POPULATION DYNAMICS AND DEMOGRAPHIC CRISES IN THE PARISH OF DETVA (1781–1920): EVIDENCE FROM INVERSE PROJECTION[1)]

Ján Golian[2)] – Piotr Rachwał[3)] – Grażyna Liczbińska[4)]

Abstract

This study provides a comprehensive historical demographic analysis of the parish of Detva, located in present-day Slovakia, covering the period 1781–1920. It aims to reconstruct long-term population dynamics and assess the determinants of demographic change in a rural Central European setting, where systematic census data are limited. Parish registers of births, deaths, and marriages serve as the primary sources, with a total of 58,551 baptisms and 39,032 deaths analysed to reconstruct population dynamics. The study applies the inverse projection method, enabling the estimation of population size, age structure, fertility, mortality, and other key demographic indicators in a context where census data are incomplete or unavailable.

The results reveal that the parish experienced gradual population growth, punctuated by periods of crisis caused by epidemics, famine, economic instability, and emigration. Crude Birth and Death Rates, along with Gross and Net Reproduction Rates (GRR and NRR), indicate sustained generational replacement, with fertility remaining high until the late 19th century and only declining under the influence of economic and wartime crises. Life expectancy at birth (e_0) remained relatively low, averaging around 32 years, reflecting high mortality among children and the elderly before the demographic transition. The age structure was dominated by children and young adults, while the oldest age groups were consistently underrepresented due to high mortality. These findings suggest that the demographic regime of Detva remained largely pre-transitional well into the late 19th century, with only partial and delayed responses to broader socio-economic transformations. This research highlights the complex interplay of economic, social, and epidemiological factors in shaping population dynamics in a rural Slovak parish. The findings contribute to a deeper understanding of historical demographic processes in Central Europe and demonstrate the value of parish registers and model-based reconstructions for studying populations in pre-statistical periods.

Keywords: inverse projection method, demographic reconstruction, vital rates, life expectancy, age structure, historical population studies

Demografie, 2026, 68(3): 182–205

DOI: https://doi.org/10.54694/dem.0389

Poznámky jsou na následující straně.

INTRODUCTION

Historical demography provides crucial insights into how populations respond to environmental, social, and economic shocks. In rural Central Europe, particularly in present-day Slovakia, demographic dynamics were heavily influenced by recurrent epidemics, famines, and economic crises (*Golian – Liczbińska*, 2022; *Golian – Liczbińska*, 2023; *Rachwał – Liczbińska*, 2025). These shocks shaped fertility, mortality, and population structure, leaving long-term effects on settlement patterns, family organisation, and social life (*Hajnal*, 1982; *Reher*, 1999). Despite growing interest in historical population studies, long-term, micro-level reconstructions of demographic processes in rural Slovak communities remain relatively scarce, especially for the period preceding the availability of systematic census data.

The parish of Detva, located in central Slovakia, offers a compelling case study of population resilience and vulnerability in pre-industrial rural communities. Established in the mid-17th century, Detva developed as a scattered settlement within primeval forests, with inhabitants primarily engaged as smallholders, shepherds, and craftsmen (*Matiáš*, 2004). Historical sources document repeated environmental and epidemiological shocks, including epidemics of smallpox, cholera, and whooping cough, as well as severe famines resulting from crop failures and climatic variability (*Slezák*, 2001; *Szabó*, 1990). These events periodically disrupted population growth, mortality patterns, and family formation, highlighting the sensitivity of rural communities to environmental stressors.

Parish registers, systematically recording births, deaths, and marriages, provide an invaluable source for reconstructing population dynamics under such shocks (*Wrigley – Schofield*, 1981; *van Zanden*, 1995). Using demographic methods such as inverse projection, it is possible to estimate population size, age structure, fertility, and mortality in periods lacking reliable census data. This approach has proven effective in analysing population responses to environmental and social crises across Europe (*Galloway*, 1994; *Bengtsson – Campbell – Lee*, 2004; *McKeown*, 1976; *Rachwał – Liczbińska*, 2025).

This study examines the interplay between demographic stability and environmental shocks in Detva from 1781 to 1920. It focuses on how epidemics, famines, and economic instability affected births, deaths, life expectancy, and population structure. The study contributes to the literature by providing a rare long-term reconstruction based on parish-level data and by offering new insights into the timing and characteristics of demographic change in rural Central Europe. By tracing these patterns, the research highlights the mechanisms through which rural populations adapted to repeated crises and the long-term consequences of environmental shocks on demographic change. The findings contribute to a broader understanding of population resilience in Central Europe and underscore the value of local-level analyses for studying historical demographic processes (*Reher*, 1999; *Bengtsson – Campbell – Lee*, 2004).

BACKGROUND TO THE DETVA REGION

The research focuses on the agricultural Catholic parish of Detva, located in present-day Slovakia. The town of Detva was founded in the mid-17th century as a woodcutting settlement. The population under study consisted of two distinct parts. The first was the town of Detva itself, which served as the administrative and ecclesiastical centre. The second part of the population lived in isolated settlements founded in the surrounding area, inhabited mainly by smallholders and shepherds (*Ďurková*, 1999: 395). These settlements often consisted of only a few houses with accompanying farm buildings.

1) The paper was written with the support of project VEGA 1/0121/25 Pokles úmrtnosti ako prejav meniacej sa spoločnosti od polovice 19. do polovice 20. storočia (Mortality decline as a manifestation of a changing Slovak society from the mid-19th to the mid-20th century).

2) Pavol Jozef Šafárik University in Košice, Slovakia. Contact: jan.golian@upjs.sk.

3) The John Paul II Catholic University of Lublin, Poland. Contact: piotr.rachwal@kul.pl.

4) Adam Mickiewicz University in Poznan, Poland. Contact: grazyna.liczbinska@amu.edu.pl.

They originated from temporary, seasonal dwellings built for workers, along with provisional barns for livestock. Over time, these temporary structures developed into permanent residences. As the population increased and colonisation progressed, the share of agricultural land in the regional economy expanded (*Janšák*, 1929: 110). This settlement pattern was very rare in the territory of present-day Slovakia. The inhabitants of the scattered *lazy* gradually came to constitute the majority of the present population, while the town of Detva continued to function as the central hub. Municipal offices were located in the town, as were the residences of representatives of the landowner, forest estate administration, and the gendarmerie (*Tomeček*, 2018: 125).

Detva became a local point for all parish residents, including those living in the surrounding hamlets, as well as for people from the wider region. At the beginning of the 1870s, it served as the seat of a local electoral district (*Žudel*, 1993: 79–80). The town acquired the right to hold regular quarterly fairs and weekly markets, which significantly increased interaction among local inhabitants and with people from the broader area (*Zemko et al.*, 1988: 31). This study extends previous research on Detva (e.g. *Golian*, 2016a; *Golian*, 2016b; *Golian*, 2017; *Golian*, 2019a; *Golian*, 2019b; *Golian – Liczbińska*, 2022; *Golian – Liczbińska*, 2023), which focused mainly on crude birth and death rates, by providing a comprehensive reconstruction of population dynamics using inverse projection, including age structure, life expectancy, and reproduction indicators. This allows for a more integrated assessment of demographic processes in rural Central Europe.

Population

The parish of Detva is located in what is now central Slovakia. In the 19th century, it was part of the Kingdom of Hungary, which was part of the Austrian Empire and, later, of Austria-Hungary. More precisely, it can be described as part of Upper Hungary, specifically the territory of Zvolen County, where the parish was one of the most populous settlements. According to the Imperial Commission's population records, at the end of the 1780s the Detva parish had 4,502 parishioners (*Golian*, 2019a: 81). Earlier ecclesiastical sources, specifically the Canonical Visitation of 1781, estimated the population of the parish at approximately 4,000 faithful (*Archives of Banská Bystrica Diocese, Canonica Visitation of Detva Parish 1781*). Church sources confirm that the early 19th century was a very difficult period for the parish in terms of population growth, due to the Napoleonic Wars and the economic crisis. In the first decade of the 19th century, marked by crop failures, famine, and economic difficulties, the population increased to 5,866 people. At the beginning of the 1820s, the population began to gradually rise. Around 1830, there were approximately 7,200 inhabitants in Detva. By the mid-1840s, this had risen to 8,413; however, nearly 1,000 people subsequently emigrated due to another economic crisis (*Golian*, 2013: 37). The population continued to grow, and by the end of the 1860s, 10,035 people lived in the region. In 1890, the area counted 12,161 inhabitants (*Sebők*, 2005; *A Magyar korona országainak. 1890 és 1891 népmozgalma*. 1892). Shortly before the First World War, 14,529 people resided in the Detva region (*A Magyar Szent korona országainak. 1910. évi népszámlálás,* 1912), and after the war, the number was 14,300 (*Štatistický lexikón obcí v republike Československej III. Slovensko*, 1927: 97).

The region was composed primarily of Roman Catholics (approximately 98–99%). The inhabitants of Detva were mainly farmers, with a smaller proportion working as craftsmen, glassmakers, or shepherds. Ethnically, the population was predominantly Slovak (96%), with linguistic minorities including Germans, Hungarians, and Roma (*Golian*, 2019a: 63–68; *A Magyar Szent korona*, 1910).

Population growth was primarily driven by natural increase. Young people generally did not face significant economic or social barriers that would have delayed marriage until approximately the mid-19th century, after which certain constraints became more evident in the context of socio-economic changes and institutional factors (*Őri*, 2015: 17–18). In peasant families, newly married couples often lived in the parents' house (usually the groom's), contributing labour to the household farm. As a result, the age at first (protogamous) marriage was very low; until the 1850s, grooms were on average around 20 years old, while brides were a few years younger (*Golian*, 2016a: 65–72). In the second half of the 19th century, Map 1 **Detva parish within a map of Slovakia during the Austro-Hungarian Monarchy.**

Source: Map modified by the authors based on 'Distribution of Races in Austria-Hungary' from the Historical Atlas by William R. Shepherd, 1911, https://commons.wikimedia.org/wiki/File:Austria_hungary_1911_and_ post_war_borders.jpg.

the age at marriage gradually rose, but generally did not exceed 25. This was partly due to new state regulations requiring compulsory military service, introduced after the Habsburg Monarchy's defeat by Prussia in 1866 (*Laclavíková – Švecová*, 2012: 603). Only upon completing service could young men marry, significantly increasing the minimum marriageable age. Improvements in health and hygiene in households during the second half of the 19th century also contributed to population growth, as the proportion of children surviving to adulthood increased (*Pekařová*, 2015).

Both the economic life of Detva and the living conditions in isolated settlements affected the spread of diseases. Extended families, composed of several nuclear families, often lived together under one roof, headed by the father as the main householder. As a result, statistical records from the second half of the 19th century frequently list households containing multiple adults and many children (*Golian*, 2019a). Poor economic conditions prevented the construction of additional housing, so these extended families often lived in just one or two rooms. These circumstances facilitated the spread of childhood infectious diseases and epidemics among adults, as isolation of the sick was rarely possible (*Golian*, 2019b).

For this study, material was drawn from the church registers of the Detva parish for the years 1781–1920. The research examined birth and death registers. In total, 58,551 baptisms and 39,032 deaths were extracted and analysed. The church registers for this period were generally well preserved and of good quality and are considered reliable sources for demographic reconstruction based on their continuity and consistency. In the Austrian lands, reforms introduced by Maria Theresa and Joseph II improved the quality and protection of registers. They became legally recognised public books, and their records were under the supervision of the relevant authorities. In the 19th century, they were elevated to the status of state books, receiving legal protection. At the end of the 19th century, marriage laws were liberalised and state registries were established. Since 1895, there have been official state records of births, deaths, and marriages, while parishes continued to record church sacraments associated with these events (*Cimmermannová*, 1974: 76).

NUMBERS OF BIRTHS AND DEATHS

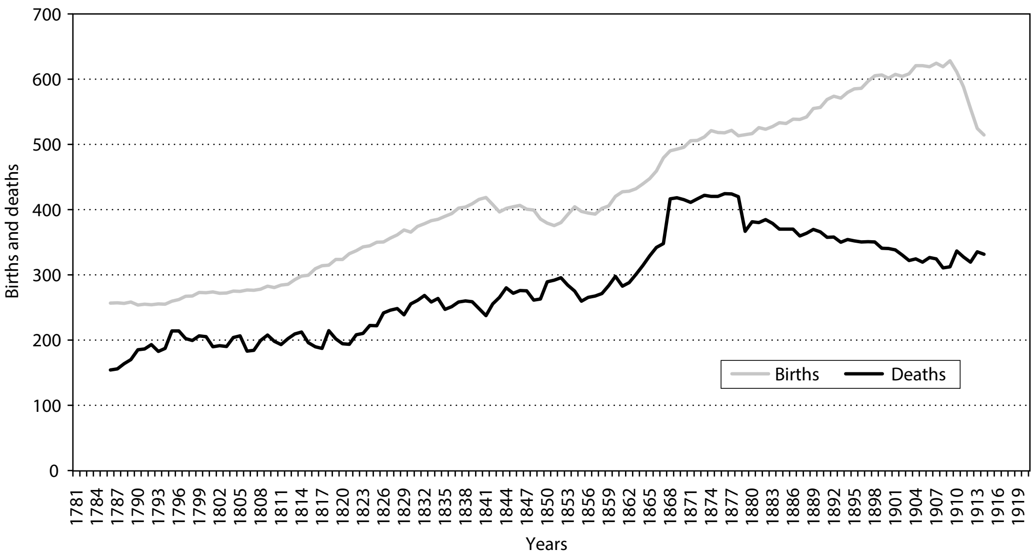
The basic indicators on which the analysis is based are the absolute numbers of births and deaths in the parish of Detva. After extracting the data, they were aggregated into five-year periods; the resulting figures (Table 1, Figure 1) show an overall upward trend in both values. A more detailed overview of births and deaths is presented in a figure displaying vital annual statistics, along with an 11-year moving average (Figure 2). The moving average confirms the general increase, which was driven by the continuous increase in population, but it also allows for a more precise assessment of temporal trends. At the beginning of the observed period, the number of births remained relatively stable, fluctuating only slightly. In the early years of the 19th century, births began to increase gradually. The slow rise in births was closely related to the low marriage rate, which was likely constrained by the difficult economic conditions prevailing in the first two decades of the century. These difficulties were linked to the Austro-French wars and subsequent state bankruptcies, which reduced the purchasing power of the population. A significant increase in births began only in the 1820s and continued until the mid-1840s. This period can be described as relatively peaceful, without internal instability (*Matula – Vozár et al.*, 1987: 560). The upward trend culminated in 1845, when 456 children were born in the parish – the highest number recorded to that time. In the following year, the number of births dropped by 65, and the decline continued in 1847, with only 289 births, followed by 305 in 1848.

Table 1 **Births and Deaths in Detva, 1781–1920**

Years	Births	Deaths	Years	Births	Deaths
1781–1785	1,327	657	1851–1855	1,870	1,411
1786–1790	1,272	795	1856–1860	2,117	1,228
1791–1795	1,250	1,125	1861–1865	2,128	1,591
1796–1800	1,338	1,096	1866–1870	2,396	1,847
1801–1805	1,424	868	1871–1875	2,601	2,334
1806–1810	1,332	956	1876–1880	2,575	1,879
1811–1815	1,479	1,025	1881–1885	2,637	1,941
1816–1820	1,559	920	1886–1890	2,742	1,678
1821–1825	1,711	1,052	1891–1895	2,867	1,897
1826–1830	1,827	1,255	1896–1900	2,999	1,615
1831–1835	1,883	1,391	1901–1905	3,050	1,759
1836–1840	2,009	1,138	1906–1910	3,169	1,500
1841–1845	2,203	1,270	1911–1915	2,987	1,843
1846–1850	1,844	1,543	1916–1920	1,955	1,418
1781–1920	x	x	x	58,551	39,032

Source: Birth and death registers of the Detva parish.

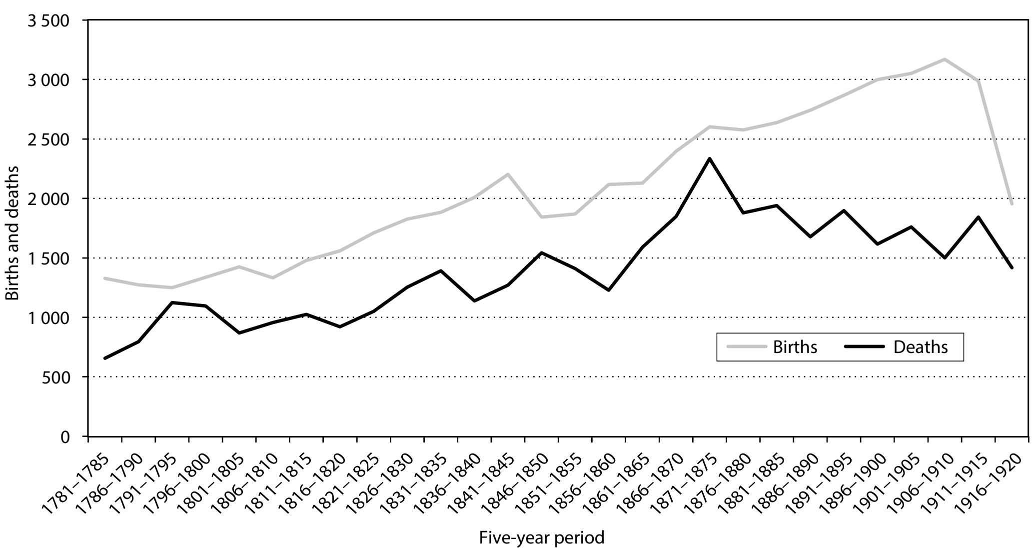
Figure 1 **Births and Deaths in Detva, 1781–1920**



Source: Birth and death registers of the Detva parish.

The decline in the number of births was directly linked to the country's economic collapse and closely associated with crop failures, particularly the potato blight. The predominance of a single crop – the potato – as the main food source had devastating consequences when harvests failed, leading to famine, as occurred in other parts of Europe (*Zadoks*, 2008). The decline in births was also exacerbated by population losses due to a wave of emigration in the mid-1840s.

Figure 2 **An 11-year average of births and deaths, 1780–1920**



Source: Authors' calculations based on the birth and death registers of the Detva parish.

Following these crisis years, the population began to increase significantly. In 1849, the number of baptised children in the Detva parish rose to 476, before declining again to 383 in 1850. From the mid-1850s onward, a significant increase in births can be observed over the following two decades, although there was a partial decline in 1860 and 1861. This temporary slowdown in the rising number of births may be associated with a decline in marriages in the preceding years, which had led to a substantial decline in first marriages (*Golian*, 2016a: 67). The number of births in Detva parish reached peak of 575 in 1872. In subsequent years, the growth of the rate of increase in births slowed, influenced by several epidemics and the crash of the Vienna Stock Exchange (*Schulze*, 1994). These events may have contributed to a decline both in marriage rates and in births within first marriages. From the early 1880s until the outbreak of the First World War, the number of births continued to increase, with occasional years showing no growth; however, these fluctuations did not alter the overall upward trend. The continuous trend of increasing births ceased during the war years, as the wartime draft led to declines in both marriage and fertility rates for social and biological reasons.

The first thirty years of the analysis of deaths in the parish of Detva reveal that the society was in a period of crisis, primarily driven by childhood epidemics. While the register records do not provide specific causes of death, the ages of the deceased suggest that epidemics of childhood diseases had a strong impact on mortality. The victims were mainly children under the age of four, with notable increases in deaths occurring in 1787, 1791, 1796, 1801, 1804, and 1809. For this period, it can be assumed that smallpox, which was widespread across Europe at the turn of the 18th and 19th centuries, was the primary cause of these child deaths (*Kahn*, 1963). In the 1810s, the consequences of the economic crisis became evident, culminating in a nationwide famine caused by crop failure by the end of the decade. The 1820s were marked by significant epidemics of childhood diseases, with notable increases in child mortality in 1823 and 1829. In 1831, the first wave of the cholera epidemic reached the area around Detva during the summer, significantly affecting the parish. Three years later, a severe dysentery epidemic further increased the death toll in 1834 and 1835. After a temporary decline in mortality, child epidemics re-emerged in 1839 and 1842. The late 1840s were marked by a Europe-wide crisis, which led to increased deaths due to famine from crop failures, followed by a wave of cholera and the Hungarian Revolution, accompanied by civil unrest (*Fazekas*, 2024).

From the 1850s onward, causes of death were recorded in the registers, allowing for more detailed analysis. In the mid-1850s, waves of cholera and smallpox contributed to elevated mortality. Childhood epidemics also played a role in increased deaths during the second half of the 1860s. The most critical year occurred in 1873, when 998 deaths were recorded in the parish, the majority due to cholera, smallpox, and whooping cough. Following this period, the number of deaths gradually decreased, although epidemics of dysentery, smallpox, and whooping cough affected the early 1880s. Four years later, measles, tuberculosis, and typhus caused a significant increase in mortality. Further gradual declines were interrupted by waves of child mortality in 1891 and 1902, primarily from whooping cough and scarlet fever. In the sub-sequent years, the number of deaths remained relatively stable, with notable changes occurring only during the First World War. In 1915, several lung diseases, particularly tuberculosis and pneumonia, along with poor nutrition due to economic hardship, led to increased mortality among middle-aged and older populations. The final major health crisis in the observed period was the Spanish flu epidemic, which primarily occurred in late 1918.

METHODS

The demographic analysis is based on the inverse projection method (*Lee*, 1974; *Wrigley et al.*, 1997), which enables the reconstruction of population size, age structure, and core demographic indicators in historical contexts where complete census data are unavailable. The method is particularly suitable for pre-statistical populations, where vital registration (especially baptisms and burials) is typically more reliable than stock population data. This is especially relevant for pre-transitional rural populations, where event registration (births and deaths) tends to be more complete and temporally continuous than population counts derived from sporadic censuses or enumerations. Unlike conventional population projection methods, inverse projection does not aim to forecast future population trends from known demographic parameters. Instead, it reverses this logic by reconstructing past population size and structure from observed demographic events, primarily births, deaths, and, where available, migration. The method seeks parameter combinations under which a hypothetical population could have generated the observed series of births and deaths over successive time intervals.

The procedure begins with specifying an initial population size and selecting model life tables and fertility schedules, typically derived from stable population models. These serve as reference patterns for mortality and fertility. Through an iterative fitting process, mortality and fertility parameters are adjusted so that the number of births and deaths implied by the model population closely matches the empirical data. The outcome is a demographically consistent reconstruction of population size, age structure, and fundamental demographic indicators.

Migration is incorporated as an exogenous component of the model. Due to the lack of detailed historical migration data, net migration is commonly assumed to be constant over the study period. This assumption allows the analysis to focus on the roles of fertility and mortality in shaping population dynamics, while acknowledging migration as a potential source of bias. Such simplification is standard practice in applications of inverse projection (*Lee*, 1974). It is therefore important to stress that migration in this model is not estimated endogenously, but is imposed as an external parameter, and its demographic effects cannot be identified separately from fertility and mortality dynamics.

The method yields estimates of a broad range of demographic variables, including Crude Birth and Death Rates, rates of natural increase, Life Expectancy at Birth, Gross and Net Reproduction Rates (GRR and NRR), and the age distribution of the population. It also facilitates the identification of periods of excess mortality, interpreted as demographic crises, which are reflected in abrupt increases in mortality and declines in survival.

It is important to emphasise that results constitute model-based reconstructions rather than direct empirical measurements. They are sensitive to assumptions about mortality, fertility, and migration. Therefore, interpretation focuses on long-term structural trends rather than short-term fluctuations. This methodological approach follows established practice in historical demography and ensures comparability with previous inverse projection studies. Inverse projection remains one of the most robust tools for analysing historical populations and is widely used in studies of the demographic transition. This constitutes the first application of this method in Slovak historical demography. Although a formal sensitivity analysis was not performed, the inverse projection procedure was evaluated using the goodness-of-fit coefficient (K^2). The obtained value ($K^2 = 0.96$) indicates a satisfactory agreement between the empirical vital events and the reconstructed demographic parameters, suggesting that the adopted assumptions provide a plausible representation of long-term population dynamics (*McCaa – Brignoli*, 1989). In addition, the ergodic properties of inverse projection imply that the influence of possible inaccuracies in the initial population structure gradually diminishes over successive iterations of the reconstruction (*Bród – Rachwał – Strzelecki*, 2016: 97).

The inverse projection procedure used in this study was designed to ensure internal demographic consistency between observed vital events and reconstructed population stocks. All parameter choices were made to allow comparability with established historical demographic reconstructions and to ensure methodological transparency. In particular, the selection of model assumptions was guided by the principle of minimising arbitrary local calibration in favour of standardised demographic structures derived from widely used model life tables and fertility schedules.

To calculate the desired parameters characterising the population of the selected parish in the study area, version 2.9 of the Populate program (developed in 1991) was employed (*McCaa*, 1989). The projection was carried out for successive five-year periods, without distinguishing by sex. The reconstructed population stocks refer to specific dates within each five-year interval. The beginning population refers to 1 January of the first year of the interval, whereas the mid-period population and the reconstructed age structure refer to 1 July of the middle year. Thus, for the interval 1781–1785, the beginning population refers to 1 January 1781, while the mid-period population and age structure refer to 1 July 1783. Five-year intervals were selected because they reduce the influence of short-term stochastic fluctuations in births and deaths, which are common in relatively small historical populations. Aggregation into five-year periods improves the stability of inverse projection estimates and corresponds to standard demographic practice in historical population reconstruction. The use of the Populate program requires the specification of several input parameters necessary for carrying out the projection. These include information on the initial population size, that is, the population level at the point from which the simulation begins; the natural movement of the population, more precisely the statistics of births and deaths for the entire study period (in this case aggregated data for successive five-year intervals); the pattern of mortality in the population, that is, the Probability of Death (q_x) in successive age groups or, alternatively, the probability of surviving to the next age group (survival probabilities); the value of the overall rate of population increase or decrease (growth rate – r); the age structure of the population under study; and the mean age of women at childbirth (mean age at childbearing), which corresponds to specific fertility schedules for successive five-year age groups within the range 15–49 years, that is, the assumed reproductive age span of women. An additional parameter, if migration is assumed to occur, is the fertility level of the parish population.[5)] Among the input parameters listed above, only the first two – the initial population size and the numbers of births and deaths (as discussed below) – could be obtained directly or indirectly from the empirical material. In the remaining cases, the selection of parameters was based on the model life tables developed by *A. J. Coale*, *P. Demeny* and *B. Vaughan* (1983). The initial population size in 1781 was estimated at 4,000 individuals. The initial population size of 4,000 individuals was adopted because this figure is reported in the Canonical Visitation of 1781, corresponding to the starting year of the reconstruction. Although the rounded number suggests an approximate estimate, it is corroborated by data from the Joseph II parish regulation (Pfarregulierung), which recorded 4,502 inhabitants. After subtracting the natural increase recorded between 1782 and 1786 (733 persons), the estimated population at the beginning of the 1780s equals 3,769 individuals, closely matching the ecclesiastical estimate.[6)] In the conducted estimates, it was assumed that during the study period Life Expectancy at Birth (e_0) was 30 years (West European model variant). The Coale–Demeny West model life tables were selected as the mortality framework for the inverse projection. Although the historical population of Detva belonged to the rural territory of the former Kingdom of Hungary and may have shared features with Eastern European demographic regimes, no empirical life tables exist for this population in the 18th and 19th centuries. The West model therefore provides a neutral and methodologically consistent baseline that ensures comparability with other historical reconstructions. The selected level of life expectancy is consistent with pre-transitional rural populations characterised by high infant and child mortality. The selected parameter corresponded to certain model age-specific

5) Populate applies, in its calculations, the age structure of migrants who arrived in Stockholm in 1841. For successive five-year age groups, the distribution was as follows: 0–4 years – 0.065; 5–9 years – 0.045; 10–14 years – 0.040; 15–19 years – 0.100; 20–24 years – 0.200; 25–29 years – 0.200; 30–34 years – 0.200; 35–39 years – 0.075; 40–44 years – 0.030; 45–49 years – 0.030; 50–54 years – 0.015 (*McCaa – Brignoli*, 1989: 37).

6) Archives of Banská Bystrica Diocese, Canonica Visitation of Detva Parish 1781; National Archives of Hungary, County Council Archives, Parish Regulation 1786–1789. Because inverse projection possesses ergodic properties, even if the initial population estimate is imperfect, its influence progressively fades during the iterative procedure, and the reconstructed age structure converges towards values implied by the empirical vital events and mortality assumptions (*Bród – Rachwał – Strzelecki*, 2016: 103; *Wachter,* 1986).

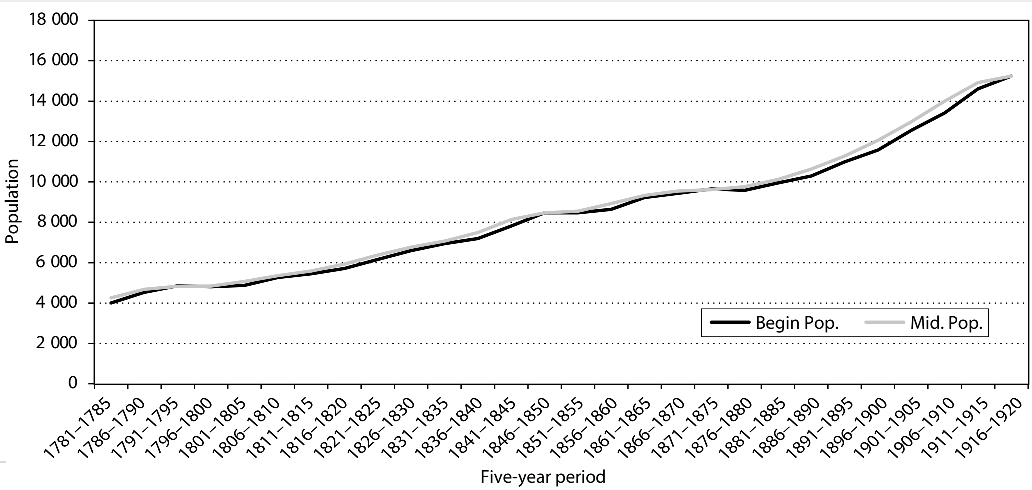
mortality rates and to a particular age structure of the population. In determining the age structure, the additional assumption of a Natural Increase Rate (r) of 0.5% per year was incorporated. It should be emphasised that the assumed rate of natural increase (r = 0.5%) was used only as an initial convergence parameter required for the construction of a stable starting population within the iterative procedure. This value is not interpreted as an empirical estimate of demographic growth and does not enter the substantive interpretation of population change in the study. For the parameter defining the mean age of the mother at childbirth, a value of 29 years was adopted. This corresponded to the following age-specific fertility rates: 0.018 for ages 15–19; 0.042 for 20–24; 0.056 for 25–29; 0.044 for 30–34; 0.028 for 35–39; 0.010 for 40–44; and 0.002 for 45–49. The assumed mean age at childbearing of 29 years corresponds closely to fertility schedules documented for pre-transitional rural populations in Central Europe, where relatively late marriage and childbearing patterns were common when compared with many non-European populations. The projection process also assumed that the population was open to migration; accordingly, a net out-migration was estimated at 7 per 1,000 inhabitants annually.[7)] Because reliable historical migration statistics are not available for the parish throughout the study period, migration was treated as a constant exogenous parameter. The assumed net out-migration of 7‰ annually should therefore be regarded as a modelling simplification rather than a direct empirical observation. This approach follows standard practice in inverse projection studies, where migration is commonly incorporated as a fixed parameter in the absence of independent migration data. Inverse projection results should be interpreted as model-based reconstructions sensitive to assumptions on mortality, fertility, and migration rather than direct empirical measurements.

RESULTS

Population at age structure

Based on the reconstruction of the population using the inverse projection method, it is possible to gradually interpret the changing number of inhabitants in the parish of Detva, as shown in Figure 3.

Figure 3 **The population of Detva in 1781–1920**



Note: Begin Pop.' refers to 1 January of the first year of each five-year interval, whereas 'Mid Pop.' refers to 1 July of the middle year.
Source: Authors' calculations based on inverse projection reconstruction.

7) The level of migration was estimated under the assumption that the initial and final population sizes are known (see above regarding the source information on the population size in Detva). Under these assumptions, the coefficient measuring the fit between the empirical data and the model parameters (K^2) amounted to 0.96. A description of the implementation and operation of R. Lee's algorithm (formula 18) within the Populate program can be found in *McCaa*, 1989: 294; *McCaa – Brignoli,* 1989: 44.

Table 2 **The population of Detva in 1781–1920**

Years	Begin Pop.	Mid Pop.	Years	Begin Pop.	Mid Pop.
1781–1785	4,000	4,256	1851–1855	8,473	8,554
1786–1790	4,530	4,686	1856–1860	8,636	8,924
1791–1795	4,848	4,826	1861–1865	9,222	9,329
1796–1800	4,803	4,840	1866–1870	9,437	9,545
1801–1805	4,877	5,066	1871–1875	9,655	9,620
1806–1810	5,262	5,357	1876–1880	9,584	9,763
1811–1815	5,454	5,584	1881–1885	9,945	10,117
1816–1820	5,717	5,933	1886–1890	10,293	10,639
1821–1825	6,156	6,374	1891–1895	10,997	11,285
1826–1830	6,600	6,768	1896–1900	11,582	12,061
1831–1835	6,941	7,064	1901–1905	12,560	12,979
1836–1840	7,190	7,493	1906–1910	13,412	13,999
1841–1845	7,809	8,132	1911–1915	14,611	14,924
1846–1850	8,469	8,471	1916–1920	15,244	15,245

Note: 'Begin Pop.' refers to the population on 1 January of the first year of each five-year interval, whereas 'Mid Pop.' refers to the population on 1 July of the middle year. For example, for 1781–1785 the corresponding dates are 1 January 1781 and 1 July 1783.
Source: Data on the population of Detva and the authors' calculations.

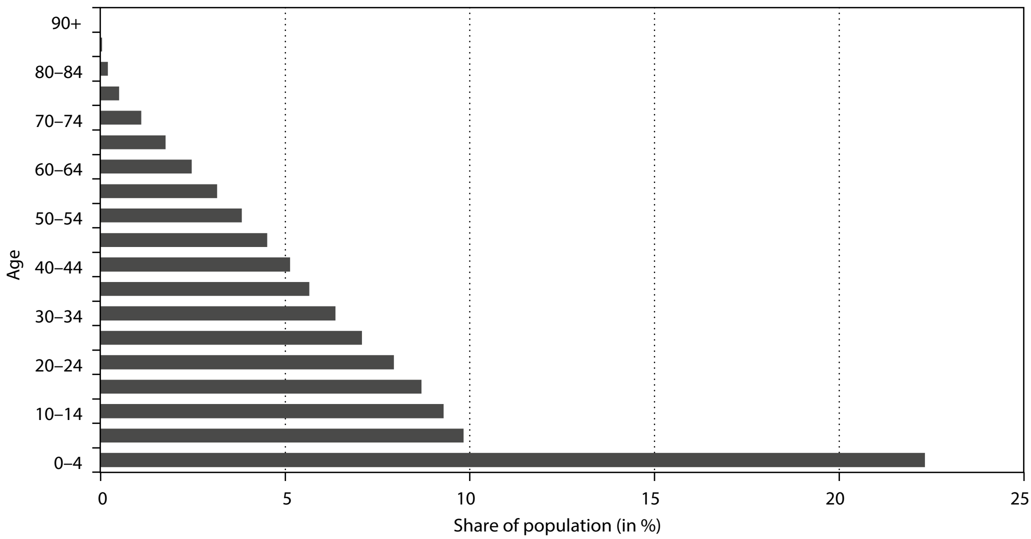
The population estimates for Detva indicate a clear long-term upward trend between 1781 and 1920, although the pace of growth was not uniform. In the late 18th century, the population increased from 4,000 to over 4,800 inhabitants, with a temporary decline visible in 1791–1795 (the mid-period value falling below the initial figure). At the turn of the 18th and 19th centuries, growth was moderate; however, from the early decades of the 19th century a marked acceleration can be observed, particularly in the years 1816–1830. In the period 1831–1845, the dynamics remained strong, and the population exceeded 8,000 inhabitants.

In 1846–1850, a clear stagnation occurred, which may be associated with the economic crisis and the revolutionary events of the late 1840s. After this period, growth resumed, although its pace slowed in the 1860s. Particularly noteworthy is the period 1871–1875, when a slight decline in the mid-period value was recorded, possibly indicating intensified emigration processes. The 1880s and 1890s brought renewed and relatively stable population growth.

At the turn of the 19th and 20th centuries, the growth clearly accelerated: between 1901 and 1915 the number of inhabitants increased from approximately 12,500 to nearly 15,000. The final period under analysis (1916–1920) shows almost complete stagnation, which may be linked to the consequences of the First World War. In the long run, the population of Detva nearly quadrupled, rising from 4,000 to more than 15,000 inhabitants, demonstrating the strong reproductive potential of this community despite periodic crises and migration pressures.

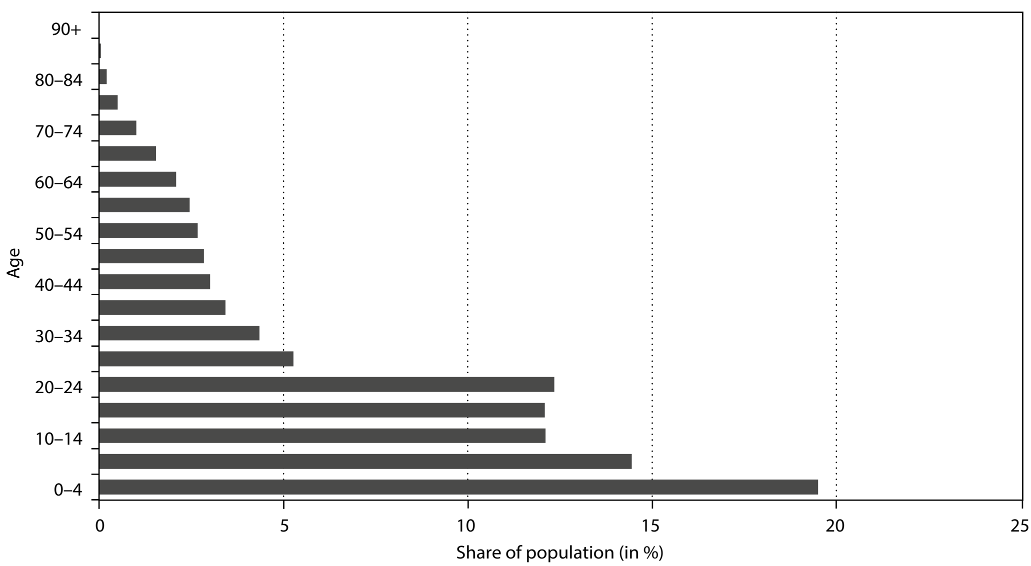
The age structure of the population of Detva, reconstructed using the inverse projection method, reflects a demographic pattern typical of pre-transitional societies, characterised by a very high proportion of the youngest cohorts and an age period with a narrow apex. In the late 18th century, the share of children aged 0–4 exceeded 20%, while the combined proportion of the 0–14 age group often surpassed 40%, indicating high fertility accompanied by persistently high mortality. At the same time, the proportion of individuals aged 60 and over remained very low (usually around 4–6%), reflecting the limited life expectancy characteristic of pre-modern populations. The age structures presented in Figures 4–8 refer to the midpoint of the corresponding five-year intervals, that is, to 1 July of the middle year, rather than to the entire interval (See Figures 4–8).

Figure 4 **The age structure of Detva on 1 July 1783**



Source: Authors' calculations based on inverse projection reconstruction.

Figure 5 **The age structure of Detva on 1 July 1803**



Source: Authors' calculations based on inverse projection reconstruction.

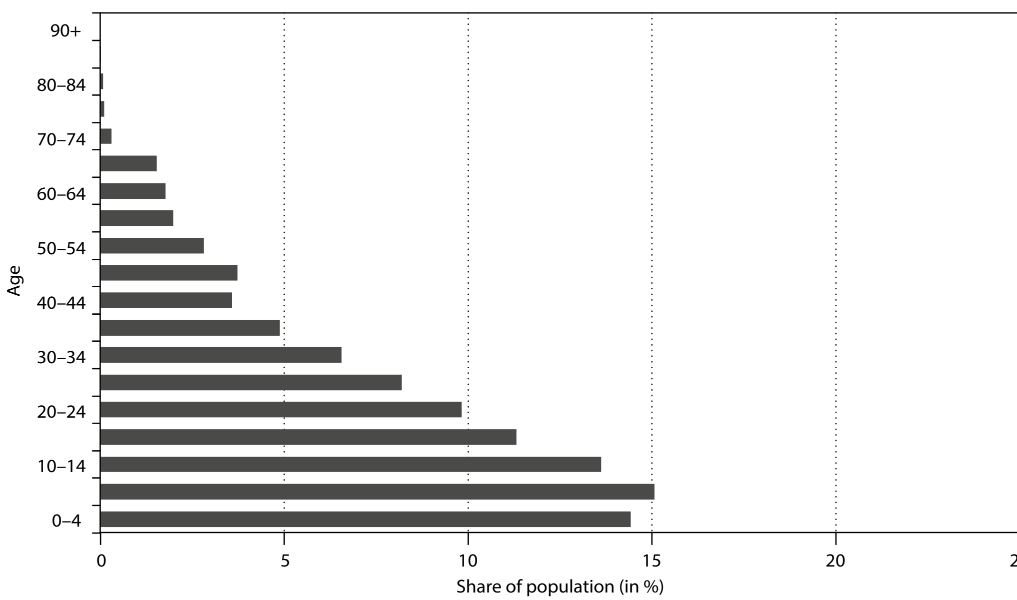
In the first decades of the 19th century, the age structure shows relative stabilisation, although distinct cohort waves appear, particularly in the 10–14 and 15–19 age groups, which may reflect earlier fluctuations in birth cohorts. In the 1840s, especially during 1846–1850, a noticeable decline in the 0–4 age group (to approximately 14%) can be observed, likely reflecting a demographic crisis associated with crop failures, political unrest, and increased migration. The age structure clearly responds to disruptions in reproduction, confirming the sensitivity of the inverse projection model to changes in the balance of vital events.

In the second half of the 19th century, the proportion of the youngest cohorts increases again and stabilises at around 17–18%, suggesting the persistence of high fertility. At the same time, a gradual – though modest – increase in the share of older individuals (60+) becomes visible, particularly towards the end of the 19th and the beginning of the 20th century. However, this was not a dynamic process; the population of Detva remained distinctly 'young' until the eve of the First World War. Irregularities in the 20–34 age groups may reflect the selective emigration of individuals in prime working ages.

At the turn of the 19th and 20th centuries, the age structure begins to show certain signs of transformation: the share of middle-aged groups (30–49) increases slightly, and fluctuations among the youngest cohorts become somewhat less pronounced. The most significant disruption appears in 1916–1920, when the proportion of the 0–4 age group declines to about 10%, a development that can be linked to the consequences of the First World War, in terms of both declining births and elevated mortality. However, there is still no clear evidence of structural population ageing; rather, the data point to a temporary disturbance of the age pyramid.

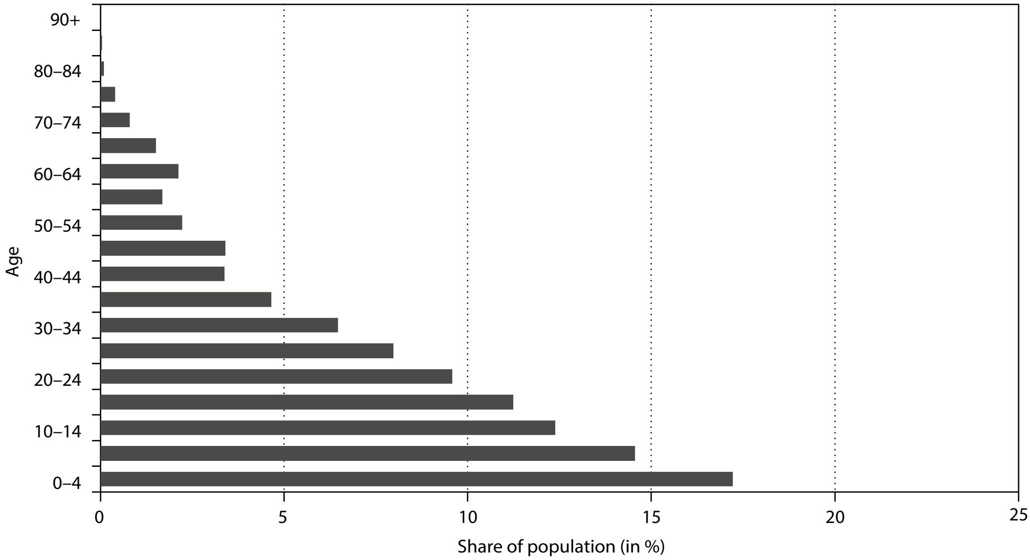
In a long-term perspective, the population of Detva retained the characteristics of a classic high-pressure demographic regime: an age pyramid with a broad base, a small proportion of elderly people, and strong sensitivity to crises and migration in the distribution of cohorts. The age structure thus confirms that until the early 20th century, this community functioned within a system of high fertility and relatively high mortality, with only limited and delayed signs of a full demographic transition.

Figure 6 **The age structure of Detva on 1 July 1848**



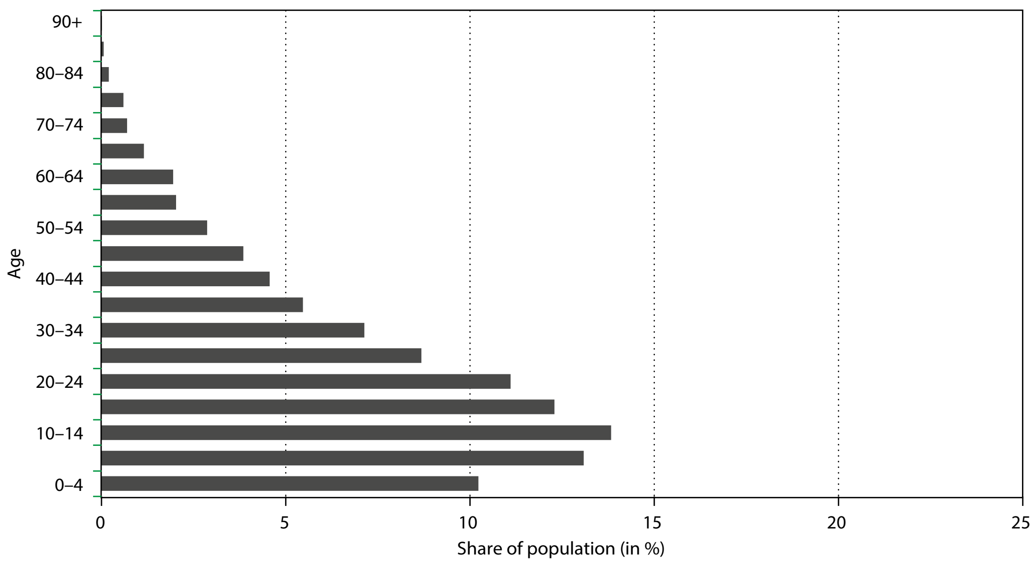
Source: Authors' calculations based on inverse projection reconstruction.

Figure 7 **The age structure of Detva on 1 July 1903**



Source: Authors' calculations based on inverse projection reconstruction.

Figure 8 **The age structure of Detva on 1 July 1918**



Source: Authors' calculations based on inverse projection reconstruction.

Crude Birth and Death Rates

A more accurate analysis of demographic processes in the parish of Detva can be derived from the Crude Birth Rate (CBR) and the Crude Death Rate (CDR) (Table 3). These measures can be used to calculate the natural rate of increase and, depending on the level of mortality, assess demographic crises. At the end of the 18th century, the CBR reached high values,

Table 3 **Crude Birth Rate, Crude Death Rate and Rate of Natural Increase, 1781–1920 (per 1,000 people)**

Years	CBR	CDR	RNI	Years	CBR	CDR	RNI
1781–1785	62.3	30.9	31.5	1851–1855	43.7	33.0	10.7
1786–1790	54.3	33.9	20.4	1856–1860	47.4	27.5	19.9
1791–1795	51.8	46.6	5.2	1861–1865	45.6	34.1	11.5
1796–1800	55.3	45.3	10.0	1866–1870	50.2	38.7	11.5
1801–1805	56.2	34.3	21.9	1871–1875	54.1	48.5	5.6
1806–1810	49.7	35.7	14.0	1876–1880	52.7	38.5	14.3
1811–1815	53.0	36.7	16.3	1881–1885	52.1	38.4	13.8
1816–1820	52.6	31.0	21.5	1886–1890	51.5	31.5	20.0
1821–1825	53.7	33.0	20.7	1891–1895	50.8	33.6	17.2
1826–1830	54.0	37.1	16.9	1896–1900	49.7	26.8	22.9
1831–1835	53.3	39.4	13.9	1901–1905	47.0	27.1	19.9
1836–1840	53.6	30.4	23.2	1906–1910	45.3	21.4	23.8
1841–1845	54.2	31.2	22.9	1911–1915	40.0	24.7	15.3
1846–1850	43.5	36.4	7.1	1916–1920	25.6	18.6	7.0

Source: Authors´ calculations.

exceeding 55‰. These results may be influenced by uncertainties in the population estimates, particularly in the early 1780s. With subsequent improvements in population data, the CBR began a downward trend. It should be noted that, in the Kingdom of Hungary, the CBR generally ranged between 50 and 60‰ at the end of the 18th century (*Svetoň*, 1969: 69–70; *Kohútová – Vozár*, 2006: 95; *Őri*, 2005: 74). The CBR in Detva remained above 50‰ until the mid-1840s, which is similar to the trends observed in other parts of present-day Slovakia (*Pocisková*, 2018: 86).

The rate declined after 1846, decreasing by approximately 10 per mile points and appearing to remain at a broadly similar level for about twenty years. This decline reflects the crisis years of the late 1840s and the subsequent period of economic consolidation in the 1850s. From the mid-1860s onward, the CBR again exceeded 50‰, a level maintained until the end of the 19th century. Comparative studies from the same region indicate that birth rates fell to approximately 40‰ in other rural areas and even lower in urban centres. The decline in Detva's CBR became noticeable only after 1900 and accelerated during the First World War. In comparison, the CBR for the Kingdom of Hungary as a whole fell to around 35‰ in the pre-war years (*Garajová*, 2019: 34; *Pocisková*, 2018: 86).

The CDR fluctuated between 30 and 40‰ from the late 18th century throughout the 19th century. The only exception was the final years of the 18th century, when it exceeded 45‰. During this period, mortality levels increased markedly, indicating the likely occurrence of epidemics or other factors affecting both children and adults. The CDR decreased during 1816–1820, following the economic collapse of the country, reaching approximately 30‰, a level similar to that observed in other rural populations in what is now Slovakia (*Garajová*, 2019: 157).

Mortality rose again in the early 1830s due to the first wave of a cholera outbreak and other childhood epidemics, resulting in a temporary increase in the CDR. After this period, the CDR decreased, reaching around 30‰ in the second half of the 1850s, comparable to other rural areas of Slovakia (*Alberty*, 1981: 25, 57, 95, 100). The situation worsened from the late 1860s to the mid-1880s due to severe childhood epidemics and cholera, trends that were observed across the country and reflected in elevated mortality levels (*Gruber*, 2009: 181). Subsequently, the CDR gradually declined, reaching approximately 20‰ before the First World War, consistent with findings from other regions of historical Hungary (*Garajová*, 2019: 83, 157; *Pakot – Őri*, 2012: 110).

The values of these crude measures can be used to calculate the natural rate of increase, which identifies periods of natural population growth and decline. Excluding the 1780s, which likely contain unreliable population data, the 1790s represented a crisis period, with the gross growth rate ranging between 5 and 10‰. Until the mid-19th century, it stabilised between 14 and 23‰. From the late 1840s to the mid-1870s, natural population growth slowed due to rising mortality. After this period, the gap between birth and death rates widened, as death rates declined while birth rates remained relatively stable, resulting in increasing natural growth. This trend ended at the close of the study period, as the First World War caused a sharp decline in the birth rate. When absolute numbers of natural increase (births minus deaths) are considered, the long-term trajectory confirms sustained positive natural growth throughout most of the period, with only short episodes of a near-zero or temporarily reduced surplus during major crisis decades (notably the 1790s, 1846–1850, and 1871–1875). This reinforces the interpretation that population growth was primarily driven by natural increase rather than migration.

Reproduction index

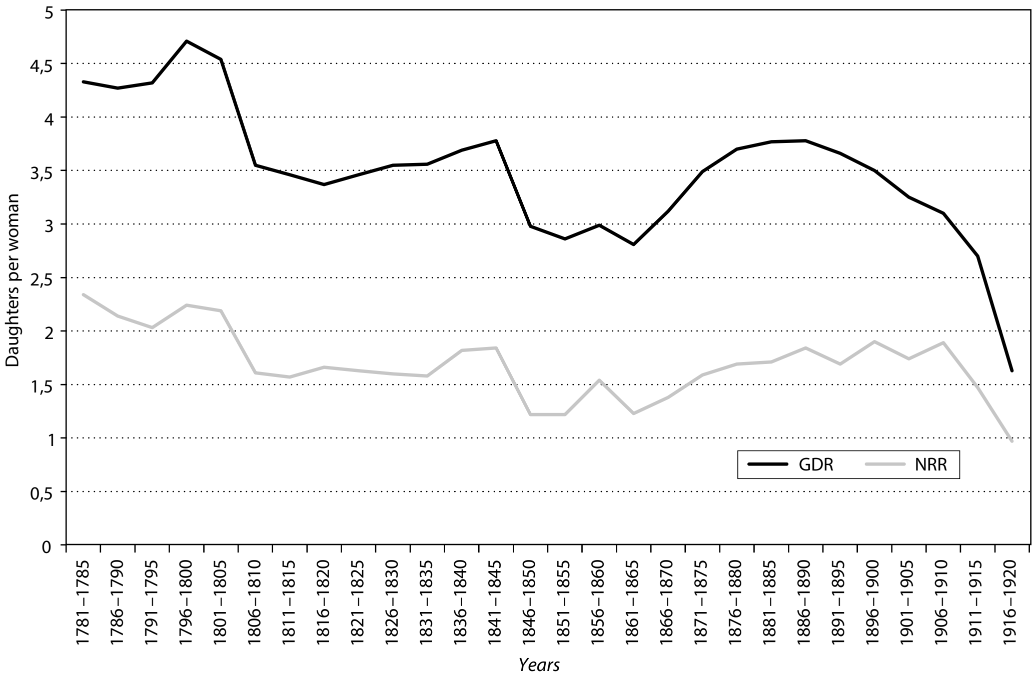
A more detailed analysis of fertility can be obtained through the calculation of the Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR). The GRR reflects the average number of female children born per woman of reproductive age. In contrast, the NRR expresses the average number of daughters who survive to the age of their mothers, per woman of childbearing age, assuming constant fertility and mortality levels according to life tables and fertility schedules. The GRR is considered when comparing the size of the parental generation, including childless individuals, with that of the offspring generation. The NRR is sued when comparing two successive parental generations (*Holzer*, 1999: 271–272). An NRR value of 1.0 indicates that fertility and mortality levels are sufficient to maintain generational replacement. Values above 1.0 indicate a growing population, while values below 1.0 signal a declining population (*Rachwał*, 2019: 345).

Table 4 **Gross and Net Reproduction Rates, 1781–1920**

Year	GRR	NRR	Years	GRR	NRR
1781–1785	4.33	2.34	1851–1855	2.86	1.22
1786–1790	4.27	2.14	1856–1860	2.99	1.54
1791–1795	4.32	2.03	1861–1865	2.81	1.23
1796–1800	4.71	2.24	1866–1870	3.12	1.38
1801–1805	4.54	2.19	1871–1875	3.49	1.59
1806–1810	3.55	1.61	1876–1880	3.70	1.69
1811–1815	3.46	1.57	1881–1885	3.77	1.71
1816–1820	3.37	1.66	1886–1890	3.78	1.84
1821–1825	3.46	1.63	1891–1895	3.66	1.69
1826–1830	3.55	1.60	1896–1900	3.50	1.90
1831–1835	3.56	1.58	1901–1905	3.25	1.74
1836–1840	3.69	1.82	1906–1910	3.10	1.89
1841–1845	3.78	1.84	1911–1915	2.70	1.47
1846–1850	2.98	1.22	1916–1920	1.63	0.97

Source: Authors´ calculations.

Figure 9 **Gross and Net Reproduction Rates (GRR and NRR), 1781–1920**



Source: Authors' calculations.

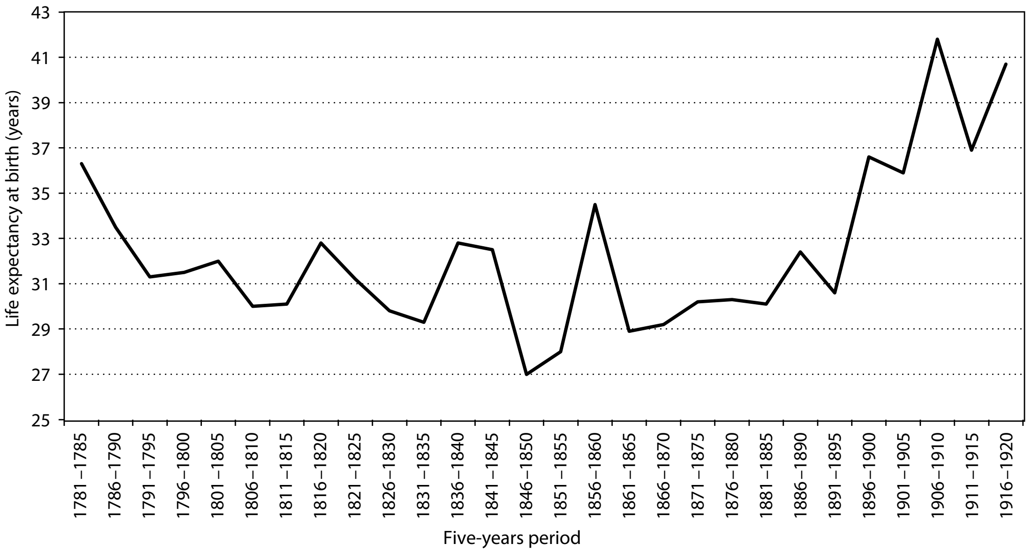
The results for the parish of Detva show that the NRR generally remained above replacement level for most of the studied period. However, during the final period (1916–1920) the NRR declined to 0.97, falling below the replacement threshold and indicating a temporary failure of generational replacement. This decline was associated primarily with a sharp reduction in fertility during the First World War rather than a sustained increase in mortality. This short-term decline in the NRR reflects a wartime fertility shock caused by broader demographic disruption, particularly the absence of young men and delayed marriages. Importantly, it does not indicate a structural demographic collapse, but rather a temporary disturbance in reproductive behaviour under wartime conditions.

Life expectancy at birth

Life expectancy at birth (e_0) is a crucial indicator of mortality that allows for comparisons across time and space. The value indicates the average number of years a person can expect to live from birth given the current conditions of population mortality as characterised by life tables. Wilhelm Lexis noted that the age at which the majority of elderly individuals die determines the 'typical' life expectancy of a population, referred to as the 'normal' age. Until the early 20th century, in most populations this typical age was significantly higher – by about 20–30 years – than the (e_0) value. Today, in populations with low mortality, the difference between these values is only a few years (*Okólski*, 2004: 77). This shift is largely explained by the demographic transition: before this transition, a substantial proportion of children died young due to epidemics, which kept the average life expectancy relatively low (*Rachwał*, 2019: 345).

The reconstruction of life expectancy at birth (e_0) for the parish of Detva, based on the inverse projection method, indicates a relatively stable long-term pattern over the 140-year study period, with an average value of approximately 32.4 years (Figure 10). Although short-term fluctuations are clearly visible, the overall level of life expectancy remained remarkably consistent throughout most of the 19th century.

Figure 10 **Life expectancy at birth (e_0), 1781–1920**



Source: Authors' calculations.

At the beginning of the period, life expectancy was relatively high, reaching about 35 years in 1781–1785. However, this early value should be interpreted with caution, as it may partly reflect the lower reliability of population estimates in the initial phase of reconstruction. From the late 18th century until the mid-19th century, life expectancy generally fluctuated between 30 and 32 years, which is characteristic of a high-mortality, pre-transitional demographic regime. Minor oscillations within this range are difficult to explain precisely, yet certain improvements in life expectancy – such as in 1816–1820 – coincided with periods of reduced mortality and are reflected in modest increases in e_0.

A marked deterioration in survival conditions occurred in the mid-19th century. Life expectancy declined sharply during the first cholera epidemic and again during the crisis of the late 1840s, reaching a low of 27.0 years in 1846–1850. The low level persisted in the subsequent five-year period, indicating sustained mortality pressure. Given the sensitivity of life expectancy at birth to infant and child mortality, these declines likely reflect significant increases in early-age deaths. Although the inverse projection method may amplify short-term instability – especially in periods affected by migration or incomplete registration – the magnitude and persistence of the mid-century decline strongly suggest a genuine mortality crisis.

With the exception of the temporary improvements observed in 1856–1860 and again in 1886–1890, life expectancy remained close to 30 years until the mid-1890s. This prolonged stagnation indicates that, despite episodic recoveries, the population continued to function within a traditional mortality regime for much of the 19th century. No sustained upward trend is visible during this phase.

A more decisive transformation only becomes apparent from the end of the 19th century onward. After 1896, life expectancy rose markedly, reaching 36–37 years and in two instances exceeding 40 years (1906–1910 and 1916–1920). This sustained improvement suggests structural changes in mortality conditions, possibly linked to better nutrition, improved hygiene, and gradual advances in public health. Interestingly, the First World War does not appear to have significantly reduced life expectancy in this population, at least as reflected in the reconstructed estimates. This relative resilience may indicate that war-related mortality pressures were either limited locally or offset by concurrent improvements in civilian survival conditions. In a long-term perspective, the trajectory of life expectancy in Detva reveals a predominantly stable but crisis-prone mortality regime throughout the 19th century, followed by a clear upward shift at the turn of the 20th century. The results thus point to the delayed onset of sustained mortality decline and the gradual emergence of early demographic transition processes in this rural community.

DISCUSSION

The demographic history of the parish of Detva between 1781 and 1920 reveals a population that functioned for most of the 19th century within a classic high-pressure demographic regime: high fertility, high but fluctuating mortality, a persistently young age structure, and strong sensitivity to external shocks. Despite recurrent crises – epidemics, famine, economic collapse, and war – the long-term trajectory was one of sustained population growth. The population of Detva increased from approximately 4,000 inhabitants in 1781 to more than 15,000 in the early 20th century, indicating a more than threefold increase over the study period. This expansion was primarily driven by natural increase, as confirmed by consistently positive rates of natural growth and NRR values generally above replacement level. Although the inverse projection model includes an exogenous migration parameter, migration effects cannot be directly identified in the reconstructed results and should therefore be interpreted as secondary and uncertain within the model framework. This long-term stability, however, was repeatedly interrupted by a series of pronounced crisis episodes that shaped short-term demographic dynamics.

The persistence of generational replacement, even during crisis decades, is particularly noteworthy. Although the NRR approached replacement level during the mid-19th-century crisis, it rarely fell below unity for extended periods. This suggests that short-term mortality shocks, however severe, did not fundamentally undermine the reproductive capacity of the community. In this respect, Detva resembles other rural populations in Central and Eastern Europe, where high fertility acted as a buffer against mortality crises well into the late 19th century. The generally high NRR values, remaining mostly above one, demonstrate the demographic resilience of the Detva population even during periods of epidemic and famine. The GRR follows a similar long-term pattern to the NRR but remains consistently higher due to the absence of mortality effects. Its gradual decline towards the end of the 19th century reflects the initial changes in fertility patterns prior to sustained mortality decline.

Several crisis phases clearly stand out in the reconstructed indicators. The end of the 18th century, the early 1830s, the late 1840s, and the early 1870s appear to be periods of heightened demographic strain. The 1790s were marked by poor harvests and an economically unfavourable situation in the country, caused by the fact that the Austrian Monarchy had entered the Austro-Turkish War (1788–1791) and subsequently remained a long-term member of the so-called Anti-French Coalitions. This period persisted into the first two decades of the 19th century, during which Austria went bankrupt twice, in 1811 and 1816 (*Bérenger*, 2014). During this period, the population of Detva was also struck by several epidemics of childhood diseases (*Golian*, 2017: 46). These were likely cases of smallpox, which were particularly prevalent in Central Europe, especially at the turn of the 18th and 19th centuries *(Fialová et al.*, 1998: 175–176). The crisis of the early 1830s corresponds to the first wave of cholera in 1831, during which nearly 90 people died in the parish. The demographic situation of the population was further worsened by severe childhood epidemics in 1834 and 1835, the actual cause of which is unknown, as church records did not yet list causes of death (*Golian*, 2019: 272). The crisis of the late 1840s was caused mainly by crop failure and the ensuing famine that affected nearly all of Europe. However, the territory of the Kingdom of Hungary was also unique in that a revolution and civil war broke out in 1848–1849, plunging the nation into political, economic, and social instability (*Fazekas*, 2018). In 1849, another wave of cholera broke out in the country, claiming 84 victims in Detva. The most severe crisis occurred around 1873 and was caused by severe epidemics of whooping cough, smallpox, and cholera. In the first two months of the year, 108 children died of whooping cough; from March to June, nearly 200 children died of smallpox; and during August and September, the parish was hit by an extremely severe cholera outbreak, during which more than 400 people died (*Golian*, 2019b: 372–373). The epidemics thus caused the sharpest short-term increase in deaths in the entire period under review. These crises are visible across multiple indicators: spikes in the CDR, declines in life expectancy at birth, temporary stagnation in population growth, and distortions in the age structure. Importantly, each crisis was followed by recovery. Life expectancy, after declining sharply during crisis years, typically rebounded within one or two five-year intervals. Such oscillatory behaviour is characteristic of pre-transitional demographic systems, in which mortality shocks were episodic rather than structurally transformative (*Livi Bacci*, 2000: 40). The absence of a sustained long-term decline in fertility during most crisis episodes further underscores the resilience of the reproductive regime.

The population's resilience can be attributed to several factors. High marital fertility, early and near-universal marriage, and dispersed settlement patterns enabled the community to recover rapidly from mortality shocks. Economic flexibility, based on small-scale agriculture and pastoralism, may have further mitigated the long-term impact of crises. From a theoretical perspective, these dynamics are consistent with a classic Malthusian regime, in which population growth was periodically constrained by positive checks (mortality crises), while preventive checks such as fertility control remained limited (*Langer*, 1972: 93). It should be noted that the identification of specific epidemics is constrained by the nature of the sources: parish registers did not always record causes of death, and some crises are inferred from indirect evidence and the broader historical context (*Golian*, 2025: 56). Alongside these cyclical crises, longer-term changes in mortality patterns only gradually began to emerge towards the end of the 19th century.

One of the most significant findings concerns the timing of sustained mortality improvement. For much of the 19th century, life expectancy at birth fluctuated within a relatively narrow band around 30–32 years, indicating persistent high mortality, particularly among infants and children. Only from the mid-1890s onward does a structural upward shift become visible, with e_0 rising to the mid-30s and even exceeding 40 years in the early 20th century.

This late and relatively abrupt improvement suggests that Detva entered the early stages of mortality transition only at the turn of the 20th century. The improvement reflects gradual changes in hygiene, nutrition, and medical knowledge, as well as broader socio-economic transformations occurring within the Habsburg Monarchy (*Buklijas – Lafferton*, 2007: 679). The First World War does not appear to have produced a lasting deterioration in life expectancy in the reconstructed series, although this may partly reflect aggregation effects and the smoothing properties of the inverse projection method rather than the absence of wartime demographic stress. These mortality and fertility dynamics were also reflected in the changing age structure of the population.

The reconstructed age structure confirms the dominance of young cohorts throughout most of the study period. Children and adolescents consistently constituted over 40% of the population, while the elderly represented only a small fraction. This pattern is fully consistent with a regime of high fertility and elevated mortality. The modest increase in the proportion of older age groups in the early 20th century aligns with the observed rise in life expectancy but does not yet indicate full demographic ageing.

Irregularities in the 20–34 age groups may partly reflect broader demographic processes affecting working-age cohorts, including possible selective out-migration, although this cannot be directly identified within the inverse projection framework. However, part of these distortions may also be explained by cohort effects linked to earlier fertility fluctuations. Major demographic crises were often followed by prolonged reductions in births, which resulted in smaller cohorts entering young adulthood 20–30 years later. This mechanism likely contributed to the observed irregularities, particularly in periods such as 1871–1875 (when there was a cohort deficit following mid-19th century crises) and 1901–1905. While qualitative evidence suggests that migration from rural areas of the Kingdom of Hungary occurred, the model assumption of constant net migration does not allow these movements to be explicitly captured; therefore, migration-related interpretations should be treated as tentative and not primary explanatory factors. Recognising this limitation is essential, as cohort effects and migration can produce similar distortions in age-specific population structures.

In a comparative perspective, Detva's demographic trajectory aligns with patterns observed in other rural regions of historical Hungary and Central Europe. A high CBR persisted until the late 19th century, mortality decline was delayed relative to Western Europe, and the demographic transition unfolded gradually and unevenly. The parish thus represents a peripheral yet typical example of late-transition rural Central Europe, where demographic modernisation lagged behind industrialised regions but eventually emerged through structural mortality decline rather than immediate fertility limitation. Taken together, these findings highlight the dual nature of demographic change in Detva, combining long-term resilience with episodic crisis-driven disruptions.

Overall, the case of Detva demonstrates that rural populations could maintain long-term growth despite repeated crises, provided that high fertility compensated for mortality shocks. The demographic regime remained fundamentally pre-transitional for most of the 19th century, characterised by instability but also resilience. Only at the turn of the 20th century did more durable changes in mortality patterns become visible, signalling the gradual onset of the demographic transition. The study confirms the analytical value of combining parish-register data with model-based reconstruction. Even in the absence of continuous census data, it is possible to trace long-term demographic processes and to situate local population histories within broader regional transformations.

Research limitations

This study offers a detailed glimpse into the demographic history of Detva, but it is important to recognise the inherent limitations of such an endeavour. Much of the analysis relies on parish registers, which, while remarkably detailed, do not always capture the causes of death or the short-term fluctuations in migration that could shape local population dynamics. As a result, some uncertainty remains in reconstructing mortality patterns and fertility levels, particularly during periods of crisis.

The use of the inverse projection method further introduces complexity: by assuming constant net migration, it may obscure the effects of selective out-migration, especially among young adults in the 20–34 age groups, temporarily masking the true pace of natural population growth. Early population estimates, especially from the late 18th century, may have been underestimated, potentially affecting the calculated Crude Birth Rates and Net Reproduction Rates.

Certain mortality spikes and crisis periods, such as epidemics, famines, or episodes of political unrest, had to be inferred from historical context rather than direct records, leaving a degree of interpretative uncertainty. Additionally, while Detva provides a fascinating case study of a rural, inland community in Central Europe, its experiences may not be directly transferable to urban areas or regions with different socio-economic and environmental conditions.

Despite these challenges, the study illustrates the power of combining parish records with model-based reconstruction. Even with imperfect sources and methodological assumptions, it is possible to trace long-term demographic processes, capture the resilience of local populations, and situate the history of a single community within broader regional transformations.

References

- *A Magyar korona országainak. 1890 és 1891 népmozgalma*. 1892. II. Kötet. Budapest: KSH.
- *A Magyar Szent korona országainak. 1910. évi népszámlálás.* 1912. I. Kötet. Budapest: KSH.
- Alberty, J. 1981. *Formovanie robotníckej triedy v obvode Brezna*. Martin: Osveta.
- Archives of Banská Bystrica Diocese, Canonica Visitation of Detva Parish 1781.
- Buklijas, T. – Lafferton, E. 2007. Science, medicine and nationalism in the Habsburg-4 Empire from the 1840s to 1918. *Studies in history and philosophy of biological and biomedical sciences*, 38(4), 679. https://doi.org/10.1016/j.shpsc.2007.09.004.
- Bengtsson, T. – Campbell, C. – Lee, J. Z. 2004. *Life Under Pressure: Mortality and Living Standards in Europe and Asia, 1700–1900.* MIT Press. https://doi.org/10.7551/mitpress/4227.001.0001.

- Bérenger, J. 2014. Austria Confronts the French Revolution (1792–1815). In *The Habsburg Empire 1700–1918*. Routledge, 125–137. https://doi.org/10.4324/9781315844725.
- Bród, D. – Rachwał, P. – Strzelecki, P. 2016. Inverse Projection as a Tool That Supports Understanding Demographic Past. *Przeszłość Demograficzna Polski*, 38(4), 89–117. https://doi.org/10.18276/pdp.2016.4.38-04.
- Cimmermannová, E. 1974. Matrika ako historický prameň. *Historický časopis*, 22(1), 71–83.
- Coale, A. J. – Demeny, P. – Vaughan, B. 1983. *Regional Model Life Table and Stable Populations. Second edition*. Academic Press.
- Ďurková, M. 1999. Podpoľanie a najstaršie dejiny Detvy. *Historický časopis*, 47, 383–403.
- Fazekas, Cs. 2024. Revolution, War and Cholera in 1848-49: The Case of Hungary. *Austrian History Yearbook*, 55, 103-120. https://doi.org/10.1017/S0067237824000122.
- Fialová, L. et al. 1998. *Dějiny obyvatelstva českých zemí*. Praha: Mladá fronta.
- Galloway, P. R. 1994. A Reconstruction of the Population of North Italy from 1650 to 1881 using Annual Inverse Projection with Comparison to England, France, and Sweden. *European Journal of Population*, 10, 223–274. https://doi.org/10.1007/BF01265303.
- Garajová, D. 2019. *Historicko-demografický náčrt dejín Kysúc v 19. storočí na príklade obce Oščadnica*. Nitra: Univerzita Konštantína Filozofa.
- Golian, J. – Liczbińska, G. 2022. The Influence of Extreme Exegenous Shocks on the Sex Ratio at Birth. A Study of the Population of Detva (Upper Hungary), 1801 – 1920. *Romanian Journal of Population Studies*, 2022, 16(2), 27–52. https://doi.org/10.24193/RJPS.2022.2.02.
- Golian, J. – Liczbińska, G. 2023. The Operation of Natural Selection through Differential Mortality: The Detva Population during the Great Epidemics, 1831–1920. *Przeszłość Demograficzna Polski*, 45, 73–99. https://doi.org/10.18276/pdp.2023.45-03.
- Golian, J. 2025. Identification of Cholera Victims in Parish Registers in Present-Day Slovakia During the Cholera Epidemics of 1831 and 1872 – 1873. In Liczbińska G., Vögele J. P., Riswick T. (eds.). *Towards the Elimination of Cholera Epidemics: From the Past to Contemporary Societies*. Warszawa: Oficyna Wydawnicza: Mówią Wieki, 40–67.
- Golian, J. 2013. Škica historickej demografie Podpoľania. *Historický zborník*, 23(2), 11–45.
- Golian, J. 2016a. Vývoj sobášnosti vo farnosti Detva v rokoch 1781 – 1920. *Historická demografie*, 40(1), 49–92.
- Golian, J. 2016b. Vývoj pôrodnosti vo farnosti Detva v rokoch 1781 – 1920. *Historická demografie*, 40(2), 227–256.
- Golian, J. 2017. Vývoj úmrtnosti vo farnosti Detva v rokoch 1781 – 1920. *Historická demografie*, 41(1), 39–72.
- Golian, J. 2019a. *Život ľudu detvianskýho*. Ružomberok: Society for Human Studies.
- Golian, J. 2019b. Detva zahalená do smútku. Tri ničivé epidémie pustošiace mestečko v roku 1873. In Bada, M. – Duchoňová, D. *Pohromy, katastrofy a nešťastia v dejinách našich miest*. Pp. 359–380. Bratislava: Igor Iliť–RádioPrint.
- Gruber, G. 2009. Demographic Change and the Family. Demographic Changes in the Time of Industrializiation (1750–1918). *Transylvanian Review*, 18(1), 159–194.
- Hajnal, J. 1982. Two kinds of preindustrial household formation systems. *Population and Development Review*, 8(3), 449–494. https://doi.org/10.2307/1972376.
- Holzer, J. Z. 1999. *Demografia*. Warszawa: Polskie Wydawnictwo Ekonomiczne.
- Hungary National Archive, County Council Archives, Parish Regulation 1786–1789.
- Janšák, Š. 1929. Príspevok k štúdiu osídlenia Slovenska. Obce a kopanice. *Sborník Muzeálnej slovenskej spoločnosti*, 23(3-4), 93–111.
- Kahn, Ch. 1963. History of Smallpox and Its Prevention. *Ameriacan Journal of Diseaes of Children,* 106(6), 597–609. https://doi.org/10.1001/archpedi.1963.02080050599011.
- Kohútová, M. – Vozár, J. (eds.). 2006. *Hospodárske dejiny Slovenska*. Bratislava: Veda.
- Laclavíková, M. – Švecová, A. 2012. *Pramene práva na území Slovenska II.* Trnava: Typi Universitatis Tyrnaviensis.
- Langer, W. L. 1972. Checks on population growth. *Scientific American*, 226(2), 92–99. https://doi.org/10.1038/scientificamerican0272-92.
- Lee, R. D. 1974. Estimating series of vital rates and age structures from baptisms and burials: A new technique, with applications to pre-industrial England. *Population Studies*, 28(3), 495–512. https://doi.org/10.1080/00324728.1974.10405195.
- Livi Bacci, M. 2000. *Mortality crises in a historical perspective: The European experience.* Oxford University Press, 38–58. https://doi.org/10.1093/acprof:oso/9780198297413.003.0002.

- Matiáš, M. 2004. *Osídlenie a spoločenské štruktúry stredného Slovenska v 17.–19. storočí.* Bratislava: Historický ústav SAV.
- Matula, V. – Vozár, J. et al. 1987. *Dejiny Slovenska II.* Bratislava: Veda.
- McCaa, R. – Brignoli, H. P. *Populate: From Births and Deaths to the Demography of the Past, Present, and Future.* Minneapolis 1989. Available online: https://perezbrignoli.com/wp-content/uploads/2020/10/Populate_from_birts_and_deaths_to_the_demography_of_the_past_present_and_future.pdf.
- McCaa, R. Populate. 1989. A Microcomputer Projection Package for Aggregative Data Applied to Norway, 1736–1970. *Annales de démographie historique*, 287–298. https://doi.org/10.3406/adh.1989.1747.
- McKeown, T. 1976. *The Modern Rise of Population.* Academic Press. https://doi.org/10.2307/1971906.
- Okólski, M. 2004. *Demografia. Podstawowe pojęcia, procesy i teorie w encyklopedycznym zarysie*. Warszawa: Wydawnictwo naukowe.
- Őri, P. 2015. Long-term demographic change and local socio-cultural patterns: marriages and household structure in 18–20th century Hungary. *Przeszłość Demograficzna Polski*, 37(3), 7–37. https://doi.org/10.18276/pdp.2015.3.37-01.
- Őri, P. 2005. Patterns of demographic behavior in late 18th Century Hungary. *Demografia*, 49(5), 43–76.
- Pakot, L. – Őri, P. 2012. Marriage system and remarriage in 19th century Hungary: a comparative study. *The History of the Family*, 17(2), 105–124. https://doi.org/10.1080/1081602X.2012.662016.
- Pekařová, K. 2015. Zdravotníctvo na území Slovenska v 19. storočí (1780 – 1918) In Kováč, D. – Kowalská, E. – Šoltés, P. (Eds.) *Spoločnosť na Slovensku v dlhom 19. storočí*. Pp. 151–182. Bratislava: Veda.
- Pocisková, M. 2018. *Historicko-demografické aspekty populačného vývoja Trnavy v polovici 19. storočia na príklade vybranej mestskej časti*. Bratislava: Univerzita Komenského.
- Rachwał, P. – Liczbińska, G. 2025. The Impact of Wars and Epidemics of Infectious Diseases on Selected Demographic Parameters of the Roman Catholic Population in Lublin in the 19th Century. *Historická demografie,* 49(1), 59–82. https://doi.org/10.21104/HD.2025.1.03.
- Rachwał, P. 2019. *Ruch naturalny ludności rzymskokatolickiej w Lubelskiem w świetle rejestracji metrykalnej z lat 1582–1900*. Lublin: Wydawnictwo KUL.
- Reher, D. S. 1999. *Economic and Social Implications of the Demographic Transition. Population Studies*, 53(1), 83–98.
- Sebők, L. 2005. *Az 1869 évi népszámlálás vallási adatai*. Budapest: KSH Levéltar.
- Schulze, M. S. 1997. The Machine–Building Industry and Austria's Great Depression after 1873. *The Economic History Review*, 50(2), 282–304. https://doi.org/10.1111/1468-0289.00055.
- Slezák, J. 2001. Epidémie a zdravotný stav obyvateľstva stredného Slovenska v 19. storočí. *Historický časopis*, 49(2), 211–234.
- Svetoň, J. 1969. *Vývoj obyvateľstva na Slovensku*. Bratislava: Epocha.
- Szabó, J. 1990. *Rural Demography in the Kingdom of Hungary: 18th–19th Centuries.* Budapest: Akadémiai Kiadó.
- *Štatistický lexikón obcí v republike Československej III. Slovensko*. 1927. Praha: Státní úřad statistický.
- Tomeček, O. 2018. Sídlo a jeho miestne časti. Formovanie sídelnej štruktúry na území chotára Detvy. In A. Ostrihonova (ed.). *Detva. Monografia Mesta*, 122–129.
- van Zanden, J. L. 1995. Tracing the beginning of the Kuznets Curve: Western Europe during the early modern period. *Economic History Review*, 48(4), 643–664. https://doi.org/10.1111/j.1468-0289.1995.tb01437.x.
- Wachter, K. W. 1986. Ergodicity and Inverse Projection. *Population Studies*, 40(2), 275–287. https://doi.org/10.1080/0032472031000142076.
- Wrigley, E. A. et al. 1997. *English Population History from Family Reconstitution 1580 – 1837.* Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511660344.
- Wrigley, E. A., – Schofield, R. S. 1981. *The Population History of England 1541–1871: A Reconstruction.* Cambridge University Press.
- Zadoks, J. C. 2008. The Potato Murrain on the European Continent and the Revolutions of 1848. *Potato Research*, 51(1), 5–45. https://doi.org/10.1007/s11540-008-9091-4.
- Zemko, J. et al. 1988. *Detva*. Martin: Osveta.
- Žudel, J. 1993. Administratívne členenie územia Slovenska za dualizmu (1867–1918), *Slovenská archivistika*, 28(2), 70–81.

JÁN GOLIAN

is an associate professor at the Pavol Jozef Šafárik University in Košice, Slovakia. He is a member of the Department of History at the Faculty of Arts of the Pavol Jozef Šafárik University in Košice. His research interests are the historical demography of Slovak urban and rural societies in the 19th century, the history of everyday life, and the history of the national movement in Upper Hungary at the turn of the 19th and 20th centuries. He has been the principal investigator on two 'VEGA' research projects (Research Agency of the Ministry of Education of the Slovak Republic) and has published more than 60 scientific articles and seven books.

PIOTR RACHWAŁ

is a professor at the John Paul II Catholic University of Lublin (KUL) and a member of the Department of Source Studies, Archival Science, and History Didactics at the Institute of History of the John Paul II Catholic University of Lublin. Since 2008, he has served as the Scientific Secretary of the Section for the History of Demographic and Social Structures within the Committee of Historical Sciences of the Polish Academy of Sciences. His research interests include historical demography, economic history, digital archival science, and studies on the Polish diaspora. He is the founder and editor of an online portal that hosts, among other resources, a digital repository of early modern parish registers from the Lublin region: https://ksiegimetrykalne.pl.

GRAŻYNA LICZBIŃSKA

is an associate professor at the Faculty of Biology, Adam Mickiewicz University in Poznań, where she is affiliated with the Institute of Human Biology and Evolution. Her research focuses on human biology and ecology, epidemiology, historical and contemporary demographic behaviour, and the effects of environmental stressors on health, biology, and social mobility. She has led and collaborated on numerous national and international projects, with a particular emphasis on historical demography and the biological consequences of social and environmental crises, and on her own initiative, the Poznań Historical Population Database (poznandatabase.pl), which was created to facilitate research on historical demography.