Quantifying Spanish Flu Mortality in the Cities of the Second Polish Republic: A Look at the Municipal Statistics

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Bartosz Ogórek *

Abstract: »*Quantifizierung der Sterblichkeit durch die Spanische Grippe in den Städten der Zweiten Polnischen Republik. Ein Blick auf die Kommunalstatistik*«. Due to war turmoil, border lability, and administrative chaos accompanying the recreation of an independent Polish state, national or even regional demographic statistics that could shed some light on the spread and intensity of the influenza pandemic in Polish territory are absent. Hence, I try to scrutinize the timing and extent of Spanish flu mortality through the local statistics gathered by the municipal statistical offices (mainly Warsaw, Lviv, Krakow, and Łódź). The gathered data is modelled using Serfling Regression to estimate excess mortality and identify waves and recurrences of the flu. These results are then juxtaposed with the outcomes of similar procedures done for other countries to address the question of direction and spread of the Spanish flu across Central and Eastern Europe. The study shows a weaker impact of the Spanish flu in Polish cities than in Western and most notably Southern Europe. It also confirms that the spread of the pandemics in Poland was not linear, as it depended on the size, importance, and connectivity of the city rather than on the mere geographic location.

Keywords: Spanish flu, pandemics, urban history, mortality, Poland.

1. Introduction

The growing amount of research output focusing on the Spanish flu reflects the rise of interest in this problem reawoken recently by the COVID-19 pandemic (Ashton 2020; Franchini et al. 2020; Javelle and Raoult 2021). This renewed attention is confirmed not only by the high incidence of influenza

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related papers, but also by a broadening thematic scope of these studies (Phillips 2014). Spanish flu is scrutinized as a "natural experiment," allowing the researchers to delve into regularities and peculiarities of human behaviour in the past. These scrutinies go now far beyond the most obvious question of "how many have died?", but touch upon more complex issues like the effect of the Spanish flu pandemics on economic performance (Barro, Ursúa, and Weng 2020), social trust (Aassve et al. 2021), or fertility (Chandra and Yu 2015; Boberg-Fazlic et al. 2021; Mamelund 2012). An important part of the research on the 1918–1920 influenza is devoted to the long-term consequences of the pandemic, showing that this event could impact not only the health of individuals that were exposed *in utero* throughout their life-course, but also to some extent on their later life income and educational attainment (Almond 2006; Myrskylä, Mehta, and Chang 2013; Richter and Robling 2015; Helgertz and Bengtsson 2019). Unfortunately, data needs for such studies are high and complex, while in the case of some European regions, even the most basic statistics are missing. Such is the case of Poland in its interwar borders. As there was no independent Polish state up until the autumn of 1918, the territories that eventually formed the Second Polish Republic were parts of combatant Empires – Germany, Russia, and Austro-Hungary. All three powers suffered from significant administrative chaos and revolutionary moves towards the end of WWI, which hampered the collection and dissemination of health and demographic statistics (Patterson and Pyle 1991; Słomczyński 2012).

Even after the birth of the independent Polish state and creation of its statistical forces, influenza was not initially among the most serious epidemic diseases that had to be reported by the physicians to authorities[1] (Janiszewski 1918; Ogórek 2018). Moreover, the scant archival material documenting the efforts of the reborn country to combat the pandemics was to large extent destroyed during World War II (Więckowska 1997; Mieszkowski 2016). These problems result in a rather modest historiography of the Spanish flu in Poland to date (Słomczyński 2012). At the same time, the international research on the topic also neglected Polish lands from the very beginning. The famous report on the Spanish flu throughout the world issued in 1920 by the United Kingdom's Ministry of Health lacks any indications of the epidemic situation in Poland (Mieszkowski 2016). Similarly, Poland is almost completely absent in the modern analyses of the spread and severity of the Spanish influenza (Patterson and Pyle 1991; Johnson and Mueller 2002; Barry 2020).[2] No wonder that researchers became rather sceptical about the possibility of shedding a

[1] This obligation was introduced by the Ministry of Public Health on 19 February 1920 (Rozporzą dzenie Ministra Zdrowia Publicznego w Przedmiocie Obowiązkowego Zgłaszania Przypadków Zachorowania Na Grypę Połączoną z Zapaleniem Płuc i Opłucnej 1920).

[2] This problem is well reflected by the actual absence of literature on Poland in most complete bibliography of Spanish flu studies (Müller 2003).

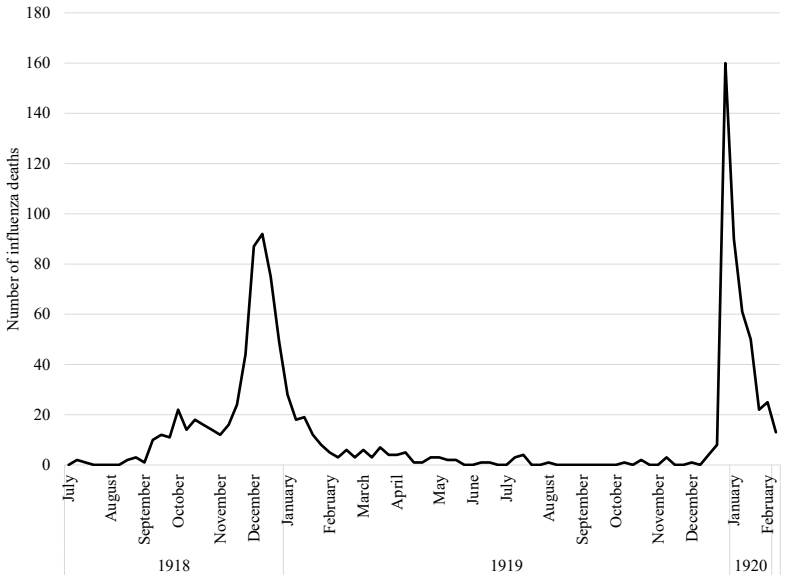
new light on the course of the Spanish flu in Poland, claiming that it is "probably impossible to reproduce today" (Grabowski et al. 2017). However, some light can be shed on the development of the pandemics in Polish lands thanks to the works of contemporary (Szenajch 1920, Adamowiczowa 1920, Bronowski 1922, Puterman 1919, Szulc 1928, Janiszewski 1918) and nowadays current researchers (Słomczyński 2012, 2013, 2014; Wnęk 2014; Mieszkowski 2016; Grabowski et al. 2017).

The available knowledge points to the occurrence of three waves of the flu in Poland, similar to the three waves in Western Europe. The first wave, the least deadly one, started on late spring/early summer of 1918 and lasted until the beginning of autumn. Mieszkowski (2016) proposes May as the date of the first Spanish flu cases in Polish lands, while the other authors and press of the time suggest June or July.[3] Some authors claimed that the pandemic came from the East, pointing to Lviv as the first city with recognized cases (Puterman 1919; Słomczyński 2014; Mieszkowski 2016, Grabowski et al. 2017).[4] Interestingly, some narrative evidence can be found on even earlier "flu-like" cases in the city of Krakow. Klemens Bąkowski suffered from them as early as the 17th of March and this led to severe complications, which were described as "double pneumonia." He recovered only in the middle of May (Bąkowski 1918). During the time of Bąkowski's sickness, another diary-keeper noted the high incidence of infectious pneumonia in April in the same city (Koy 1918). Obviously, the sickness could not be named "Spanish flu" back then, but it could be the mild version of the virus. The first mentions of "Spanish sickness" or "Spanish fever" in Krakow were found in the writings of Elżbieta Ciechanowska, whose friend suffered from the sickness in July 1918. Ciechanowska herself underwent flu-like symptoms one month later (Ciechanowska 1918).

[3] The scientific journal *Gazeta Lekarska* published the communicate on Spanish Flu with the date of 24 August 1918 in two military garrisons (Ostrów, Garwolin), not far from Warsaw. Nine percent of soldiers were sick at the time the article was written, but "no fatalities or serious complication occurred" (Epidemia Influenzy w Wojsku Polskiem 1918).

[4] At the same time, the occurrence of Spanish Flu near the Western borders of Polish lands are well recorded. The data from Breslau (now Wrocław, Poland) indicate the first flu fatalities in June 1918 (Morens and Fauci 2007). Słomczyński (2012) hypothesises that Spanish flu arrived in Poland almost simultaneously from multiple directions, showing that in July 1918 the flu morbidity peaked in Pomerania and Greater Poland (Słomczyński 2012).

Figure 1 Weekly Number of Influenza Deaths in Warsaw, July 1918- February 1920

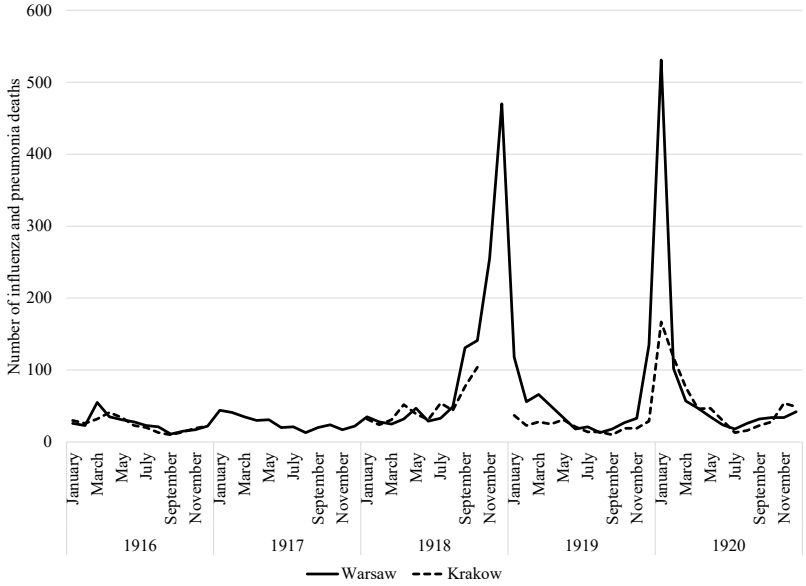


Source: Szenajch 1920; Adamowiczowa 1920.

According to the researchers and contemporary press, the second wave lingered from September 1918 to February 1919, peaking in October/November. The third wave appeared in December 1919 and lasted until early spring of the next year. The fragmented statistical data partially confirm these observations. Figure 1 presents data on the weekly number of influenza deaths in Warsaw gathered by Szenajch (1920).[5] Clearly, the second and third wave of the Spanish flu are well represented, conversely to the first one, which is either absent (probably due to low fatality) or it happened later than hypothesized (September and October rather than June and July).

[5] The data can be found in Adamowiczowa (1920).

Figure 2 Monthly Number of Influenza and Pneumonia Deaths Combined in Warsaw and Krakow, January 1916 - December 1920



Source: Magistrat m. st. Warszawy (1918–1923); Biuro Statystyczne Miasta Krakowa (1916–1928, 1998)

The monthly data on fatal cases of influenza and pneumonia published by the statistical offices of Warsaw and Krakow depicted in Figure 2 tells a similar story on the course of pandemic. Here, the second and third waves are even more pronounced, but one can see also a slight rise in respiratory-diseases-related deaths already in late spring/summer of 1918, which could be an indication of the least deadly first wave. It is worth mentioning that these data have to be treated as the minimum death toll, as the registration was far from complete. According to Landau (1937), for each registered case of Spanish flu there were at least two more that were unnoticed. Moreover, part of the deaths should be attributed to "normal" influenza and pneumonia activity as can be observed in years 1916 and 1917. Grabowski et al. (2017) estimated the number of victims in the Polish lands vaguely to 200-300 thousand. Given the fact that, according to the 1921 population census, Poland had approximately 27 million inhabitants, it would mean the combined casualties of all waves of the Spanish flu reached approximately 1% of the population.[6]

Taking into consideration the arguments presented above, the contribution of this study is as follows. Firstly, previously unused data from several Polish

[6] See Mieszkowski (2016) for slightly lower estimates.

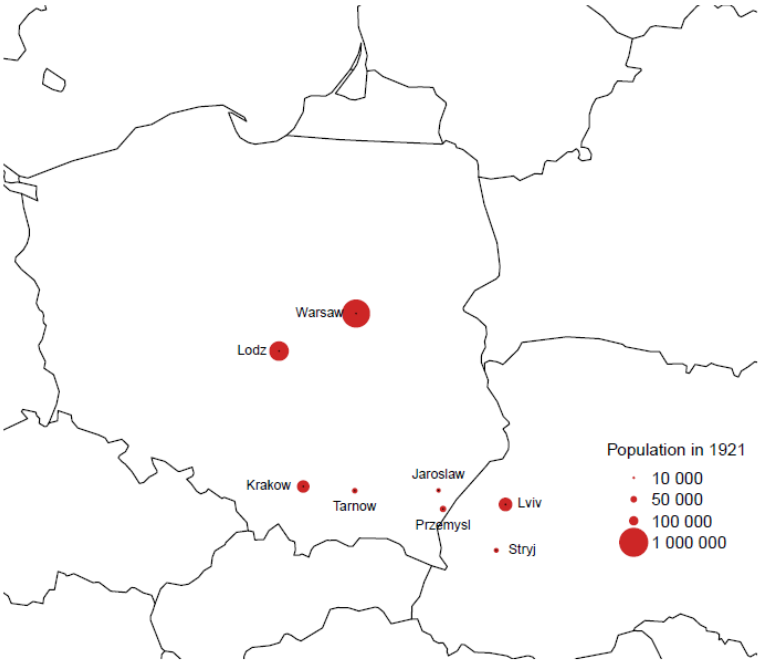
cities is employed to propose new estimates of the severity of the pandemic in Poland. Secondly, this paper tries to redraw the chronology and direction of the disease spread. It is in line with recent trends showing that despite the long tradition of research on Spanish flu, new sources and estimates are still being brought up (e.g., Fornasin, Breschi, and Manfredini 2018). The remainder of the paper is divided into three sections: data and methods, results, and conclusions and discussion.

2. Data and Methods

The lack of aggregated statistics for Polish lands and Poland during the years of Spanish flu pandemics force the use of data on the sub-national level. These data were frequently provided by the municipal statistical offices that were set up and developed across imperial Europe, including Polish lands (Łazowska 2018; Małecki 2000; Domański 2019). Thanks to this approach, I have gathered information on the monthly numbers of deaths from all-causes in the period of 1917 to 1928 from Warsaw, Łódź, Lviv, and Krakow (Magistrat m. st. Warszawy 1918, 1923, 1924, 1926, 1927, 1928, 1930; Magistrat Miasta Łodzi 1919; Rosset 1923, 1925, 1926a, 1926b, 1927, 1928, 1929; Lwów 1926–1928, 1926b, 1928b; Biuro Statystyczne Miasta Krakowa 1916–1928, 1998; Ogórek 2018). To a smaller extent, I was able to collect data from smaller cities of former Galicja, i.e., Tarnów, Jarosław, Przemyśl, and Stryj (Austria. 1917–1919), however, this data covers only the period up to late October 1918. Figure 3 presents the analysed populations against the current borders.

Surprisingly, the data issues resulting from registration problems do not concern only the events as distant in time as the Spanish flu. Difficulties in obtaining the accurate figures on prevalence and spread of respiratory diseases in the US cities during 1957–1958 influenza epidemics motivated Robert Serfling (1963) to develop a new method that would provide "early quantitative measure of the severity of an influenza epidemic and its geographic localization" (Serfling 1963, 494). To do so, he employed a mathematical function that combined a "linear term describing secular trend with sine and cosine terms describing seasonal change" (ibid., 496).

Figure 3 Location and Size of Analysed Cities in 1921



Importantly, conversely to his predecessors, Serfling claimed that all-cause number of deaths should be used in such a model instead of rates when analysing cities, since an approximation of the rate denominators (size of population that produces deaths) is impossible due to rapid growth of metropolitan areas. The outcome of modelling was an epidemic threshold line (number of expected deaths in a city in endemic year accounting for random variation), which could be juxtaposed to the actual number of deaths occurring during the epidemic, allowing for estimation of the excess-mortality. The original formulation of what is now called the Serfling Regression Model was later on developed to better suit the peculiarities of seasonal changes (Chowell, Viboud, et al. 2012; Chowell, Erkoreka, et al. 2014; Cobos et al. 2016; Cilek, Chowell, and Fariñas 2018; Gaddy 2021). In this paper, the formulation proposed by Cilek, Chowell, and Fariñas (2018) was employed, taking the form of an equation:

$$Number\ of\ deaths_t = intercept + \alpha_1 * (t) + \alpha_2 * \left(\frac{100}{2}\right)^2 + \beta_1 * sin\left(2 * \frac{\pi}{12} * t\right) + \beta_2 * sin\left(4 * \frac{\pi}{12} * t\right) + \beta_3 * sin\left(8 * \frac{\pi}{12} * t\right) + \gamma_1 * cos\left(2 * \frac{\pi}{12} * t\right) + \gamma_2 * cos\left(4 * \frac{\pi}{12} * t\right) + \gamma_3 * cos\left(8 * \frac{\pi}{12} * t\right) + \varepsilon_t$$

where t represents the month number, while α, β, and γ are coefficients to be estimated from the data – α represents the time trend, β and γ represents seasonal changes, and ε is an error term. The epidemic threshold is determined by the value of the upper 95% confidence interval of the baseline mortality estimation. This type of methodology was frequently used in the context of the historical Spanish flu pandemic (Ansart et al. 2009; Chowell 2012; Cilek, Chowell, and Fariñas 2018; Gaddy 2021), as it is independent from the registration biases of influenza cases and deaths.

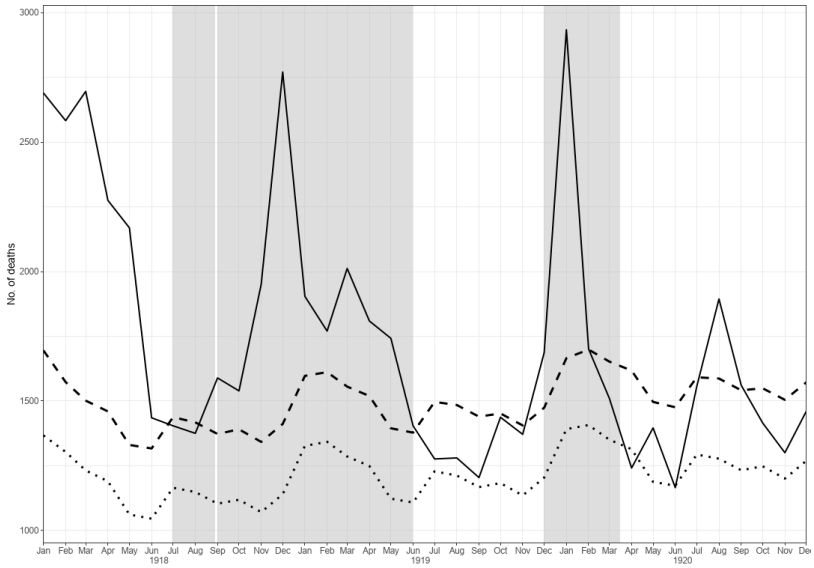
In this paper, for Warsaw, Łódź, Krakow, and Lviv, the expected mortality was calculated on the basis of all-cause number of deaths between January 1921 and December 1923. This allows the model to capture the time trend while the post-war situation is still rather harsh in terms of the living standards and disease load. The trend of the number of casualties in Polish cities during that time is quite stable as two contradicting processes cancel out – the mortality decline connected to the demographic transition (Ogórek 2013, 2018) and the rising number of inhabitants due to urbanization and general development of the country. In the case of Tarnów, Jarosław, Przemyśl, and Stryj, the model is based only on 1917 data, as post-war demographic information is unavailable.

3. Results and Discussion

Figures 4-7 present the results of the modelling, i.e., the comparison of expected and observed number of deaths between the beginning of 1918 and the end of 1920 for Warsaw, Łódź, Krakow, and Lviv. Comparing the mortality peaks with hypothetical chronology of flu waves derived from the literature (grey rectangles) generally confirms the timing of disease occurrence in Polish lands. The first wave, however, is noticeable only from August/September of 1918 in Warsaw, Krakow, and Lviv, but not in Łódź. This does not rule out the earlier presence of the Spanish flu in the Polish cities, as this wave was universally characterized by low fatality. Moreover, we have to account for the time from first infections to first mass deaths, which could take at least two weeks. The second wave indeed spans between September 1918 and June

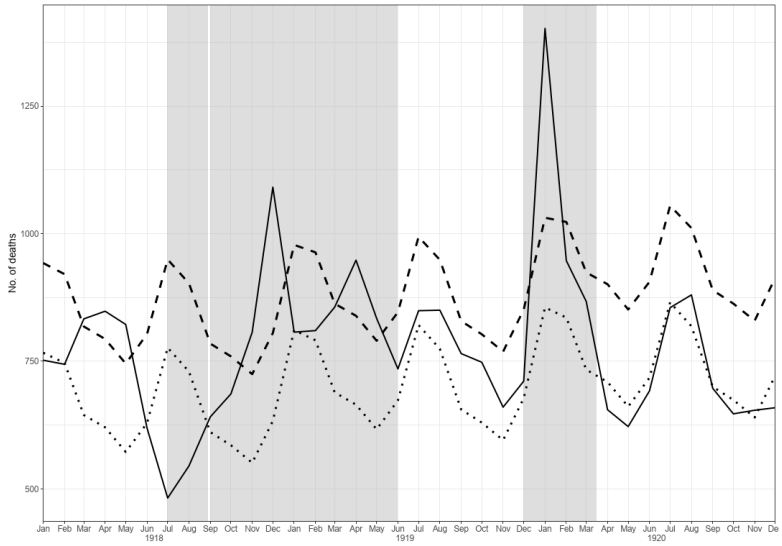
1919 with some local peculiarities. Its peak occurs in October for Lviv and Krakow, but in December for Łódź and Warsaw. This fact could point to the south-eastern direction of the pandemic's origin in Polish lands. Interestingly, the second wave could seem to have two recurrences separated by a significant drop of surplus deaths at the beginning of 1919. After that, a less deadly, but easily distinguishable subpeak occurs during the March-June period of 1919 (except from Krakow, where this resurgence is completely absent). The timing of the third wave provides probably the best fit between narrative descriptions and the result of this exercise, with the exception of Warsaw and Lviv, where its beginnings could be preponed to November of 1919. Finally, the fourth pandemic mortality wave can be spotted during the spring/summer of 1920, similarly to some other regions of Europe (Ansart et al. 2009).

Figure 4 Observed and Expected Total Number of Deaths in Warsaw, January 1918–December 1920



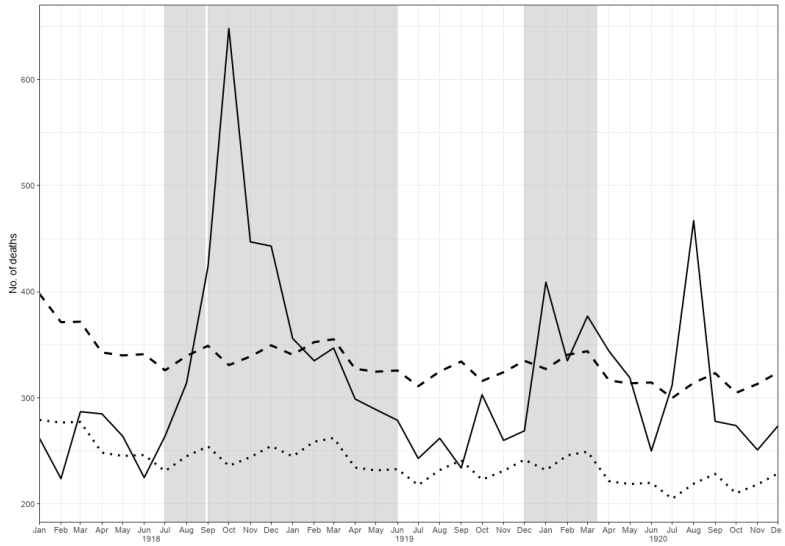
Note: The solid line represents observed number of deaths. The dashed line represents the epidemic threshold of number of deaths (the upper value of 95% confidence interval from the model). The dotted line represents the median of the model prediction.

Figure 5 Observed and Expected Total Number of Deaths in Łódź, January 1918–December 1920



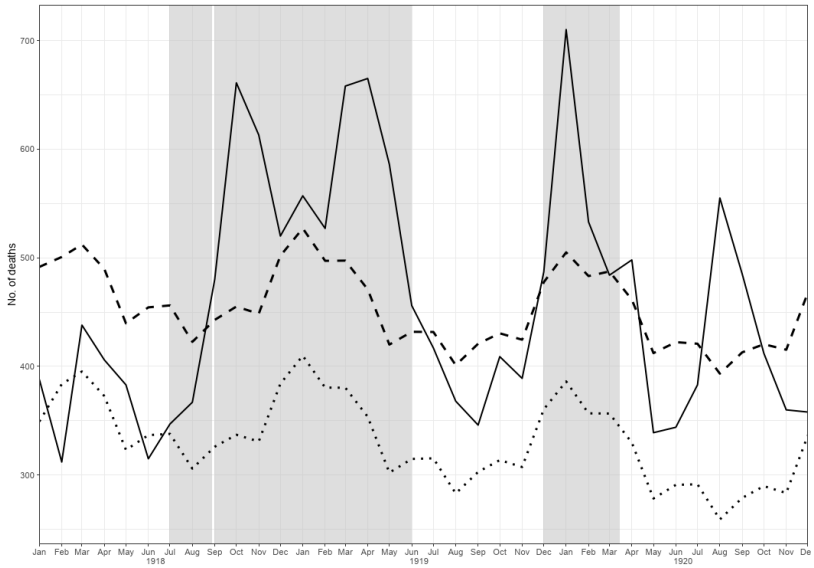
Note: see Figure 4.

Figure 6 Observed and Expected Total Number of Deaths in Krakow, January 1918–December 1920



Note: see Figure 4.

Figure 7 Observed and Expected Total Number of Deaths in Lviv, January 1918–December 1920

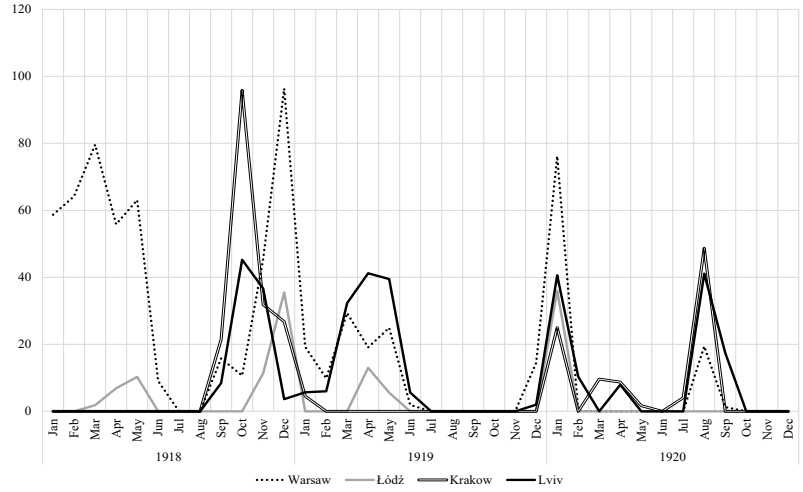


Note: see Figure 4.

Direct comparisons of the pandemic mortality surplus across four cities are shown in Figure 8. Since the cities differ in population size, the surplus deaths were divided by the epidemic threshold to show, in percent, how many more deaths took place in each place with regard to the "normal" mortality. It is clear that the surplus mortality constituted almost 100% of the normal number of deaths during the second wave of pandemics in Warsaw and Krakow. In the case of Łódź and Lviv, the influence intensity turns out to be much less pronounced (up to 40% more deaths than expected). At the same time, Krakow suffered fewer deaths after the autumn peak of the second wave. In general, the Spanish flu seems to have had a much different impact on the four analysed cities. Warsaw and Lviv experienced similar levels of pandemic consequences, while Krakow was slightly less struck. According to the gathered data and employed method, Łódź was the safest city of the four, relatively speaking (Table 1). It is important to contextualize the obtained results in order to compare the severity of the Spanish flu in Polish lands with the situation in other European countries and cities. Analysing solely the ratio between excess and expected deaths, it may seem that Polish cities suffered much less from the pandemics. The ratio in analysed cities range from 6 to 21%, that is, much less than in European countries analysed by Ansart et al. (2009), where the percentage lies between 33% (Finland) and 172% (Italy).

This comparison, however, is sensitive to the differences in "normal" mortality expected in various populations.

Figure 8 Percentage of Excess Deaths in Warsaw, Łódź, Krakow and Lviv, January 1918-December 1920



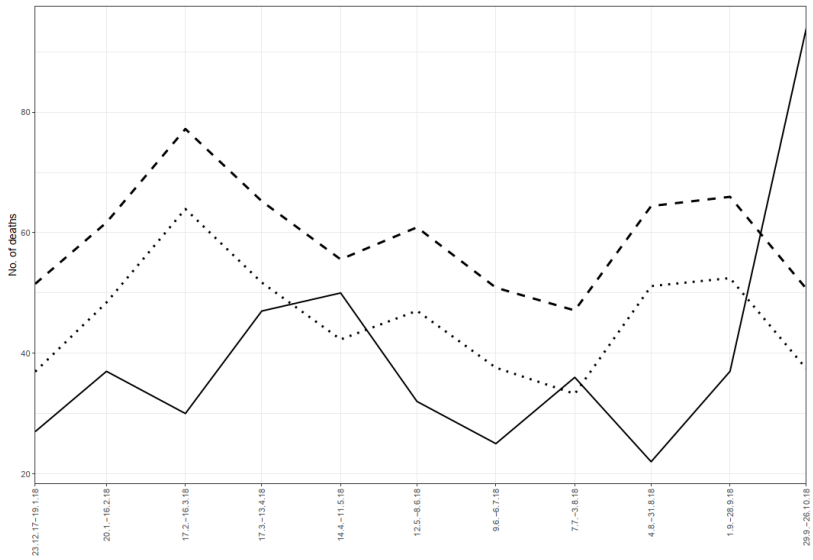
Since Poland still experienced very high mortality rates due to delayed demographic transition process during that time, even sizeable numbers of surplus deaths create relatively low ratios. It is probably more informative to use a different basis of the comparisons, namely population size. Here, the intensity of pandemic mortality in Polish cities is much closer to the experience of Western and Central Europe. Lviv, with 0.61 pandemic related deaths per 100 inhabitants, and Warsaw, with 0.58, are close to the values for Norway (0.56), the Netherlands (0.62), or Germany (0.66). Interestingly, comparison with the city of Madrid (0.89), which is more adequate since urban areas probably suffered much more from the disease than the rural ones, shows relatively milder mortality in Polish cities.

Table 1 Summary of the Results

City	Inhabitants in 1921	Expected deaths July 1918 - December 1920	Surplus deaths July 1918 - December 1920	Ratio (per 100 inhabitants)	Ratio (surplus/ expected deaths)
Warsaw	936713	25644	5404	0.58	21.07%
Łódź	451974	14575	892	0.20	6.12%
Krakow	183706	5010	756	0.41	15.10%
Lviv	219388	7111	1331	0.61	18.72%

Since the result partially confirm the hypothesis on the south-eastern origins of the Spanish flu in Polish lands, it is worthwhile to examine this region in greater detail. Figures 9-12 report pandemic over-mortality up to October 1918 for four smaller locations within Galicja. Bearing in mind that in both Lviv and Krakow the autumn wave began to take its toll in September, similar chronology can be seen in the case of Jarosław and Przemyśl, while in Stryj and Tarnów, the significant surplus of deaths took place in October. This would point to a rather non-linear spread of the Spanish flu in that region and could probably be linked to the importance of the urban centres and their connectivity rather than mere geographic location.[7]

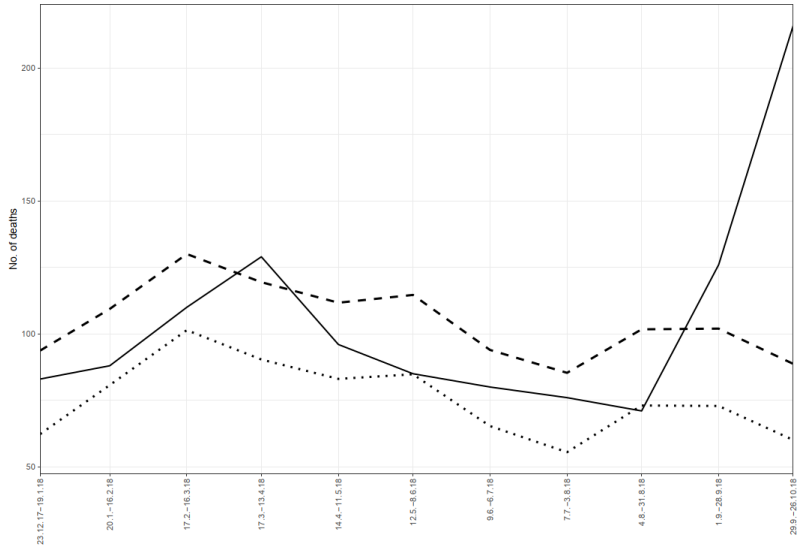
Figure 9 Observed and Expected Total Number of Deaths in Stryj, December 1917–October 1919



Note: see Figure 4.

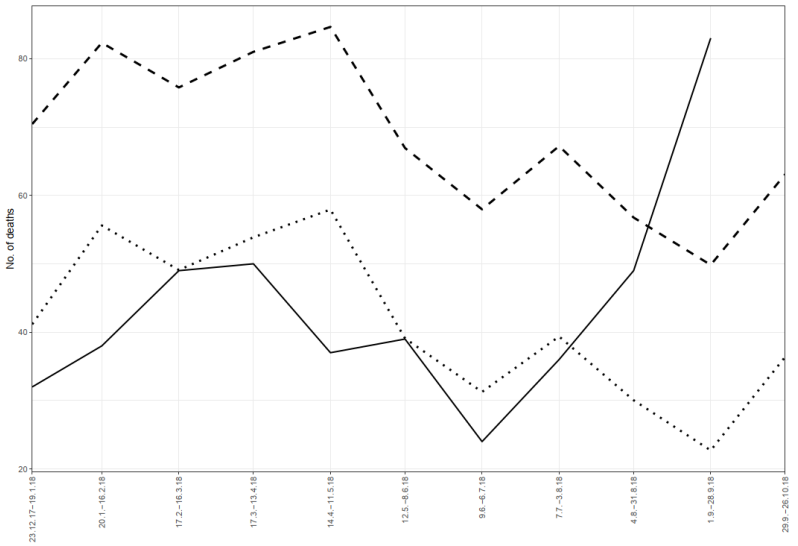
[7] Both Przemyśl and Jarosław played an important military role, being the headquarters of many military units and having large garrisons (see Baczkowski 2009; Szczepanik 2018).

Figure 10 Observed and Expected Total Number of Deaths in Przemyśl, December 1917–October 1919



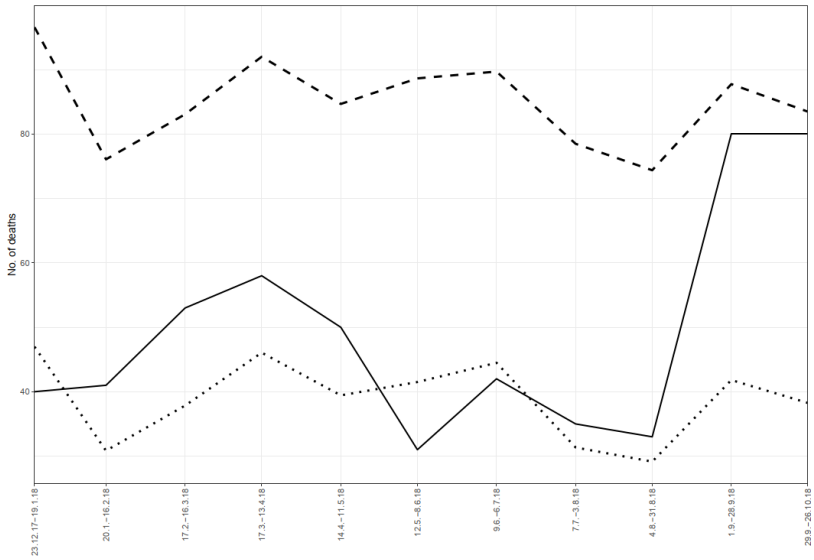
Note: see Figure 4.

Figure 11 Observed and Expected Total Number of Deaths in Jarosław, December 1917–October 1919



Note: see Figure 4.

Figure 12 Observed and Expected Total Number of Deaths in Tarnów, December 1917–October 1919



Note: see Figure 4.

4. Conclusions

This study suffers from several limitations, which can weaken its results and their interpretation. The first of these limitations is that the monthly numbers of city inhabitants' mortality rates are unavailable, and this analysis relies solely on the number of deaths. This omission can produce biases in both expected and observed mortality levels as the violent changes in population sizes of the cities would surely affect the monthly numbers of deaths. These changes can be produced by migratory moves, which are frequent around the end of the World War I and result from demobilization, desertion, and the return of war refugees (Korzeniowski 2018; Ogórek 2018; Ruszała 2020). Secondly, it needs to be stressed that the use of total number of deaths, regardless of the cause, hinders the ascription of the surplus mortality solely to Spanish flu and its complications (mainly pneumonia). Due to the turmoil of war and the collapse of the living standards in the Polish lands towards the end of the war, epidemic disease other than influenza also took a heavy toll. Among them, dysentery and typhoid fever were most notable. This phenomenon could be partially responsible for the lower number of Spanish flu casualties in this part of Europe as sui generis demographic backwardness of Central Eastern Europe and rather early phase of epidemiologic transition among its

population created much more "competition" for the Spanish flu. Despite those drawbacks, this study shows the possibility of shedding a new light on the course of the influenza pandemic in countries with no national-level statistics. Using the municipal data has proven useful for determining the general severity of the Spanish flu as compared to the other regions of Europe, as well as indicating some hints about the direction and tempo of the spread of the disease. The results of this study in general confirm relatively lower impact of pandemics on overall mortality in Polish cities as well as the periodization of Spanish flu in Polish lands, showing that the three waves indicated in narrative material holds when confronted with statistical figures.

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