



New housing, old gaps: Unequal kindergarten accessibility in the Bratislava suburbs

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Abstract

The accessibility of pre-primary education is a crucial dimension of spatial justice, directly influencing children's educational opportunities and family well-being. This study analyses the spatial accessibility of kindergartens in the suburban hinterland of Bratislava, a region that has experienced rapid residential expansion since the early 2000s. Using high-resolution population data from the 2021 census, we modelled walking and car-based accessibility at a 100x100 m grid level. An accessibility index, weighted by the number of children, was calculated for each municipality. The results reveal significant disparities: newly developed residential zones consistently show poorer access to kindergartens than older built-up areas. These accessibility deficits are most pronounced in municipalities with intensive suburbanisation, where residential development has outpaced the provision of social infrastructure. Statistical testing confirms the robustness of these differences. The findings highlight a mismatch between housing development and public service provision, with implications for social equity, parental mobility, and regional planning. We argue for the adoption of proactive planning strategies integrating pre-primary facilities into new developments to mitigate spatial inequalities and ensure equitable access to early childhood education in dynamically transforming suburban regions.

Key words:

kindergartens accessibility,
suburbanisation,
spatial analysis,
Bratislava, Slovakia

1 INTRODUCTION

Transport accessibility is a fundamental pillar of sustainable urban development and social equality, as it significantly impacts the quality of life and opportunities for individual families. One of these opportunities is access to education, or rather, the accessibility of educational and pre-primary facilities. Early childhood education and care represent the first opportunities for children to develop their skills and learn to cooperate. Preschool education plays a key role in the psychomotor, cognitive, social, and emotional development of children (Greenburg et al., 2020), helping to bridge socio-economic and cultural gaps (Sharma & Patil, 2022; Nichols & Ryan, 2023), and increasing school success and thus the quality of their future lives. Kindergartens, as institutions focused on the upbringing, education, and care of preschool-age children, thus have an irreplaceable position in the education system (Sládeková Madajová et al., 2021). The accessibility of social services can rightly be classified as one of the important contemporary concepts of geospatial sciences, with kindergarten accessibility among its current topics.

Introducing compulsory pre-primary education from 2021 has increased pressure on an already overburdened network of pre-school facilities. Despite efforts to expand the capacity of kindergartens – often in the form of relocated workplaces, modular buildings or reconstructions – the accessibility of pre-primary

education remains insufficient in many municipalities in the Bratislava hinterland. According to estimates, there is a shortage of hundreds to thousands of places in the region, which is reflected in the inability to place younger children. Private kindergartens partially compensate for the lack of capacity, but their accessibility is limited. The resulting situation creates inequality between localities and social groups, and the decrease in kindergarten accessibility thus affects the quality of life and the functionality of regional planning. In rural areas, there is not only a lack of kindergartens, but also a lack of capacity for their expansion, which leads to longer commuting distances and increases the pressure on individual (car) transport (Borbélyová & Miňová, 2024; Švecová & Tolmáči, 2025). A representative survey from December 2023 (Focus, 2023) revealed that the accessibility of kindergartens is one of the key factors for parents when choosing a facility; up to 94% of respondents consider accessibility a decisive aspect of their decision-making (Križan et al., 2025). Low-income and rural households are more sensitive to accessibility issues than households with greater financial resources. Urban areas have a higher concentration and increased competition between public and non-public kindergartens. In contrast, kindergarten choices in rural areas are more limited; in addition, almost a third of municipalities

in Slovakia do not operate a single kindergarten (Švecová & Tolmáči, 2025). This situation necessitates that children commute to more distant locations, increasing the temporal and financial burden for their parents (Križan et al., 2025).

The spatial accessibility of kindergartens thus directly influences parents' mobility, the organisation of family life, and ultimately the housing choice. Parents with higher incomes have a wider range of choices and often prefer kindergartens with a specific focus or additional activities, even if it means a less comfortable commuting distance. On the other hand, families with lower incomes place particular emphasis on accessibility and price. This inequality in access to preschool education can have long-term consequences for children's educational and social opportunities, thereby deepening existing social disparities (Križan et al., 2025).

This paper aims to analyse the accessibility of pre-primary education facilities in the Bratislava hinterland by various modes of transport (walking, car). Other modes of transport were omitted due to a lack of preference in Slovakia. In a representative survey (Focus, 2023) conducted in December 2023, public transport was reported by 3% of parents, while bicycles, scooters (including electronic versions), and other modes of transport were reported by less than 1% of respondents. The research questions that the paper seeks to answer are:

1. In which municipalities in the Bratislava hinterland is access to pre-primary education insufficient?
2. Are there differences in the accessibility of kindergartens between existing buildings and new developments in suburban areas?
3. Are there differences in the accessibility of kindergartens depending on the intensity of suburbanisation processes?

2 THEORETICAL BACKGROUND

The current society is characterised by high mobility, on which its life depends. The intensity of transport links and interactions at all levels constantly increases, dynamically changing spatial patterns and structures. Transport accessibility refers to the ease of reaching a specific destination using a particular mode of transport. Transport (in)accessibility is a key concept in studying households' social and economic situation. The concept of real access deserts is often applied in the literature. In these studies, authors identify households living in so-called access deserts, i.e., areas with insufficient access to selected social services (see Guo & Brakewood, 2024), and analyse selected characteristics of their socioeconomic status (usually income). In his research, Horňák (2012) compared the potential salary in a regional centre and the combination of estimated costs of daily commuting to work from regional municipalities and material-need-assistance income. Currently, a multidimensional approach is increasingly being used in accessibility research. It does not limit interpretation to distance or temporal accessibility alone, but also considers qualitative aspects of mobility and individual possibilities for its use. Paez et al. (2012) distinguish between positive indicators (observed accessibility, such as commuting time or the number of services available within a certain buffer) and normative indicators (expected or ideal level of accessibility based on social or planning goals). This approach enables the assessment of mobility and its implementation in the context of fair and equitable development.

The uneven spatial distribution of educational opportunities is a key theme in the field of education geography. Butler & Hamnett (2007) examined how space influences national educational outcomes and contributes to social exclusion or mobility. In his work on space, place, and race, Massey (1994) suggests that structural inequalities are reinforced through the geography of opportunity. The location of childcare facilities, therefore, affects not only children but also other stakeholders in pre-primary education, especially parents, and particularly women, who are predominantly responsible for childcare (Rišová, 2024).

According to Moroni and De Franco (2024), space also enters the discussion of justice as an element influencing the fulfilment of certain rights. For example, to ensure the right to education, it is necessary to provide schools in a manner that ensures every resident has a school within a certain distance from their home, taking into account public transportation. Alexander and Massaro (2020) point out, on the other hand, that mapping and analysing the geographic accessibility of good schools offers a starting point from which to consider spatial justice in education policy.

Sufficient transport accessibility to educational institutions plays a key role in urban and rural areas. It allows parents to organise their time more efficiently when dropping off and picking up their children before and after work, giving children more free time instead of spending it on lengthy journeys. However, the kindergarten accessibility is not the only factor in parents' decision-making strategy. Households choose a kindergarten in a broader context, based on capacity (sufficient places available), the location of the kindergarten concerning the parents' workplace, the quality of the kindergarten, language and special needs, etc. If the chosen kindergarten is not the nearest one, it is deemed excess commuting (Hu et al., 2024). Additionally, suburban and rural areas are more willing to travel longer distances than urban populations (DeBaryshe et al., 2024). Moreover, research in Sweden (Nichols & Ryan, 2023) has shown that liberalising the school admission system has led to a significant redistribution of children between schools. Previously, enrolling a child was limited to a school in a predetermined and strictly fixed catchment area. The reform allowed parents to choose a preschool facility for their child. On the one hand, this led to a decline in school accessibility. Still, on the other hand, it contributed to reduced income inequalities between individual catchment areas.

An overview of the modes of transport children use to commute to kindergartens is a key starting point for assessing the transport accessibility of pre-primary education. A comprehensive picture of the consequences of choosing a mode of transport is provided by the review study by Hopson et al. (2022). The authors analyse the relationship between the mode of transport to school, the duration of commuting, and school performance. The research results show that the most common form of transport for children to kindergarten is individual car transport, which allows parents to combine leading their children to kindergarten with their commute to work. At the same time, however, several reviewed studies (Hopson et al., 2022) indicate that dependence on private cars can negatively impact attendance in traffic jams or vehicle breakdowns (Cordes et al., 2022). An alternative is organised school transportation, which, according to Edwards (2022), reduces chronic absenteeism, especially among children from low-income households or rural areas with limited

public transportation. In Slovakia, organised school transport has long been used primarily in sparsely populated rural areas, but without a unified national system. Recently, there has been discussion about the wider introduction of school buses as part of inclusive pre-primary education. As part of the Slovak Recovery and Resilience Plan, a proposal has been made to provide free transport for children to kindergarten, including accompaniment. Such a system could improve the attendance of children from marginalised groups or areas with insufficient kindergarten capacity, thereby strengthening equal opportunities in access to the education system. A similar model has also been proposed on a pilot basis in connection with the extension of compulsory pre-primary education from the age of five.

In terms of promoting a healthy lifestyle and environmental benefits, walking to work is particularly desirable. However, surveys often show that it only plays a role for short distances (up to 1,000 metres), significantly limiting its usability in sparsely populated areas. Hopson et al. (2022) also note that walking to school is not systematically associated with higher academic performance compared to other modes of transport. However, there is evidence of a positive impact on children's physical fitness. However, these findings are primarily based on the American environment, which differs significantly from the Slovak context in many ways. For example, in the US, school attendance is often organised within large school districts with extensive use of school buses, while in Slovakia, the school network is denser and commuting distances are shorter, which influences the preferred forms of transportation. Public transport for younger children is used only exceptionally, mainly due to safety and organisational barriers (DeBaryshe et al., 2024). However, in the case of older children, research indicates that those from lower-income neighbourhoods benefit most from the accessibility of public transport (Huang & Zhou, 2025). A common denominator of all modes of transport is the time it consumes. Previous research has shown that longer commuting times are associated with higher absenteeism rates (Blagg et al., 2018; Burdick-Will et al., 2019). That can be particularly problematic in preschool, when commuting habits are formed and parents must harmonise their work schedule with kindergarten hours (Rišová, 2024).

3 STUDY AREA

The object of interest in this study is the hinterland of Bratislava. In the context of this work, it is delimited on the one hand by the administrative boundaries of Bratislava (urban area) and on the other by the boundaries of the Bratislava Self-Governing Region. Although several studies indicate that the hinterland of Bratislava extends even further (see Halás & Klapka, 2024), the reason for delimiting this territory was limited by the data obtained.

The Bratislava region is one of the most developed areas in the EU in terms of GDP per capita. Although this indicator does not accurately reflect reality, the fact is that Bratislava is struggling with many phenomena typical of developed cities in Western Europe, albeit with its specific characteristics, more similar to those of the former Eastern Bloc. One of these is various manifestations and forms of residential suburbanisation, resulting in significant change in this area. High housing prices in Bratislava are pushing the population out of the city into its hinterland (Výboštok & Štefkovičová,

2023), while lower real estate prices, relatively good transport accessibility to Bratislava, and a „peaceful“ environment are also attractive to people from other regions of Slovakia (Šveda et al., 2021).

Since the beginning of the 21st century, and especially after 2010, intensive suburbanisation processes have occurred in the region under study, fundamentally changing the population dynamics and functional character of several municipalities (Šuška & Šveda, 2019). This development followed a period of demographic decline caused by low birth rates in the second half of the 1990s (Ďurček et al., 2019). The financing of pre-primary education became the responsibility of local authorities, and many of them decided at that time to reduce the capacity of kindergartens and discontinue classes and entire kindergartens as a result of the decline in the number of children (Nestorová-Dická, 2011; Križan et al., 2022). However, in the context of the so-called delayed parenthood effect of the „Husák generation“, which led to a slight increase in the birth rate in the second decade of the 21st century, it became apparent that such measures were systemically unsustainable. In addition, the increase in young families in suburban communities, often supported by housing development without the parallel construction of social infrastructure, has led to large residential areas without adequate basic social services, including kindergartens. That resulted in an uneven distribution of the kindergartens' network that does not reflect actual demand (Sládeková Madajová et al., 2021). Local authorities initially welcomed new residents and the prospect of increased tax revenue. However, insufficient evidence of permanent residence has largely limited this effect.

On the other hand, this process has a significant impact on the urban structure, land use, and technical and social infrastructure requirements. Given that it is largely „young and educated“ people who are moving here (Novotný & Pregi, 2019), i.e. affluent residents with higher demands on public services and often in the reproductive stage of life, pressure on the capacity of kindergartens (and primary schools) has increased. A shortage of places has gradually emerged in individual municipalities in the Bratislava region (Sládeková Madajová et al., 2021). The growth of Bratislava's suburbs thus often precedes adequate infrastructure development, leading to growing disparities in the accessibility of essential social services and increasing pressure on the transport system (Podolák & Šveda, 2019).

An important aspect of suburbanisation is transport accessibility. Most municipalities in the Bratislava hinterland are well connected to Bratislava city and other central business districts by individual car transport. That, combined with the low attractiveness of public transport, causes increasing traffic congestion at the main entrances to the city, longer commuting times and increased demand for parking spaces in urban areas (Šuška & Šveda, 2019). Due to insufficient capacity and frequency of public transportation, as well as waiting times and potential transfers (cf. Tahmasbi & Haghshenas, 2019), and the lack of a coherent approach to many suburban development projects, residents are becoming increasingly dependent on cars. Due to insufficient capacity in kindergartens, parents are forced to seek places in kindergartens in neighbouring municipalities or private facilities, which increases their economic and/or transport burden.

4 DATA AND METHODS

Kindergarten accessibility

This research is based on analysing and evaluating the transport accessibility of kindergartens in the Bratislava hinterland. Data on the location of kindergartens were obtained from a publicly available dataset of the Slovak Centre of Scientific and Technical Information (CVTI SR, 2023). After cleaning the data and correcting erroneous longitude and latitude coordinates, we obtained 161 kindergartens in the Bratislava hinterland.

Demographic data on children of kindergarten age were obtained from the 2021 census (SO SR, 2024b). These are children born between Sep 1, 2014 and Aug 31, 2017, i.e. those who could start kindergarten in the 2020/2021 school year. These data were provided for individual cells of the 100x100-metre grid network. Due to personal data protection, data in cells with three or fewer children were redistributed to neighbouring cells. After redistribution, data in 692 of 9,702 cells (7.13%) were adjusted, with an average change of 1.465 persons per cell. The impact of protection on spatial distribution was minimal, with Moran's I changing by +0.242%.

Transport accessibility (distance) was modelled using the Open Source Routing Machine (OSRM) tool, using road network data from OpenStreetMap (as of Sep 1, 2023). The results of the analysis distribute the geospatial grid into four categories of travel distance:

1. *up to 400 metres* – optimal walking accessibility (equivalent to a 10-minute walk with a child aged 3–6 years)
2. *up to 1,000 metres* – optimal car accessibility (approximately 2–3 minutes' drive),
3. *up to 2,000 metres* – sufficient car accessibility (approximately 5 minutes' drive),
4. *over 2,000 metres* – insufficient accessibility.

When assessing the walkability of kindergartens, a distance of 400 metres is defined as an appropriate threshold, corresponding to approximately a 10-minute walk with a preschool-aged child (Cavagna et al., 1983). This approach is supported by several empirical and conceptual studies that use the same or similar distances when analysing attendance at educational facilities (e.g. Mitra & Buliung, 2012; Oreskovic et al., 2014; Jauregui et al., 2016). For car accessibility to kindergartens, a speed of approximately 30 kph is considered, corresponding to real conditions in built-up areas (Cameron, 2001). Although the maximum speed limit in built-up areas is usually 50 kph, empirical findings show that average travel speeds are significantly lower, ranging from approximately 27 kph on secondary roads to 38 kph on primary urban roads (Rietveld et al., 1998). These values are further supported by the findings of Cameron (2001), who, in the context of traffic safety and flow, recommends a speed of around 30 kph as the optimal speed in residential urban areas.

An average weighted accessibility index was constructed to classify the accessibility of kindergartens at the municipal level. This indicator represents the average accessibility of the nearest kindergarten, weighted by the number of children in each GRID cell. It is calculated using the following formula:

$$D_w = \frac{\sum_{i=1}^n d_i p_i}{\sum_{i=1}^n p_i} \quad (1)$$

where d_i is the distance from the GRID cell to the nearest kindergarten; p_i is the number of children aged 3–6 in the GRID cell i , and n is the number of all GRID cells included in the calculation.

New vs. old residential zone

To answer the research question of whether there are statistically significant differences in transport accessibility of kindergartens between new and old residential areas, population data are used in a 100x100-metre grid. Eventually, each GRID cell was classified according to the type of development (new/old) in all municipalities in the Bratislava hinterland (i.e., within the Bratislava Self-Governing Region, except the capital city). The aim was to distinguish between new and old developments to further analyse the spatial distribution of children aged 3–6, based on data from the 2021 census.

Orthophotos from 2003 and 2021 were used as input data, and the type of development was identified by visually comparing these two time frames. Based on this comparison, each GRID cell was assigned a value expressing the presence or absence of new construction. GRID cells with residential buildings in 2003 and with no visible changes in the extent of urbanisation between 2003 and 2021 were classified as unchanged (i.e., “old”). Conversely, all cells outside the built-up areas in 2003, with many new residential buildings in 2021, were classified as “new”.

Subsequently, statistical tests were performed to identify differences between the new and old development. The intensity of suburbanisation processes index was used to control the test results. This index was proposed by Šuška et al. (2018), who divided the individual municipalities in the Bratislava hinterland into two zones based on housing construction and internal migration variables. The first zone represents intensive suburbanisation processes, and these municipalities are closer to Bratislava. The second zone includes municipalities where suburbanisation occurs, but its manifestations are less intense. The rest of the municipalities show no significant signs of suburbanisation processes. Since the authors' methodology is based on outdated data (2000s), the same index parameters were applied to more recent data (2014–2023). The classification of individual municipalities into suburban zones is shown in the map below (Fig. 1).

5 RESULTS

Using the Open Source Routing Machine tool, the road distance from each GRID cell to kindergartens was calculated (Fig. 2); the dataset is described in Table 1. The results show that the highest number of cells (2,817) and children living in them (6,563) are located at a distance of 401–1,000 meters, which can be considered relatively accessible. The literature suggests that the optimal distance to kindergartens is under 400 meters (i.e., a 10-minute walk, see Abulibdeh et al., 2024). However, as this limit is primarily mentioned in urban environments, it may not accurately reflect the reality in suburban areas. A representative survey revealed that more than two-thirds (68.7%) of suburban parents are willing to commute to kindergarten for more than 15 minutes when using a car. However, actual commuting times are significantly shorter; for 85% of parents who use a car, the commute to kindergarten is less than 15 minutes (Focus, 2023). However, both variables indicate that a commute of up to 1,000 meters is sufficient for parents who use a car. A zone of up to 2,000 meters is relatively far away, but still within the parents' declared willingness to commute to kindergarten. A total of 3,807 children live in these zones, although the actual attendance at kindergartens may be higher, as attendance at educational institutions is not limited to

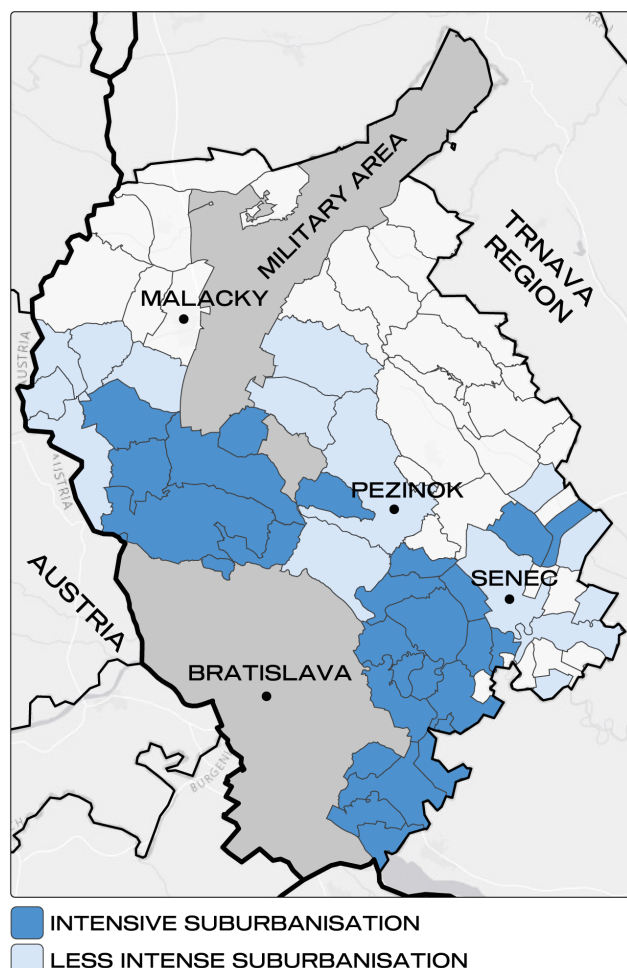


Fig. 1. Classification of residential suburbanisation zones in the Bratislava hinterland (according to Šuška et al., 2018)

Source: SO SR (2024a, 2024b); authors' elaboration

the nearest ones.

The results obtained for all GRID cells in individual municipalities were recalculated using formula (1) above and plotted on a map (Fig. 3); they indicate several spatial phenomena. The first is a spatial cluster of high weighted-distance values (i.e., low transport accessibility) in the southern part of Bratislava's hinterland (with a higher proportion of Slovak Hungarians), an area recently marked by intensive suburbanisation. These municipalities exhibit above-average housing construction, migration, and natural population growth. The second group mostly consists of the municipalities in the Sub-Carpathian region with favourable or moderate weighted distance values. That is attributed to the lower intensity of new housing construction compared to old development. Finally, the third group includes the Záhorie region

(the western part of the Bratislava hinterland). The group observed average values, attributed to a combination of old and new residential buildings with differentiated accessibility to kindergartens in several municipalities (Majerík, 2025).

Table 1 shows a decrease in the number of children with increased distance from the kindergarten. However, this tendency differs between new and old residential areas. Initial results indicate that the accessibility of kindergartens is less sufficient in newer developments. Statistical tests were used to verify the validity of this hypothesis. The results of the independent two-sample t-test show statistically significant differences in spatial accessibility (distance) to the nearest kindergarten in the Bratislava hinterland. Three t-tests were performed (Welch t-test for differences in weighted distance at the municipal level, Welch t-test for differences in distance at the 100x100 meter GRID cell level, and a population-weighted design-based t-test at the 100x100 meter GRID level). The test results are shown in Table 2. All tests confirm that the distance (accessibility) of kindergartens is less sufficient in new residential complexes compared to the older residential areas. This phenomenon points to an insufficient response by the responsible authorities to the increased demand for (high-quality) kindergartens in the rapidly growing hinterland of Bratislava. And although some analyses suggest that private facilities contribute to increased accessibility (Sládeková Madajová et al., 2021; Majerík, 2025), neither the construction of new kindergartens nor the increase in the capacity of existing ones has ensured improved transport (time) accessibility for all children. In fact, new residential areas with less sufficient accessibility are characterised by higher real estate prices (Ondoš et al., 2017) and therefore often attract higher-income populations (Výboštok & Štefkovičová, 2020). While this may not be a disadvantage for new residents in terms of transport, a kindergarten too far away has several negative consequences for parents' mental health, children's cognitive development, and their emotional and social skills (Young et al., 2020).

Eventually, the resulting values were verified using a linear model with the intensity of suburbanisation processes as a control variable. It appears that although municipalities outside the two suburban zones (cf. Fig. 1) recorded more favourable accessibility to kindergartens (Welch t-test $p = .013$), this factor has a negligible impact (Cohen's $d = -.069$). The same applies to the simple distance model and the model with the independent variable of new versus old development. This finding can be attributed to the fact that although the intensity of suburbanisation manifests differently in space, new construction occurs in the outskirts of municipalities throughout the study area. Kindergartens are often

Tab. 1. Descriptive statistics for distance intervals to the nearest kindergartens

Distance to nearest kindergarten [m]	units	Number of cells			Number of children		
		new	old	sum	new	old	sum
up to 400	abs.	1,125	197	1,322	2,920	687	3,607
	%	85.1	14.9		81.0	19.0	
401–1,000	abs.	2,159	658	2,817	4,646	1,917	6,563
	%	76.6	23.4		70.8	29.2	
1,001–2,000	abs.	778	737	1,515	1,581	2,226	3,807
	%	51.4	48.6		41.5	58.5	
2,001 or more	abs.	100	140	240	242	330	572
	%	41.7	58.3		42.3	57.7	

Source: SO SR (2024), authors' elaboration

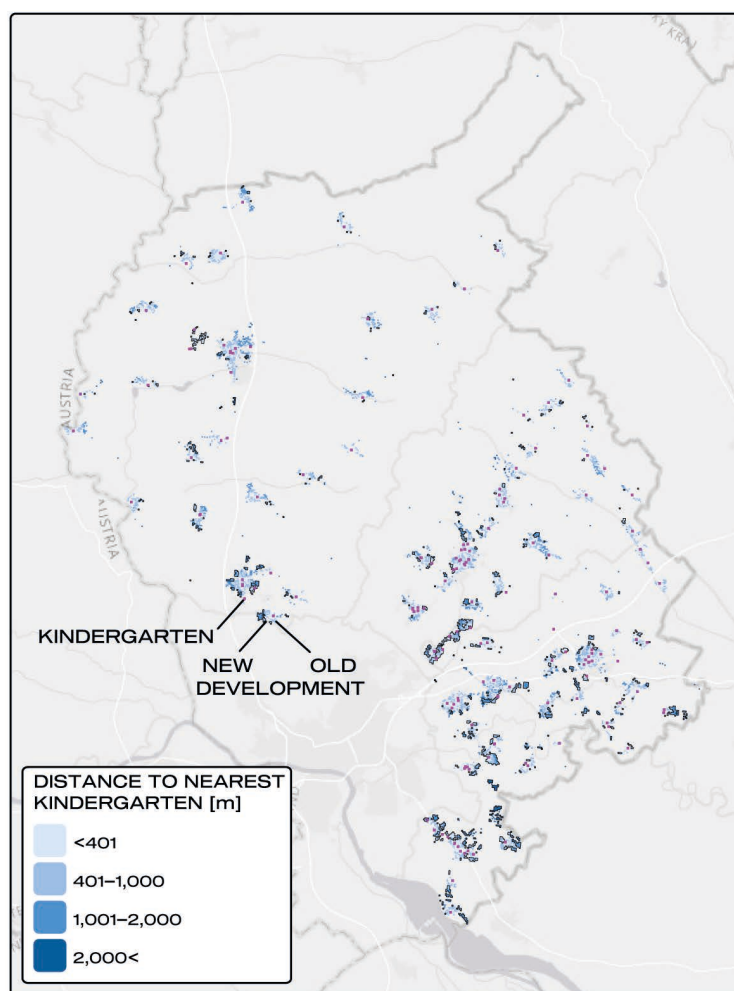


Fig. 2. Distance to kindergartens from the 100x100 m GRID network distinguished by new/old residential development
Source: SO SR (2023); authors' elaboration

Tab.2. Statistical test results

test	variable	scale	t-value	df	p-value	95% CI	Cohen's d
Welch t-test	log(weighted distance)	municipalities	-6.905	124.39	<.001	-.602; -.334	-1.207 (large)
Welch t-test	log(distance)	GRID cells	-22.697	3,755.4	<.001	-.538; -.453	-.609 (medium)
Design-based	log(distance)	GRID cells	-15.392	5 892	<.001	-.561; -.434	-.616 (medium)

Source: authors' elaboration

established in response to new construction and are rarely part of planned development projects. According to these findings, the opening of new kindergartens is insufficient, resulting in new residential areas suffering from poorer transport accessibility to existing kindergartens.

6 DISCUSSION AND CONCLUSIONS

This study examined the accessibility of kindergartens in suburban areas. It primarily focused on the walking and car accessibility to kindergartens. These are the two modes of transport most commonly used for commuting to kindergarten in Slovakia; other modes of transport may also be emerging. It was confirmed that several municipalities affected by suburbanisation processes have less favourable transport accessibility to kindergartens. A significant factor is the construction of new residential areas without basic social infrastructure. New residential developments are being built haphazardly, without

quality urban planning. As a result, the much-described monofunctional horizontal development of family houses, also known as urban sprawl, is emerging (Šveda, 2019; Šuška & Šveda, 2023). Other, non-residential functions are supplied to these zones reactively, often with a significant delay. Households are thus forced to look for kindergartens in locations inaccessible by foot. As a result, private cars have become the preferred mode of transport for suburbanites. Given that public transport is not preferred for commuting to kindergartens in the suburbs, local authorities will have to seek alternative strategies to increase the accessibility of pre-primary facilities. One possibility is to open private, even non-registered childcare facilities for children aged 3-6, which are not authorised to provide compulsory preschool education for 5-year-olds. Additionally, tuition fees in these facilities may be more expensive than in other facilities due to the absence of state financial support. However, they can serve as a complementary service and reduce

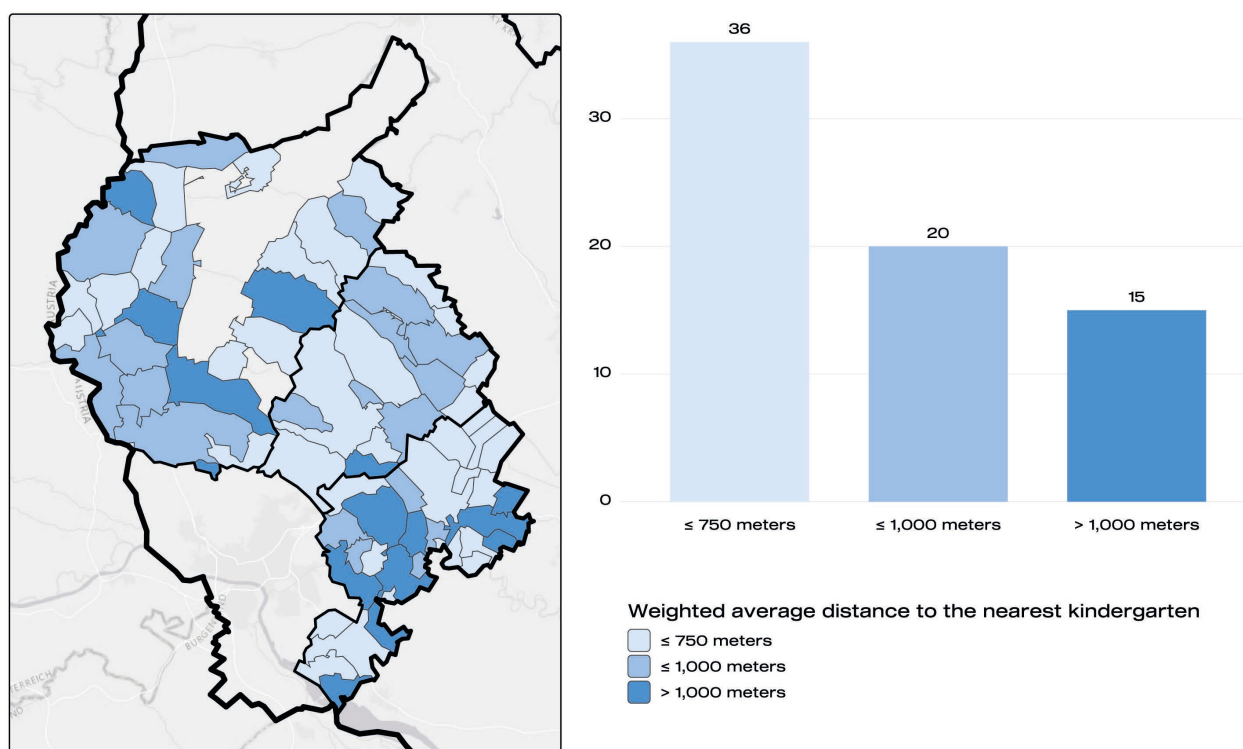


Fig. 3. Average weighted distance in municipalities in the Bratislava hinterland to the nearest kindergarten

Source: authors' elaboration

capacity pressure in regular (network) kindergartens. One possible solution would be to open joint facilities (kindergartens and nurseries). Such facilities may represent a lower financial burden for opening and maintenance, but currently face legislative obstacles. As previous research has shown (Greenburg et al., 2020), children attending nurseries and then kindergartens in the same facility (and thus the same social environment) achieved higher pre-academic (school readiness) skills and exhibited higher social skills with fewer behavioural concerns.

The analyses were based on official data from CVTI (2023) and the 2021 Slovak census (SO SR, 2023). Although these are robust databases, they are limited to a certain extent in terms of quality and timeliness. Every year, changes occur in the register of schools and school facilities (CVTI, 2023), including the addition, closure or expansion of kindergartens. That also affects their capacity, which is determined by regional health authorities. On the other hand, the database of the current residence of preschool-aged children, i.e., where the child resides most frequently, is available only once per decade and depends on the quality of the data entered. In Slovakia, problems persist with the (non-)reporting of permanent residence (Šveda & Podolák, 2014). That means that even though data on a child's permanent residence is, in principle, available for any period, this data is insufficient for detailed research using a high-resolution spatial grid, and more accurate results can be obtained from the census database of current residence. There is potential in utilising mobile network data (Chen et al., 2021). However, these are irrelevant for preschool-aged children, and data on their parents' mobility is an alternative.

A limiting factor in measuring kindergarten accessibility using road distance is the omission of the capacity of individual facilities. Several studies have highlighted differences between the supply (capacity) and potential demand (number of children) in catchment areas of kindergartens. Given the poor

quality of records on kindergartens regarding pupils' place of residence, considering capacity in the case of research on suburban areas may not make sense. In fact, according to research, most parents prefer a kindergarten close to their place of residence (Križan et al., 2025); however, many (suburban) parents have their children enrolled in a kindergarten close to their workplace or in another kindergarten that is relatively far from their permanent residence.

Further research focusing on the (transport) accessibility of kindergartens in suburbs should include either data on actual commuting flows or kindergarten capacities, e.g. using floating catchment area methods. These methods have already been applied in research on kindergarten and primary school accessibility. They analyse not only transport accessibility but also demand (number of children) and supply characteristics (facility capacities) in the analysed region. Alternative supply-demand indexes have been applied in education accessibility research, for example, the potential quotient index (Rosik et al., 2021). Such research can identify, on the one hand, areas with insufficient transport accessibility to kindergartens or areas with insufficient capacity coverage. On the other hand, it will reveal some voluntary preferences or forced strategies of households in choosing alternatives, i.e., kindergartens that are not the most accessible. In such a case, high data granularity (ideally at the address point level) on the current residence of kindergarten-aged children is particularly important, as it allows for more precise modelling of potential commuting flows as a proxy for analysing the actual (in)accessibility of individual facilities.

Acknowledgements:

This work was supported by the Slovak Research and Development Agency under Contract No. APVV-21-0286 and APVV-24-0360, and by the VEGA grant agency under Contract No. VEGA 2/0008/24 and 1/0531/26.

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Article first received: 25 August 2025
Article accepted: 23 October 2025