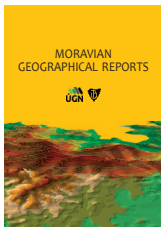

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Where should the support for preschool education be directed? A case study from Slovakia

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Abstract

The low participation rate of preschool children in pre-primary education is most often due to (i) a lack of kindergartens or available places in them, and (ii) low participation of children from a socially disadvantaged environment. Lack of knowledge and information on the specific features of (un)availability of kindergartens, the nature and drivers of low enrolment of preschool children, are often the cause of the poor effectiveness of programmes to increase children's participation in pre-primary education. The approach presented here reflects a broader spectrum of aspects of availability in pre-primary education. The paper aims to identify regions suitable for targeting interventions and funding to support pre-primary education. The intention is to assess the spatial differentiation of availability of pre-primary education based on the regional typology of municipalities and to identify potential factors influencing its variability. Key findings reveal significant regional differences in participation in pre-primary education. The results show that children's participation in pre-primary education is conditioned not only by insufficient kindergarten capacity but also by different demographic, social, and economic conditions. The findings are useful for planning pre-primary education. They highlight the need for targeted interventions and spatially differentiated education policies to improve access to pre-primary education.

Keywords: Pre-primary education, cluster analysis, Regional Types of Availability, kindergarten, targeted interventions, Slovakia

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1. Introduction

In recent years, the issue of early childhood education and care (ECEC) has also found a prominent place in social science research. The key role of pre-primary education in the educational system of society has been repeatedly confirmed by several research studies showing that children's participation in preschool childhood education improves not only their readiness for school entry but also their later school achievements (Barnett & Masse, 2007; Berlinski et al., 2009; Heckman et al., 2010; Mistry et al., 2010). Early childhood education not only enhances cognitive and social skills but also influences children's character traits. In addition to its educational importance, pre-primary education also has substantial economic benefits, as confirmed by several analyses in the field of economic sciences (e.g. Barnett & Masse, 2007; Temple & Reynolds, 2007; Kaščák & Pupala, 2013; van Huizen & Plantenga, 2015; Ragoobur & Narsoo, 2022). The importance of quality preschool education is confirmed by the European Commission's observation that the experience children gain at their earliest age form the basis for their further education and thus make it more likely that they will continue their education throughout their lives, reducing the risk of premature school leaving, increasing the level of highest educational attainment, and reducing the costs to society in terms of lost talent and public expenditure on the social, health and even justice systems (European Commission, 2011). The main direct benefit of early childhood education is the resulting improvement in a child's future life, which is partly reflected in higher lifetime earnings, self-sufficiency (van Huizen & Plantenga, 2015), as well as lower crime (Barnett, 1995) and lower costs for the criminal justice system (Bartik, 2014).

Spatial inequalities in schooling and education are an important topic in the politics of many countries and have led to the development of research that highlights different aspects of the link between education and space (Butler & Hamnett, 2007; Holloway et al., 2010; Kučerová et al., 2020b; Kraftl et al., 2022). Geographical research focuses not only on the locations where education takes place, but also on the role of education within broader socio-economic, cultural, and spatial processes (Holloway & Jöns, 2012; Jahnke et al., 2019; Kučerová et al., 2020b). The geography of education has significant potential for interdisciplinary research on the relationship between space and education (Taylor, 2007). It not only focuses on research on spatial inequality, equity, or the neoliberalisation of education (Holloway et al., 2010; Matlovič & Matlovičová, 2017; Sládeková Madajová et al., 2021; Meyer & Kučerová, 2023; Kučerová et al., 2024), but also explores the everyday experience of parents, children, and pupils with the environments in which education takes place (Kučerová et al., 2020a; Abulibdeh et al., 2024; Rišová, 2024). However, the topic of pre-primary education still has a marginal position in geographical research, despite the relevance of the spatial approach to problem-solving.

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Research consistently highlights the unequal access to pre-primary education, with variations in its utilisation observed across countries, regions, and among children from different socioeconomic backgrounds. These disparities are influenced by a range of factors, not only economic but also demographic and social conditions. The socioeconomic background of households is generally identified as a key determinant of such inequalities. Children from higher socioeconomic backgrounds typically have better and easier access to kindergarten services. In contrast, children from socially disadvantaged environments face multiple barriers – despite the fact that pre-primary education potentially has the most significant positive impact on their further development and success within the education system (Abrassart & Bonoli, 2015).

Another crucial factor influencing access to early childhood education is spatial accessibility, particularly in terms of the capacity of educational facilities and their geographical proximity to children's places of residence (Kim & Wang, 2019). Recent studies suggest that spatial inequalities in the accessibility of pre-primary education are present even in countries where this sector is predominantly publicly funded (e.g. Slovak Republic), where equal access for all children should, in principle, be guaranteed regardless of social background. In general, urban areas with more socioeconomically advantaged populations tend to offer greater kindergarten capacity compared to socioeconomically disadvantaged regions (Pennerstorfer & Pennerstorfer, 2021). Addressing these disproportions requires targeted and tailored interventions that reflect the specific needs of individual communities and child populations.

The aim of this paper is to assess the spatial differentiation of the availability of pre-primary education in Slovakia at the local level. The intention is to highlight spatial inequalities in early education in Slovakia based on the regional typology of municipalities and to identify regions suitable for directing interventions and funding to support pre-primary education. This is a reflection on the practical implications of the research results for the possibilities of more effective planning and allocation of resources, specifically to problem regions.

This paper offers a comprehensive overview of the specific characteristics of pre-primary education in terms of the indicators assessed, as well as their spatial distribution, using the example of a post-socialist state where pre-primary education has long been a neglected topic (Švecová & Tolmáči, 2025).

2. Theoretical background

Policy conversations about educational opportunity are spatial in nature. Spatial patterns shape school enrolment trends, educational access, perceptions of school quality, and countless other issues (Tieken & Auldridge-Reveles, 2019, p. 826). We can draw on key concepts of social justice and spatial inequality or spatial opportunity to explore where support for pre-primary education should be directed geographically (Harvey, 2009; Massey, 1994; Holloway, 1998; Putnam, 2000; Soja, 2010; Moroni & De Franco, 2024; among others). A significant theme in the geography of education is the unequal distribution of educational opportunities. Butler & Hamnett (2007) have explored how space affects national educational attainment and contributes to social exclusion or mobility. Massey (1994) in her work on space, place, and gender suggests that structural inequalities are reinforced through the geography of opportunity. Thus, the location of childcare facilities affects not only children but also other actors in pre-primary education, such as parents, especially women, who are predominantly responsible for childcare (Rišová, 2024). Drawing on the concept of Social Capital and Neighbourhood Effects (Putnam, 2000), the availability of preschools is crucial for building social capital, as early childhood education plays a significant role in shaping the long-term development of a community. In regions with weak social infrastructure, support to improve the availability of education facilities is often lacking. In the case of social inequality, we are particularly concerned with research on inequality and racial segregation, i.e. finding connections between racial and socioeconomic isolation and the resulting availability (or lack thereof) of educational opportunities in different communities (e.g. Brown & Greenfields, 2018; Butler & Sinclair, 2020). Research on general education policy has examined how parents and students select schools (Križan et al., 2025), and school closures (Kučerová et al., 2024), among others.

A geographical approach to social issues in early childhood education suggests that interventions should focus on regions where disparities in approach, availability, and quality of early childhood education are most pronounced. Holloway (1998) developed the concept of childcare culture by distinguishing two approaches within the geography of justice: (i) the territorial (spatial) equity approach, which is based on a liberal understanding of equity, and (ii) the childcare culture approach, which is based on a post-structural understanding of equity. The above approach emphasises that access to preschool education is not only a matter of policy but also of spatial justice, where inequalities in provision can exacerbate existing social inequalities. The provision of (preschool) education is often (and naturally) unequally distributed across space and is guided by patterns of wealth rather than the needs of actors. More privileged regions tend to have more well-funded childcare facilities, while marginalised communities suffer from limited access to education facilities. Applying this approach, support should be targeted at regions where access to facilities is limited but the need is high. Examples are rural regions with a lower concentration of preschool facilities or regions with a high concentration of minority or marginalised groups. It is precisely such regions that geographers can identify using spatial analysis and geographic information systems tools.

3. Regional context

In Slovakia, early childhood education (ECE) for children aged three and older is provided in preschools of various types[1], however, according to Act No. 209/2019 Coll. (hereinafter the School Act), only the so-called kindergartens registered in the Network of Schools and Educational Establishments (which is administered by the Ministry of Education of the Slovak Republic, hereinafter the Network) are the facilities that are authorised to provide pre-primary education (§27 of the School Act). In addition to kindergartens, other, usually private facilities not included in the Network, provide 'only' childcare services[2]. ECE is provided in the form of a public service, to which not only the state but also parents contribute. However, it is free of charge only for

[1] There are several types of preschool institutions in Slovakia. They can be classified from various perspectives (by founder, educational program, etc.), but we will not go into their categorisation in more detail. It is sufficient to distinguish preschools by founder, where we divide them into state-run (the founder is the municipality), church-run (church or religious society) and private (legal entity/natural person).

[2] These are kindergarten-type facilities, or children's groups and clubs, or various alternative institutions (children's forest clubs). Data (capacity, number of children) for these facilities is not collected, but according to our own estimates, they may be attended by 3,000–4,000 children. According to official statistics, these children are registered as unschooled. Given the complexity of pre-primary education and its institutional provision, but primarily due to data availability, in the paper, we have proceeded to focus the research specifically on kindergartens and the term pre-primary education is purposely applied to kindergartens.

children from the age of 5 until they enter primary school (except for private facilities), when it is defined as compulsory pre-primary education[3]. In 2023, there were 3,155 kindergartens registered in the Network, of which 2,795 were state-run, 114 church-run, and 246 private (Fig. 1). In 2023, 858 municipalities in Slovakia (29.3%) did not have a kindergarten. Individual municipalities determine the catchment areas for the kindergartens under their jurisdiction. However, parents have a choice when choosing a preschool for their child.

Several decades ago, many Central and Eastern European Countries (CEECs) experienced a process of decentralisation of competences, including those related to education (e.g. Buček, 2017; Nemec, 2018). At the same time, however, there are cases (and Slovakia is an example of this) in which laws passed at the national level become a problem at the local level. To increase enrolment of children aged 3–5 years, the Parliament of the Slovak Republic approved an amendment to the School Act, according to which compulsory attendance in kindergartens for children aged five years, i.e. one year before compulsory school attendance in primary school, was introduced from September 2021. A further amendment to the School Act of 9 May 2023 established the right to admission to pre-primary education in kindergarten from September 2025 for children aged three. (Section 3 of the School Act)[4]. This should facilitate[5] to which Slovakia committed itself by joining the European Union in 2004. This legislation has put pressure on local authorities (municipalities and towns), which have been given several new obligations to create the conditions for compulsory school attendance (completing the missing capacity of kindergartens, providing qualified staff). Several municipalities and cities have responded to the need for increased interest in kindergarten places and have engaged in several calls for proposals aimed at expanding existing capacities or building new preschool facilities – ranging from temporary measures (container kindergartens, kindergartens on the premises of primary schools) to successfully completed projects (Švecová & Križan, 2023).

However, despite the measures implemented so far, Slovakia continues to be one of the countries in the European Union with the lowest participation of children aged three years and older in preschool education. According to Eurostat, the overall participation rate of 3–5-year-old children in Slovakia was 78.6% in 2022[6]. Moreover, enrolment rates in Slovakia are also highly differentiated regionally. The low participation rate not only concerns economically and socially deprived regions, but also developed ones (Sládeková Madajová et al., 2021). The reasons for these disparities are often generalised into two sets of explanations: (i) the absence of kindergartens or the lack of places in them, and (ii) the low participation of children from socially deprived backgrounds. Undoubtedly, sufficient capacities of facilities providing pre-primary education and training are a fundamental prerequisite for increasing the enrolment of preschool children (Polačková et al., 2013). Still, other factors (social policy, parents' financial situation, their attitudes and individual strategies, the nature of the household, etc.) are also relevant. A lack of knowledge and information among policymakers – regarding the specific features of the (un)availability of kindergartens, the nature and drivers of low preschool enrolment in Slovak municipalities, the absence of complete data on children's enrolment (a lack of data on facilities outside the official Network), insufficient awareness of the importance of pre-primary education, and cultural and personal preferences of families favouring home care – are common reasons for the poor effectiveness of programmes aimed at increasing children's participation in pre-primary education.

The new conditions of pre-primary education in Slovakia thus bring challenges not only for kindergarten administrators and parents of preschool children, but ultimately also for social science research. Can the existing network of kindergartens fulfil the letter of the law on compulsory pre-primary education (planned mandatory pre-primary education for all 4-year-olds from September 2027 and September 2028 for all 3-year-olds)? Which regions appear to be problematic? Is the reason for the low

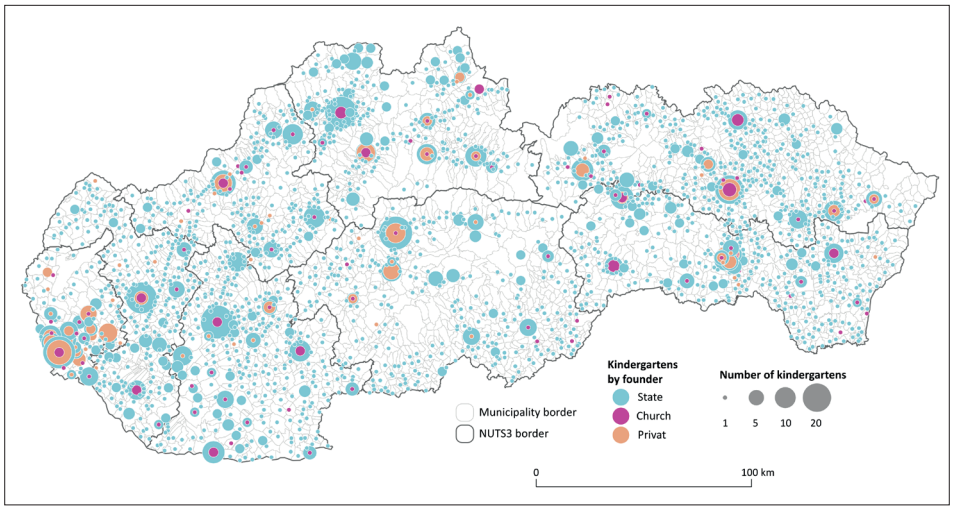

Fig. 1: Spatial distribution of kindergartens in regions of Slovakia in 2023
Source: Authors' elaboration based on data of CVTI (2024) – Slovak Centre of Scientific and Technical Information

[3] In summary, children are admitted to pre-primary education from the age of three, while pre-primary education is currently mandatory from the age of five (respectively one year before compulsory education). Compulsory school attendance in Slovakia applies to children who reach the age of 6 by August 31 of the given year.

[4] Due to the lack of capacity, according to §161l of the School Act, during the transitional period (from September 1, 2021 to August 31, 2026), children are allowed to complete compulsory pre-primary education in other (non-network) preschools.

[5] Increase in the employment rate of parents (especially women) of young children and gender equality in working life; in this context, the European Council has called on Member States to ensure that by 2010 at least 90% of children aged 3 years to school entry age and at least 33% of children under 3 years of age are enrolled in preschool (European Commission, 2013).

[6] The enrolment rate in 2022 for 5-year-olds in was 90.5%, for 4-year-olds 78.6% and for 3-year-olds only 66.6% (https://ec.europa.eu/eurostat/databrowser/view/educ_uoe_enrp07__custom_12850544/default/table?lang=en)

enrolment of preschool children really the insufficient capacity of preschool facilities, or are they rather other (local) specificities? The present article investigates spatial inequalities in access to pre-primary education (differences in demand and supply factors of childcare attendance) in Slovakia and tries to identify the potential determinants that influence its variability.

4. Data and methods

4.1 Study area and Applied methods

The study area consisted of 2,894 municipalities (out of a total of 2,927 municipalities in Slovakia), with at least one child aged 3–6 years in 2023. Municipalities are classified into rural municipalities and those with city status (141). Slovakia is administratively divided into 8 NUTS3 regions (called 'župy') in the context of the European Union classification (Fig. 2). In total, in 100 municipalities in Slovakia there was no child aged 3–4 years in 2023 and in 32 municipalities there was no child aged 3–6 years.

The methodological procedure of the analysis consists of several steps. In the first step, we examined potential factors that influence the development of pre-primary education at the local level. These are a set of demographic, social, economic and other variables (Tab. 1). Their selection is related to the thematic literature search, discussion with local authorities, data availability at the local level, and our empirical experience from field research. Data for all variables used are at the municipality level, but not all refer to the same time period (2023; the most up-to-date data was used). In the set of all municipalities with present children aged 3–6 years, we proceeded in the next step to identify similar clusters and classified the individual municipalities into relatively homogeneous units – regional types. Cluster analysis methods (Everitt et al., 2011) are a suitable means of dividing objects into a certain system of categories so that the mutual similarity of objects classified into one category is maximised, while at the same time the degree of association between objects in different categories is minimised. Since our objects (municipalities) are characterised multidimensionally, i.e. based on multiple variables (11 indicators), the application of the above approach requires their independence from each other. Given that a statistically significant correlation between multiple variables was demonstrated, we transformed the input variables into new hypothetical variables through principal component analysis. Using this multidimensional statistical technique, certain dimensions (factors) in a set of multiple correlated variables can be identified that explain that particular relationship, and the same amount of information can be described by a smaller number of new, independent variables, subject to the least loss of information (Johnson & Wichern, 2007). At the same time, we can uncover the underlying theoretical dimensions of the interrelationships between observed variables (Gorsuch, 1983).

We then proceeded to cluster analysis and classified individual municipalities into relatively intraclass homogeneous and interclass heterogeneous clusters (Everitt, 2009). We used Ward's method as a clustering algorithm, which belongs to the so-called hierarchical agglomerative clustering techniques and seeks to create stable and approximately equal groups (Klapka, 2019). We used the squared Euclidean distance to assess the similarity of objects to be assigned to a common cluster.

Although applied analyses help in the construction of individual dimensions and regional types of municipalities, they do not allow for an understanding of their spatial organisation. Therefore, we visualised the results of the cluster analysis in a geographic information systems environment that is standardly used in geography education (Taylor, 2007; Yoon et al., 2018; Cobb, 2020).

4.2 Characteristics of the selected indicators concerning their manifestation in the study area

In this section, we provide arguments for choosing the analysis variables used in the classification process. At the same time, we briefly assess their manifestation in the regions of Slovakia (Fig. 2) in an attempt to outline the spatial pattern of the potential of the variables affecting pre-primary education.

Capacity and occupancy

The spatial arrangement of pre-primary education is not homogeneous and creates regional disparities (Anderson & Mikesell, 2019; Blumenberg et al., 2023; Sipple et al., 2020). While pre-primary education policy is set at the national or regional level, differences in capacity and occupancy are identified at the local level (Speight et al., 2020; Azuma et al., 2023). Insufficient preschool capacity is considered one of the most serious causes of low participation of children in early childhood education (Sládeková Madajová et al., 2021; Rigová et al., 2020; Polačková

Variables	Description	Time period	Source
Capacity	(Capacity of kindergarten (KG) in the municipality/3–6-year-olds in the municipality) * 100	2023	CVTI**, Statistical Office of the Slovak Republic (SO SR)
Occupancy	(Number of children in KG in the municipality/capacity of KG in the municipality) * 100	2023	CVTI, SO SR
Enrolment[7]	(3 and 4-year-olds in KG/3–4-year-olds in the municipality) * 100	2023	CVTI, SO SR
Accessibility	Time accessibility of the KG from the centroid of the municipal built-up area in minutes	2023	OSRM***
Education higher	Percentage of the population with a tertiary education attainment aged 15–64 in the municipality	2021	Census, 2021
Education primary	Percentage of the population with no higher than primary level education or no education, aged 15–64 in the municipality	2021	Census, 2021
Unemployment	Unemployment rate	2022	CoLSAF****
Wage	Median average monthly gross wage	2014–2017	Social Insurance Agency
Migration	Average net migration rate of 20–40-year-olds	2013–2022	SO SR
MRC*****	Percentage of the population living in marginalised Roma communities in the municipality	2019	Atlas of Roma Communities, 2019
Poverty	(Number of recipients of benefits in material distress in the municipality/number of inhabitants aged 0–64 in the municipality) * 100	2022	CoLSAF

Tab. 1: Description of variables used in the analysis
*Source: Authors' processing of data from ** Slovak Centre of Scientific And Technical Information (CVTI), *** Open Source Routing Machine (OSRM), **** Centre of Labour, Social Affairs and Family (CoLSAF), ***** Marginalised Roma Communities (MRC)*

[7] Enrolment rate calculated for children aged 3–4 years due to the fact that pre-primary education is compulsory for children aged 5 years up to primary school entry.

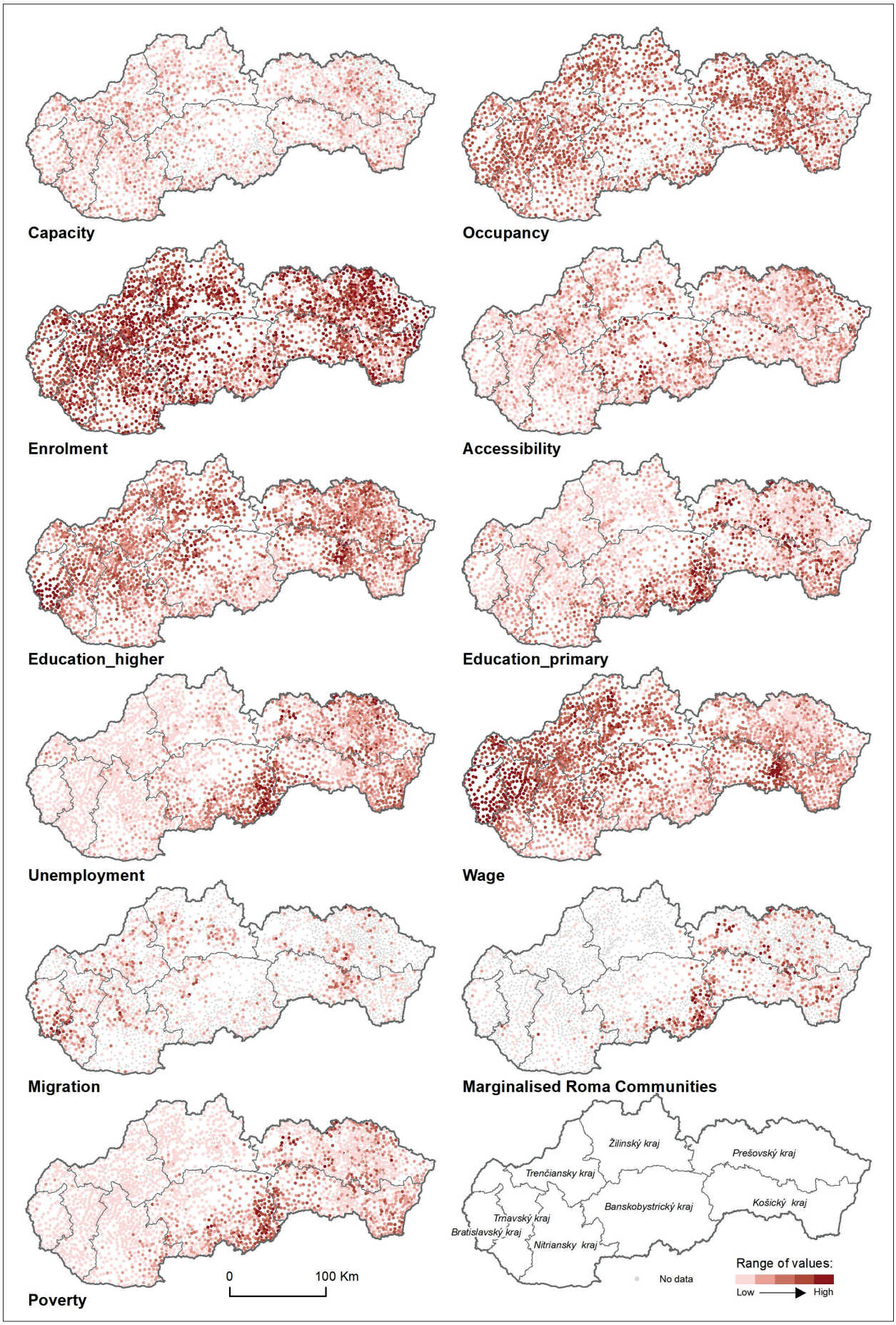

Fig. 2: Spatial distribution of analysed variables in regions of Slovakia
Source: Authors' calculations and elaboration

et al., 2023; Švecová & Tolmáči, 2025). The identification of sites with insufficient capacity is key in strategic planning for expanding services and guaranteeing places in preschools. Even though in 2023, almost a quarter of kindergartens in Slovakia had more than 20% places available, more than half of the municipalities did not have sufficient capacity to guarantee a place for children aged 3 years and older in a catchment kindergarten.

Different values of capacity and occupancy rates of kindergartens show a significant mismatch between demand and supply of kindergarten places in Slovakia at the local level. Many municipalities in Slovakia have more than 100% capacity availability, i.e. the capacity of kindergartens in a settlement is greater than the number of children aged 3–6 years (Fig. 3). These are primarily small municipalities or, in some cases, smaller towns that do have a kindergarten (or kindergartens). However, due to a decline in the number of children compared to previous decades, these facilities are no longer utilised solely by the local population. At present, they increasingly serve as providers of preschool capacity for neighbouring municipalities.

Enrolment

Early childhood enrolment refers to the participation rate of children in pre-primary education. It is one of the key indicators for assessing access to pre-primary education. It reflects not only the spatial distribution and capacity availability of pre-primary facilities (Fig. 2), but also the socio-economic, geographical, cultural, etc. factors that influence parents' decisions to enrol their children in pre-primary facilities. Thus, the causes of low enrolment of children in kindergartens are manifold and often intertwined. In some communities, preschool education is not considered a priority, which may be related to parents' lower education or their negative experiences with the school system. However, lower enrolment of children in preschool education may also be related to a lack of awareness of the opportunities and benefits of preschool education (Küçükturan & Akbaba Altun, 2017).

According to the School Act, a kindergarten "shall be established, as a rule, when the number of children is ten". Although ten children are the minimum threshold at which it is economically viable to establish a kindergarten, given the difficult economic situation of local governments (especially small municipalities), establishing a kindergarten with 10 children can be very challenging. Thus, a number equal to the average of the maximum allowed number of children in one class, namely 20 children, can be considered as a threshold value (Polačková et al., 2023). Out of 2,927 municipalities in Slovakia, 858 did not have a kindergarten, and in as many as 1,162 municipalities, the number of children aged 3–6 was less than 20. An interesting finding is that the average enrolment of children aged 3–4 years is higher in the least populous municipalities (up to 500 inhabitants) than in small towns (5,000–10,000 inhabitants). It rises to an

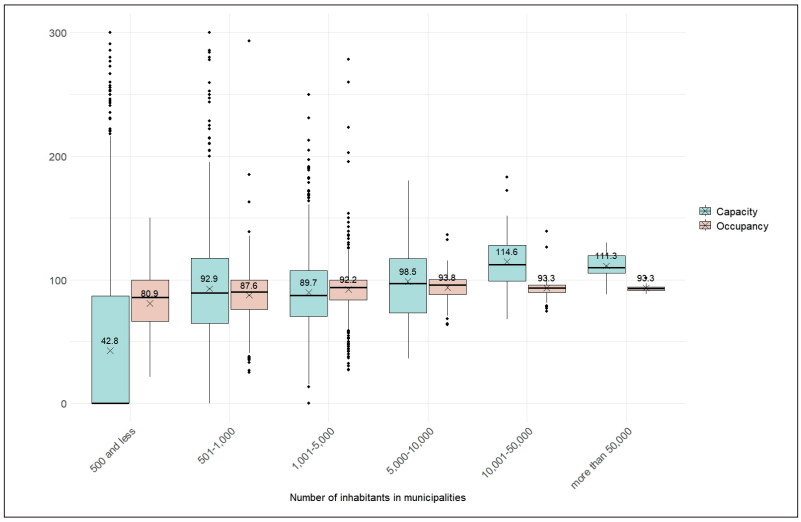

Fig. 3: Capacity (%) and Occupancy (%) of kindergartens in categories of municipalities
Source: Authors' calculations and elaboration

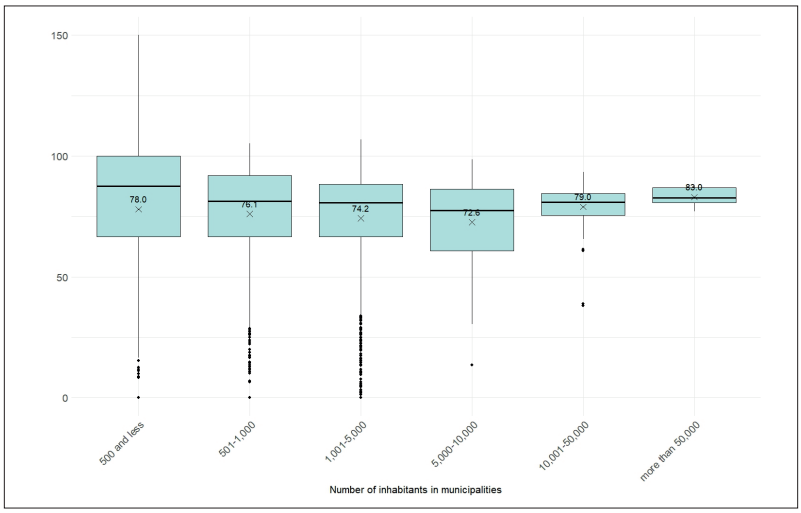

Fig. 4: Enrolment rate (%) of children by municipality category
Source: Authors' calculations and elaboration

average of 83% in the following size category of municipalities (Fig. 4). The officially reported enrolment rates in cities and suburban municipalities of major Slovak urban areas (especially Bratislava and Košice) tend to be lower, largely due to the fact that a proportion of children attend preschool institutions operating outside the official Network. As these institutions are not included in administrative data collections, the children enrolled in them are omitted from official statistics, thereby leading to a systematic underestimation of the actual level of participation.

Time accessibility

The spatial arrangement of school facilities (in our case, kindergartens), which we consider an essential service, is not homogeneous and creates natural regional differences. The distance between homes and childcare providers is crucial in evaluating accessibility and equity in ECE (Hu et al., 2024). However, space is heterogeneous and inequitable in this sense (Fig. 2). When addressing education policy, parents are typically expected to prioritise pre-primary education providers closer to their homes to simplify their daily routines (Köse et al., 2021). However, the reality is often different, and for two main reasons. The first is based on the concept of so-called education deserts (Alexander & Massaro, 2020; Sipple et al., 2020), i.e. areas with limited access to school facilities. The second is based on the specific preferences of parents in raising a child (special schools, private vs. religious vs. public schools, etc.), i.e. their preferences may not (and often do not) align with the ideal spatial arrangement (Križan et al., 2025). This leads to disparities in the temporal accessibility of preschools and thus to a less efficient and equitable conception of childcare. In Slovakia, the average time accessibility of preschools is 3.6 min (by car), but with significant differences between different categories of municipalities. Many rural municipalities have a kindergarten accessible in more than 10 minutes (6% of municipalities with more than 44,000 inhabitants).

Education

Often discussed factor influencing the decision to place a child in kindergarten is the parents' education. Several studies confirm that a child's participation in primary education is closely related to the parents' educational level (Choudhury et al., 2023; Scholz et al., 2019). Educated parents are more aware of the importance of preschool education for the child's cognitive and social development. They understand the long-term benefits of preschool education, such as better academic performance and more developed social skills (Cuartas, 2022). The higher the parents' educational level, the more likely the child is to participate in early childhood education. Higher levels of parental education are often associated with higher incomes, allowing families to pay for quality early childhood education. Conversely, parents with less education may face financial constraints that reduce their child's chances of enrolling in kindergarten (Kachi et al., 2020).

Unemployment

An important socio-economic factor influencing the level of early childhood education is the active participation of their parents in the labour market (Jensen, 2023). Loss of employment leads to their exclusion from the labour market and a lack of opportunities to meet their needs, as it is associated with a loss of income. Consequently, unemployed individuals may adjust their lifestyle (Pohlan, 2019). Exclusion from employment can lead to social exclusion, but it also increases the risk of long-term social welfare benefit dependency (Bhuller et al., 2017). Parental unemployment can also reduce children's well-being and school performance (e.g. Rege et al., 2011; Powdthavee & Vernoit, 2013) and lead to lower investment in children's education. This can contribute to lower educational attainment, poorer labour market outcomes and lower lifetime earnings for children (Schmidpeter, 2020; Reis, 2024). Unemployment rates are highly differentiated across Slovakia (Fig. 2) and are closely related to the socioeconomic level of regions (UPSVAR, 2024).

Wage

Wages are an important economic indicator closely related to providing the basic necessities of life for an individual. Wages and their level are among the basic determinants of social differentiation and social classes, and they also influence a person's social status. Low wages can lead to unemployment and an increase in the number of people receiving social benefits (Michálek & Podolák, 2014). The household income level is also closely related to parents' willingness to invest in their children's development (Aughinbaugh & Gittleman, 2003; Taylor et al., 2004). Several studies have shown that there is a significant correlation between family income and the level of intellectual and behavioural development (Morrissey et al., 2014), which is particularly important for children from low-income families, with lower parental education, and children from disadvantaged backgrounds (Shea, 2000; Berger et al., 2009). The importance of family investment for early child development is also confirmed in the work of Cunha (2014), Del Boca et al. (2014) and Caucutt et al. (2017). However, such investments vary across space, so not all parents (or their children) have the same opportunities. The monthly average wage in Slovakia increases with the size of the population of municipalities.

Migration

Internal migration also has a significant impact on the effective provision of pre-primary education through several factors. The movement of young people from rural areas to larger cities leads to a concentration of population in urban areas (Novotný, 2019; Maris, 2020), which increases demand for pre-primary facilities and often causes overcrowding in classrooms and increased pressure on existing infrastructure. On the other hand, regions suffering from depopulation face reduced demand, which can lead to the closure of preschools or limited investment in their modernisation. A specific case is the movement of populations to the suburbs. In these regions, there is often a rapid increase in the number of families with children, which usually leads to insufficient capacity of existing preschool facilities (Ostenda et al., 2019). Overall, changes in internal migration pose dynamic challenges for the planning and provision of pre-primary education (Źróbek-Różańska et al., 2021)

Marginalised Roma communities (MRC)

The lack of equal (fair) access to education for Roma is highlighted in several studies (Klaus & Siraj, 2020; Mirgová, 2021; Patache & Neguriţă, 2020; Mendes et al., 2021) or institutional documents (Resolution on the segregation and discrimination of Roma children in education, 2023/2840 – European Parliament, 2023). Justice and injustice have shaped – and are shaped – by locating changing social, political and economic conditions (Butler & Sinclair, 2020). In Slovakia, there are not only large regional disparities in the enrolment of children aged 3–6, but also significant differences between the participation of Roma and non-Roma children in preschool education and training (Markovič & Plachá, 2021). In addition to the lack of kindergarten capacity, reasons for low participation of Roma children in pre-primary education include lack of professional staff, language and cultural barriers, physical distance between residence and kindergarten, and lack of public transport, as well as financial constraints in accessing pre-primary education due to formal and informal fees and other expenses (Kahanec et al., 2020; Polačková et al., 2023). While the issue of MRC has a society-wide impact, its manifestations are highly concentrated. In Slovakia, there are marked differences in the presence of the MRC in municipalities. In some municipalities,

the proportion of the community is as high as 100%, in others it is virtually zero (Fig. 2). While in rural municipalities this is often an almost intractable problem of segregation of children[8], in towns of over 10,000 inhabitants it is almost non-existent.

Poverty

As several sociological studies have shown, price is among the significant factors influencing the choice of preschool (Ghosh & Dey, 2020; Grogan, 2012), especially for vulnerable populations such as the unemployed, divorced parents, low-income households and multi-child families (Križan et al., 2025). Families in material need often face barriers that can affect their children's participation in kindergarten. Although preschool may be free, additional costs such as fees for meals, school supplies, or transportation can be burdensome for families in material need (Walakisa, 2024). The highest share of recipients of material distress benefits is concentrated in the socio-economically least developed regions, most affected by unemployment (Fig. 2). In municipalities with up to 500 inhabitants, an average of 47 inhabitants aged 0–64 receive material distress benefits. The number decreases as the population increases.

5. Results

Transforming the original vector of selected indicators by principal component analysis and using the Varimax rotation method, three factor-pure dimensions were extracted (goodness of fit: Kaiser-Meyer-Olkin measure (KMO) = 0.817, Bartlett's test of sphericity $p < 0.001$), capturing 73.45% of the variability of all variables (Tab. 2).[9]

	1. component	2. component	3. component
Education_primary	0.931		
MRC	0.921		
Poverty	0.901		
Unemployment	0.840		
Enrolment	− 0.739		
Occupancy		0.853	
Accessibility		− 0.822	
Capacity		0.727	
Migration			0.869
Wage			0.648

Tab. 2: Rotated Component Matrix (Notes: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation. Rotation converged in 4 iterations)
Source: Authors' calculations

The first component is positively saturated with four variables related to the share of primary education of parents, marginalised Roma communities, benefits in material need, and unemployment rate, with factor loadings ranging from 0.840 to 0.931. Their counterpart, the preschool enrolment rate (− 0.739), is also included. This latent variable can be interpreted as a factor of socio-economic deprivation. That is, the more inhabitants in a municipality with primary education or no education, the higher the proportion of inhabitants living in marginalised Roma communities, the more inhabitants receiving material distress benefits, or the higher the unemployment rate, the lower the enrolment rate of children aged 3–4 years.

The second component is primarily saturated by the variables occupancy (0.853) and capacity (0.727), which are negatively correlated with (time) accessibility of kindergartens (− 0.822). This result can be interpreted as a factor of the physical availability of kindergartens, which captures the discrepancy between good capacity and occupancy (utilisation) of kindergartens and their real-time (spatial) accessibility. Although the kindergartens are full and sufficient in capacity, they are less accessible – their time or time-space accessibility is impaired.

The third component is positively correlated with two variables: migration (0.869) and wage (0.648). This dimension can be termed as an economic attractiveness factor because the primary motivation for migration of the population aged 20–40 years is better economic conditions, which are closely correlated with the wage level (Tab. 2). Thus, this component links more economically attractive locations with a positive migration balance and higher income levels/better working conditions (Tab. 2).

In the next part of the analysis, we proceeded to the regional typology of individual municipalities. A total of four variables entered our cluster analysis; in addition to the three new variables (components), we also used the previously omitted indicator Education_higher from the PCA. These variables are already independent of each other, so they can be used to classify the municipalities. We arrived at six significant clusters (Tab. 3, Fig. 5), referred to as Regional types based on pre-primary education availability. We provide their general descriptions below.

Type 1: Municipalities without a kindergarten with average development potential

This type consists of 782 municipalities in the Slovak Republic with a small total population (the average number of inhabitants is 257). Post-productive inhabitants dominate in

Type	1	2	3	4	5	6	National Average
Number of municipalities	782	54	156	351	1,128	423	
Capacity	1.6	54.0	42.2	165.7	104.5	91.0	77.8
Occupancy	1.4	67.3	69.9	78.9	91.2	89.5	63.6
Enrolment	77.3	79.3	29.0	85.5	84.9	60.2	76.2
Accessibility	7.6	2.6	3.2	2.2	2.2	1.7	3.6
Education_higher	15.9	34.4	5.0	15.9	20.3	13.7	17.1
Education_primary	15.0	8.4	54.8	12.8	11.0	25.3	16.7
Unemployment	7.1	2.6	22.4	5.4	3.6	8.8	6.5
Wage	621.7	869.2	530.7	578.2	713.9	614.2	651
Migration	− 2.7	77.7	− 3.7	− 9.0	5.0	− 3.9	0.8
MRC	5.4	0.9	71.4	1.6	1.6	26.6	10.0
Poverty	4.0	0.5	24.9	1.9	1.0	7.0	4.1

Tab. 3: Average values of variables for regional types
Source: Authors' calculations

[8] In general, according to several European Commission reports, Slovakia is the EU Member State with the highest level of segregation of Roma in education.

[9] Based on consideration of the values of the KMO sub-measure, the estimated communality, as well as in terms of obtaining a pure factorial solution, the variable Education_higher was excluded from the PCA analysis. This variable, along with the resulting three components, entered the cluster analysis as a separate variable.

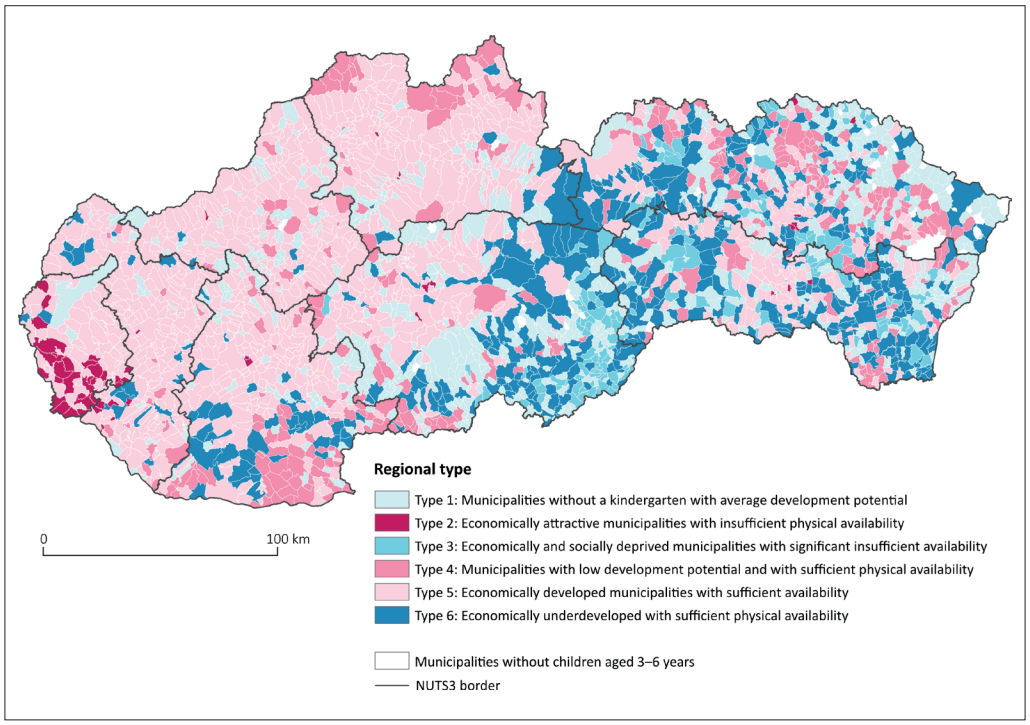

Fig. 5: Regional types based on pre-primary education availability
Source: Authors' elaboration

these municipalities, and the average number of children aged 3–6 years per cluster is less than 10 (Tab. 4). It is unprofitable for these municipalities to establish and operate their own kindergartens. Therefore, most municipalities falling into Type 1 do not even have a kindergarten[10]. This is also why these are the municipalities with the highest values of average time accessibility to kindergartens. Children from these municipalities have to commute to kindergarten on average, almost 8 minutes by car. However, enrolment rates for 3–6-year-olds in these municipalities are among the highest (Fig. 6). Given the above, it can be assumed that municipalities falling into this type can provide pre-primary education in neighbouring municipalities or catchment regions. Spatially, these municipalities are located throughout Slovakia, with an increased concentration in the Banská Bystrica, Prešov and Košice regions (Fig. 5).

Type 2: Economically attractive municipalities with insufficient physical availability

This type is the smallest in terms of the number of municipalities (54), but up to 12.2% of children aged 3–6 years live here (Tab. 4). This type mainly includes several urban districts of the capital city of Bratislava and municipalities located in their suburbanisation zone (Fig. 5). They are characterised by a high socio-economic level with the highest average wage, the lowest unemployment, high educational level and a low proportion of MRC. They have the highest (extreme) migration rates for the population aged 20–40 years (77.7%). However, the average capacity of kindergartens in this type of municipality is the second lowest in Slovakia (54%). This region has faced a shortage of places in public kindergartens and, at the same time, there is a large variety of facilities – including many out-of-network ones that are not included in official statistics. The lower values of average occupancy of facilities (67.3%), as well as the level of schooling of 3–4 and 3–6-year-old children (almost 80% and 88.2%, respectively), are related to the possibility of parental choice regarding where the child will attend the facility. In such an environment, factors such as the quality of the facility, personal references, or the additional activities offered may play a key role in parents' decision-making. As a result, some children attend facilities outside their home municipality. Furthermore, parents who did not wish – or could not afford – to enrol their child in a more expensive non-public (non-network) facility were often compelled to seek placement elsewhere, sometimes beyond the nearest available kindergarten. In many cases, this meant commuting to a kindergarten located in a different municipality.

Type 3: Economically and socially deprived municipalities with significant insufficient availability

A characteristic feature of municipalities of this type is socio-economic as well as educational marginalisation. In almost all the indicators assessed, these municipalities performed the worst. The average monthly wage of the inhabitants of this type of municipality is the lowest, nearly 25% of the inhabitants receive benefits in material distress, and up to 22% are unemployed. The average proportion of the population living in the MRC is more than 70%, and the proportion of the population with primary education or no education is almost 55%. These are municipalities with a low overall population (the average population is the second lowest), but at the same time, the highest proportion of preschool age children of the total population of the municipality (Tab. 4). However, the enrolment rate of children aged 3–4 is only 29%, and the numbers of children aged 3–6 without enrolment in pre-primary education are also high (and the worst) (Fig. 6). Although municipalities are only able to provide a place in kindergarten for 42% of children, kindergarten occupancy rates are at 70%. In this case, the decision to put or not to put a child in kindergarten is motivated by the price and other ancillary expenses related to

[10] A small number of municipalities (13) with a kindergarten were included in Regional Type 1. This is due to the clustering algorithm, which assigned municipalities to clusters based on overall similarity across multiple variables – particularly high travel time to the nearest kindergarten – rather than solely on the presence or absence of a kindergarten. As a result, the average values for capacity and occupancy in this cluster are not zero, although they remain very low.

Type	1	2	3	4	5	6
Population	200,765	586,219	186,868	487,630	3,094,887	866,415
Average value	257	13,323	1,205	1,389	2,800	2,057
No. of children 3–6 years	7,057	25,460	13,731	16,040	110,628	35,038
Average value	9	579	89	46	100	83
(No. of children 3–6 years/Population)*1000	34.1	43.4	73.4	32.9	35.7	40.4
No. of children 3–6 years/3–6 years in Slovakia	3.4	12.2	6.6	7.7	53.2	16.8

Tab. 4: Basic population characteristics by regional type
Source: Authors' calculations

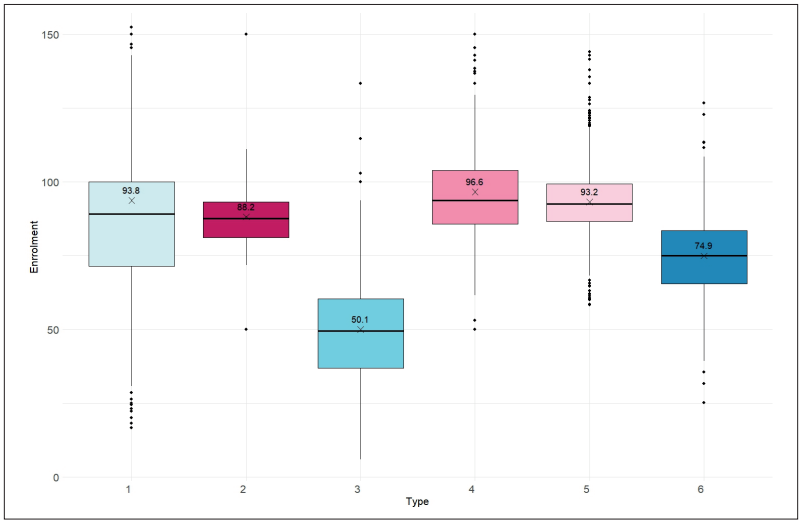

Fig. 6: Enrolment of 3–6-year-olds in municipalities by type
Source: Authors' calculations

attending the facility, which parents in material distress or on the verge of poverty are not able to pay. The spatial distribution of municipalities classified as Type 3 is mainly in the regions of Eastern Slovakia (Fig. 5).

Type 4: Municipalities with low development potential and with sufficient physical availability

The type consists of municipalities with a sufficient (to above average) number of places in kindergartens. These municipalities have an average low number of children aged 3–6 years (Tab. 4), including those who do not attend kindergarten (Fig. 6). The enrolment rate of children aged 3–4 years is the highest among all types (more than 85%). These are marginal municipalities concentrated in the south-west of the Nitra, south-east of the Banská Bystrica, north of the Žilina and Prešov regions (Fig. 5). Due to the low median wage and negative values of migration, these municipalities are characterised by low development potential, which means that especially young people from these municipalities leave for better living conditions, e.g. to larger cities and economically stronger regions.

Type 5: Economically developed municipalities with sufficient availability

It is the most widespread type of municipality. It comprises up to 1,128 municipalities, mainly in Western and Central Slovakia (Fig. 5), and is home to more than half of all children aged 3–6 years (Tab. 4). Municipalities of this type are located in regions with favourable socio-economic conditions, with the second highest average wages, low unemployment, a low share of young children and a favourable educational level of the population. The enrolment rate of 3–4-year-old children in these municipalities is close to 85%, and the kindergarten occupancy rate is slightly above 90%. The municipalities can provide places in kindergartens for almost all children. The average number of children not enrolled in a kindergarten (Fig. 6) is increased by the city of Košice (underestimation of participation due to the exclusion of out-of-network facilities). To a greater extent, Type 5 municipalities are concentrated in the western regions of the state.

Type 6: Economically underdeveloped with sufficient physical availability

It is typical for the municipalities of eastern Slovakia and the southern districts of the Banská Bystrica region (Fig. 5). These are municipalities with low economic potential, with a high emigration of mainly young population in search of work, with a registered unemployment rate of almost 9%, with a below-average educational level, and with a 25% share of the MRC. The second largest number of children aged 3–6 years (16.8%) is found here. Although municipalities can fully provide a place in a kindergarten for almost all children (91% capacity and best time availability), the enrolment of 3–4-year-olds is the second worst (60%).

6. Discussion

This study is based on the idea of spatial equity in research on the availability of pre-primary education and the identification of potential factors influencing children's participation rates. The results point to a significant spatial differentiation of pre-primary education opportunities in Slovakia.

The analysis identifies several types of municipalities with varying levels and potential for providing pre-primary education, shaped by a combination of economic, social, and capacity-related or proximity-based factors. The classification allowed the identification of key determinants influencing children's participation in education. Not only are communities with a lack of pre-primary school capacity (Types 1, 2, 3) problematic, but especially those where the lack of places either coincides with low socio-economic status (Type 3) or is a direct consequence of it (Type 6). It has been shown that the absence of a preschool does not automatically imply low enrolment rates (as exemplified by

Type 1). Conversely, the mere existence of a facility with sufficient capacity is no guarantee of high participation (Type 6).

The results suggest that the identified disparities in pre-primary education reflect broader social or socio-economic inequalities. Such findings are consistent with theoretical frameworks and build on previous findings from several conceptual frameworks relating to the themes of justice, space and inequalities, such as Holloway's (1998) Geographies of Justice, as well as Harvey's (2009) Theory of Uneven Development, Massey's (1994) Concepts of Space and Gender, and Putnam's (2000) notion of social capital. As Moroni & De Franco (2024, p. 3) note, geographic space influences the possibility of obtaining something. Therefore, space has to be taken into account – by urban policies and planning, for instance, in providing certain rights. In other words, one cannot avoid considering space if one wants to grant certain (positive) rights effectively. Spatial perceptions influence education policy, while education policy influences spatial perceptions (Mann & Dudek, 2024). Therefore, it is also necessary to view educational policy as well as spatial policy, which creates opportunities and arguments for a geographical approach to pre-primary education research. We agree with Holloway (1998), who emphasises that preschool education will continue to reinforce existing social and economic inequalities without a spatially equitable approach. Therefore, targeted support must focus on the most disadvantaged communities (Types 3 and 6) and ensure that every child has equitable access to basic educational opportunities. This idea is also supported by education policy in the context of Slovakia, where preschool education is compulsory for children from the age of 5 (Sládeková Madajová et al., 2021; Polačková et al., 2023) and all children from the age of three are legally entitled to a place in kindergarten from September 2025 (Act 209/2019 Coll.). We note that such legislative measures to increase children's participation in pre-primary education are indeed a step forward, but in practice, they encounter (and will encounter) implementation problems. The founders (most often municipalities) do not have equal opportunities to provide pre-primary education. Not only capacity constraints of kindergartens and their time accessibility, but above all, economic constraints and/or cultural and social aspects have meant that not all municipalities have been able to respond effectively to the new legislative requirements. These claims are based in particular on the enrolment rate, which remains below 50% in many regions of Slovakia. This poses a challenge for policymakers and local authorities to direct targeted intervention.

The spatial accessibility of preschool facilities is undoubtedly one of the important factors in the decision to attend kindergarten (Križan et al., 2025; Köse et al., 2021). In Slovak conditions, there are some reports on community transportation organised by local authorities in some municipalities, but these refer mostly to school children's transportation to schools. They are not supported by any systematic tools, and they depend purely on the financial capacities of the municipalities (Horňák et al., 2023; Hluško et al., 2024). Although less favourable timing of kindergarten is generally negatively associated with the level of children's participation in pre-primary education, it turns out that it is not a decisive barrier (Type 6). The analysis shows that the key determinants of pre-primary education in Slovak municipalities, in addition to capacity and spatial accessibility, are mainly social and economic level factors. This finding is consistent with findings from other studies, which suggest that parents' education and their willingness to invest in their children's development, as well as household income levels and household exposure to poverty, respectively, have a significant impact on children's access to education (Taylor et al., 2004; Shapiro et al., 2019; Zaw et al., 2021; Choudhury et al., 2023). At the same time, economic factors, such as wages and employment opportunities, have a crucial influence on population migration (Zaw et al., 2021). In the conditions of Slovakia, migration of the population aged 20–40 is mainly motivated by the desire for better economic conditions (Pregi & Novotný, 2025; Maris, 2020), which are directly correlated with the level of wages in given regions (Michálek & Výbošťok, 2018; Michálek, 2023). Wage and its level are one of the main factors that determine society's distribution and influence individuals' social status. The wage level affects labour mobility and can lead to unemployment and the growth of welfare recipients (Michálek & Podolák, 2014). Migration in particular is often a response to economic inequalities and can affect the demographic and social composition of regions, and thus, indirectly, local pre-primary education.

Overall, there is considerable variation in pre-primary education opportunities between regions. Although the situation in more than half of the municipalities (51%, which includes 53.2% of all preschool children) can be considered problem-free (Types 4 and 5), more than 23% of children aged 3–6 live in municipalities that require a special approach. The most significant problems are concentrated in regions of poverty, with lower levels of parental education and a higher proportion of marginalised groups. It can be assumed that self-regulatory mechanisms at the level of municipalities and communities cannot overcome them (Škvarenina & Martinák, 2023). Therefore, one solution to reduce identified spatial (in)justice is targeted government intervention (Hotz et al., 2019). Drawing on the results of the presented typology, we highlight the need for a strategic direction of support for pre-primary education. While infrastructure is a priority in some communities, in others the focus is on overcoming social barriers. The analysis shows that one-size-fits-all solutions are not effective, and support needs to be differentiated according to the local context.

Priority measures should be targeted at the most critical municipalities. That is, those falling into Type 3 (economically and socially deprived municipalities with insufficient availability) and Type 6 (economically lagging municipalities with sufficient physical availability), where the main barrier is not so much physical availability, but the social situation of families and weak motivation for pre-primary education. Therefore, in addition to investments in construction and capacity expansion, awareness-raising activities linked to incentives and support measures for families (support for social outreach work, cooperation with community centres, free kindergartens, including coverage of ancillary costs – food, transport, supplies) are essential in these regions.

In growth regions (Type 2) and in relatively functional environments (Type 5), it is desirable to introduce a systematic mapping of all forms of providers (including non-public) in order to plan comprehensively for the development of pre-primary education capacity. However, it should not be forgotten to ensure reserve capacities in case of demographic changes (future demographic development) and availability of facilities for children from low-income families (Polačková et al., 2023). In municipalities with low population without a kindergarten (Type 1), where it is not economically efficient to run their own kindergarten, it is necessary to strengthen inter-municipal cooperation and support transport accessibility of pre-primary education (e.g. school buses, attendance allowances).

Despite the relevance of the methods used and the nature of the indicators analysed, it is necessary to point out several research limitations. First, this is research from one country, and results from other regions may not be consistent with our conclusions. The specifics of educational policy due to the long-term development during socialism and the long period of transformation of education also bring different spatial patterns of pre-primary education. Spatial inequalities in pre-primary education depend heavily on a country's policy context, and results

must therefore be interpreted accordingly. Further, these are limits of the data. The variables used reflect primarily quantitative aspects of pre-primary education. Qualitative factors such as parents' preferences or quality of education were not included in the analysis. In addition, the results need to be interpreted in a temporal context. The data analysed represent the situation at a particular time, and future policy interventions or demographic (social or economic) changes may affect the long-term validity of the findings. Last but not least, there are methodological limitations. The chosen combination of component and cluster analysis provides a valuable framework for regional typology of municipalities, but both methods are heavily tainted by the subjectivity of the researcher. Also, on this basis, the results need to be interpreted in a broader context.

Despite these limitations, using a geographical approach to identify social inequities in early childhood education suggests that support should be targeted at spatial inequalities rather than general policies. Regions with historically unfavourable demographics and low investment in early childhood education, often characterised by economic deprivation, social marginalisation or generally underdeveloped educational infrastructure, should be prioritised. By incorporating spatial equity frameworks, policymakers can ensure that early childhood education serves as an instrument of equity rather than a tool to reinforce existing inequalities.

7. Conclusion

Supporting pre-primary education in Slovakia requires a differentiated approach considering specific local conditions. Its direction should be guided by the principle of targeted intervention that takes into account the needs of municipalities, enrolment rates, capacity and socio-economic context. While infrastructure is a priority in some municipalities, the focus is on overcoming social barriers in others. Children from marginalised and low-income groups deserve special attention, for whom pre-primary education is a key tool for reducing inequalities and breaking generational poverty.

Based on the identified regional patterns, planning practices can be targeted to increase public funding, expand awareness of the importance of preschool education and integrate preschools with existing social services. Improving transport links to preschools to increase enrolment rates, or strengthening non-governmental organisations that provide educational support in areas with limited access, are also viable options for addressing these challenges. Conversely, in regions with a favourable situation, we propose maintaining the status quo while exploring successful models that could be applied in regions where intervention is necessary or even essential.

The above practices and findings have important implications for education policy making, suggesting the need for greater targeting of (public) interventions and a regionally differentiated approach. Incorporating a geographical approach into education policy planning will allow for a more efficient allocation of resources in the context of spatial equity of pre-primary education for all children, regardless of their place of residence or socio-economic background.

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