P., Collins, M., & Couch, H. (2023). Strengthening Early Childhood Education and Care in a “Childcare Desert”. *Early Childhood Education Journal*, 51, 1317–1333. <https://doi.org/10.1007/s10643-022-01375-6>
- Rajčáková, E., & Švecová, A. (2018). Ľudské zdroje – regionálne disparity v kontexte politiky súdržnosti EÚ 2007–2013 na Slovensku. *Geografický Časopis*, 70(1), 79–96. <https://doi.org/10.31577/geogrcas.2018.70.1.05>
- Rišová, K. (2025). Transport exclusion of suburban mothers: A critical review. *Geografický časopis*, 76(4), 319–339. <https://doi.org/10.31577/geogrcas.2024.76.4.17>
- Rodriguez-Segura, D., & Kim, B. H. (2021). The last mile in school access: mapping education deserts in developing countries. *Development Engineering*, 6, 100064. <https://doi.org/10.1016/j.deveng.2021.100064>
- Rochovská, A., Miláčková, M., & Námesný, L. (2013). Bratislava - mesto narastajúcich sociálnych nerovností. In J. Buček & P. Korec (Eds.), *Moderná humánna geografia mesta Bratislava: priestorové štruktúry, siete a procesy* (pp. 89–118). Geografický ústav SAV.
- Rosik, P., Stępnia, M., & Wiśniewski, R. (2021). Delineation of health care deserts using accessibility measures: the case of Poland. *European Planning*

- Studies, 29(6), 1151–1173. <https://doi.org/10.1080/09654313.2020.1818184>
- Shaw, H. J. (2006). Food deserts: Towards the development of a classification. *Geografiska Annaler: Series B, Human Geography*, 88(2), 231–247. <https://doi.org/10.1111/j.0435-3684.2006.00217.x>
- SIA SR (2019). Information system for social insurance [Data set]. Social Insurance Agency of the Slovak Republic. Internal database.
- Sipple, J. W., McCabe, L. A., & Casto, H. G. (2020). Child care deserts in New York State: Prekindergarten implementation and community factors related to the capacity to care for infants and toddlers. *Early Childhood Research Quarterly*, 51, 167–177. <https://doi.org/10.1016/j.ecresq.2019.10.007>
- Škobla, D., Mušinka, A., & Majo, J. (2025). Bridging the Gap: Roma Access to Public Services in Slovakia. Bratislava. Institute of Ethnology and Social Anthropology, SAS.
- Sládeková Madajová, M., Šveda, M., & Výboštok, J. (2021). Bude miesto pre všetky deti? Kapacita predškolských zariadení v Bratislavskom samosprávnom kraji. *Geografický časopis*, 73(4), 301–322. <https://doi.org/10.31577/geogrcas.2021.73.4.16>
- SO SR (2023). The 2021 Population and Housing Census - GRID 100x100 m [Data set]. Statistical Office of the Slovak Republic. Internal database.
- SO SR (2024). EU-SILC microdata 2005–2022 [Data set]. Statistical Office of the Slovak Republic. Internal database.
- SO SR (2025). DATAcube (np3110rr, pr3113rr, sp0004ms). [Data set]. Statistical Office of the Slovak Republic. <https://datacube.statistics.sk/#!/lang/en>
- Statz, M., & Evers, K. (2020). Spatial barriers as moral failings: what rural distance can teach us about women's health and medical mistrust. *Health & Place*, 64, 102396. <https://doi.org/10.1016/j.healthplace.2020.102396>
- Stephens, C. M., Crosby, D. A., & Smith, J. M. (2024). Accessibility of the early care and education supply: Variation within the center-based provider sector. *Children and Youth Services Review*, 164, 107846. <https://doi.org/10.1016/j.childyouth.2024.107846>
- Švecová, A., & Križan, F. (2023). Aká je podpora zaškolenosti detí materských škôl z prostriedkov EŠIF? *Geografické informácie*, 27(2), 75–90. <https://doi.org/10.17846/GI.2023.27.2.75-90>
- Švecová, A., & Tolmáči, A. (2025). Pre-Primary Education in Slovakia over the Last Three Decades: Temporal and Spatial Analysis. *Geografický časopis*, 77(1), 33–42. <https://doi.org/10.31577/geogrcas.2025.77.1.03>
- Šveda, M., & Boris, R. (2021). Predmestie alebo dedina? Typizácia areálov rezidenčnej suburbanizácie. In M. Šveda & P. Šuška (Eds.), *Suburbanizácia 2: sondy do premien zázemia Bratislavy* (pp. 85–118). Geografický ústav SAV.
- Šveda, M., & Výboštok, J. (2020). Dostupnosť bývania v prostredí extenzívnej suburbanizácie. In M. Šveda & P. Šuška (Eds.), *Suburbanizácia 2: sondy do premien zázemia Bratislavy* (pp. 27–45). Geografický ústav SAV.
- Šveda, M., Výboštok, J., & Gurnák, D. (2021). Atlas suburbanizácie Bratislavy. Institute of Geography, SAS.
- Tobler, W. R. (1970). A computer movie simulating urban growth in the Detroit region. *Economic Geography*, 46(sup1), 234–240.
- United Classifieds. (2025). Property prices 2020–2024 [Data set]. Trhové reporty.
- Vecchio, G., Tiznado-Aitken, I., Castillo, B., & Steiniger, S. (2022). Fair transport policies for older people: accessibility and affordability of public transport in Santiago, Chile. *Transportation*, 51, 689–715. <https://doi.org/10.1007/s11116-022-10346-0>
- Voľanská, E., Káčerová, M., & Majo, J. (2017). Bližšia košeľa ako kabát? Sociálne siete rodiny a komunity seniorov v slovenských mestách. *Český lid*, 108, 289–321. <https://doi.org/10.21104/CL.2021.3.02>
- Walker, R. E., Keane, C. R., & Burke, J. G. (2010). Disparities and access to healthy food in the United States: A review of food deserts literature. *Health & Place*, 16(5), 876–884. <https://doi.org/10.1016/j.healthplace.2010.04.013>
- Wisseh, C., Hildreth, K., Marshall, J., Tanner, A., Bazargan, M., & Robinson, P. (2021). Social determinants of pharmacy deserts in Los Angeles County. *Journal of Racial and Ethnic Health Disparities*, 8(6), 1424–1434. <https://doi.org/10.1007/s40615-020-00904-6>
- Wrigley, N. (2002). 'Food deserts' in British cities: Policy context and research priorities. *Urban Studies*, 39(11), 2029–2040. <https://doi.org/10.1080/0042098022000011344>
- Ying, X., Kahn, P., & Mathis, W. S. (2022). Pharmacy deserts: more than where pharmacies are. *Journal of the American Pharmacists Association*, 62(6), 1875–1879. <https://doi.org/10.1016/j.japh.2022.06.016>
- Young, M., Montazer, S., & Singh, D. (2020). The Consequences of Living in Childcare Deserts: Evidence from Canada. *Canadian Review of Sociology*, 57(4), 550–578. <https://doi.org/10.1111/cars.12316>



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