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RESEARCH NOTE

Seasonal variation in mortality in the city of Barnaul based on the Pokrovsky parish registers (1877-1897)*

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Abstract

The paper analyzes seasonal fluctuations in mortality among the parish population on the basis of parish registers of the Pokrovsky parish in Barnaul in the last third of the XIX century. The study results show that infant mortality in Barnaul in 1877-1897 was still strongly dependable upon the time of year. Summer and winter peaks suggest a continued role of exogenous causes of death. Infant mortality rates in summer were three times higher than the annual average. The mortality peak is mainly registered in June. Starting from the age of 10-14, the seasonal factor passes from the picture, and deaths are distributed more evenly over the seasons.

The analysis of seasonal fluctuations in mortality by cause of death showed that in children, summer peaks are associated with infectious diseases, while winter peaks are due to cold-related diseases. Seasonal fluctuations in mortality by social class are not fundamentally different. It can be assumed that the demographic transition was still in its early stages and yet to be developed even in the upper classes, which had always been at the forefront of demographic modernization.

The obtained results and conclusions about seasonal fluctuations in infant and child mortality are consistent with pre-revolutionary and modern research. The existing differences in seasonal fluctuations in infant mortality exemplified by different cities and settlements in Russia with peaks either in July or August, may indicate a wide climatic diversity and socio-economic differences between regions of the country, as well as differences in calculation methods.

Keywords

historical demography, parish registers, infant mortality, child mortality, Barnaul population, seasonal fluctuations in mortality, social classes

JEL codes: I0, I1

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Introduction

At the beginning of demographic transition in each country, a monthly distribution of deaths remained rather unchanged. The distribution of deaths was influenced by climatic, economic, social, and epidemiological characteristics of the territories at a certain point. Seasonal distribution of deaths shows an evolution from the summer peaks in mortality to the winter ones with a gradual attenuation of seasonal fluctuations due to better control over infectious diseases and a higher role of endogenous causes of death that are less dependable upon environmental factors (Demographic Development… 2011; Kvasha 2001; Sakamoto-Momiyama 1980).

In pre-revolutionary surveys of various governorates (a major and principal administrative subdivision) or uyezds (an administrative unit of the governorate) of the Russian Empire in the second half of the XIX century, seasonal distributions of mortality were mentioned by Gilyarovsky (1866), Ershov (1888), Yanson (1892), Sokolov and Grebenshchikov (1901), Nikitenko (1901), Kurkin (1902, 1925), Shingarev (1906; 2010) and Rubakin (1912). This issue was also covered by works of the following modern researchers: Avdeev et al. (2002), Kvasha (2001, 2003), Kalmykova et al. (Demographic Development… 2011), Golikova (2012), Vinnik (2012), Mironov (2015), Bakharev (2018a; 2018b), etc.

The purpose of this paper is to identify specific features of seasonal dynamics in age–specific mortality in Barnaul in the last third of the XIX century.

The study is based on the database of registers of the Pokrovsky parish in Barnaul in 1877-1897 implemented in MS Excel.

Sources

The main source of data for analyzing seasonal fluctuations in mortality was the database «Population of Barnaul», which contains information from the registers on births, marriages and deaths in the Pokrovsky parish in Barnaul in 1877-1897. Initially, the database completely copied the form of the parish registers in terms of its contents, each section of parish register was separately entered into the database. During further processing, the database was significantly refined and expanded with new fields for a more detailed and in-depth analysis of socio-demographic processes.

The Pokrovsky parish has been selected for several reasons. First, the complex of registers of the Pokrovsky parish available in the archive does not have significant time gaps. For the studied period from 1877 to 1897, only the 1883, 1887, 1889 registers of the Pokrovsky parish were missing. Second, the parish population of the Pokrovskaya Church is socially heterogeneous, which is of great importance for analyzing influence of social class characteristics on demographic processes.

Methodology for calculating seasonal fluctuations

To study peculiar features of seasonal dynamics in mortality, the seasonal index was used, which was calculated as the ratio between monthly rates and the average annual rate (Venetsky 1971, 1978; Henry, Blum 1997).

Seasonal death indices developed for children aged 0, aged 1-4, 5-9, 10-14 years and over 15 years and individually for each social class on the basis of registers of the Pokrovsky

parish for 1877-1897. Seasonal fluctuations were calculated with due regard to the number of days in a month and a year, therefore, when referring to distribution of deaths by month, the author will mean adjusted values rather than the absolute ones. Possible differences in the method of calculating seasonal fluctuations could serve one of the factors of differences between modern and pre-revolutionary studies. The analysis of deaths by month not adjusted for the number of days in the month will make the peaks in seasonal fluctuation fall on July-August.

Results

Many pre-revolutionary researchers paid much attention to problems related to high infant mortality, since it is one of the important indicators of the social well-being defining the environmental, economic and social situation, as well as the level of health development in the country. Even at the end of the XIX century, the infant mortality rate remained quite high in most regions of European Russia. According to S.A. Novoselsky, this indicator ranged from 270 to 260‰ (Novoselsky 1916) and remained extremely high in Siberia (according to some estimates, over 500‰) (Sagaidachny 2000), while in a number of European cities this indicator had begun to significantly decrease as early as the mid XIX century. All this suggests insufficient development of the Russian medicine, low level of sanitary literacy among population and low standard of living in general (Demographic development… 2011). The infant mortality rate in the Pokrovsky parish in the last third of the XIX century remained rather high, however it decreased from 448‰ to 418‰ under the study period.

An important characteristic of infant mortality in pre-revolutionary Russia is its seasonal fluctuations. The database included information on 2,524 infant deaths, 871 child deaths (1-4 years), 249 deaths among children aged 5-9, 90 deaths among children aged 10-14 and 1,496 deaths among children aged over 15 (in 17 cases, the age at death was not specified). Figure 1 shows that infants have the highest risk of dying in the summer months, infant mortality rates were three times higher than the annual average. Historians and demographers explain high rates of infant mortality in summer by prevalence of infectious and gastrointestinal diseases with peaks mainly associated with the environmental factors, namely dry and hot weather, as well as «peculiar features of feeding newborns» (Avdeev et al. 2002).

According to our study, the same trend is typical for children aged 1-4, while in contrast to infant mortality, there is a reduced contribution of the June deaths and increased contribution of the August deaths (Fig. 1).

Small peaks in winter mortality are associated with cold-related diseases, however, despite the harsh climatic conditions in Russia, infant mortality in the winter months was not as high as in summer.

In the last third of the XIX century, infant mortality was still strongly dependable upon the time of year. Researchers studying seasonal fluctuations in infant mortality noted that the mortality peak was recorded in summer, it is consistent with our study: summer deaths account for 52% of all infant deaths. Among the summer months, June stands out accounting for 26% of infant deaths while July was responsible for 16% of deaths.

Infant mortality in spring, winter and autumn equals to 23%, 13% and 12%, respectively. Among the spring months, the highest number of deaths – 10% was registered in May. In autumn, September stands out (4.3%) with a higher average monthly temperature, and January (5.4%) – in winter.

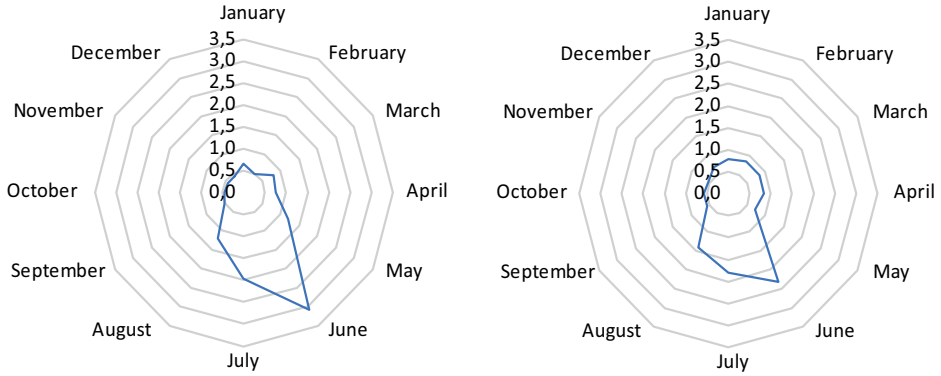

Figure 1. Seasonal indices of infant mortality (left) and child mortality (right) in the Pokrovsky parish (1877-1897), both sexes. *Source:* author's calculations based on parish registers.

Analyzing seasonal fluctuations in mortality in the second half of the XIX century, Sokolov and Grebenshchikov, like many other researchers, wrote that the highest infant mortality was registered in summer months; they noted that this was completely unusual for Western European states (Sokolov, Grebenshchikov 2004).

Analyzing seasonal fluctuation in mortality among urban and rural population of the Tomsk governorate in 1886, Efimov (1890) emphasized the fact that the maximum temperature during this period was recorded in July, and that hot weather contributed to «rapid development of pathogens» (Efimov, 1890), resulting in higher mortality rates during this period. The maximum number of deaths among rural population of the Tomsk governorate was registered in June and July, and in July and August - among rural population.

Distribution of deaths among children aged 1-4 in summer, spring, winter and autumn equaled to 46%, 20%, 20% and 14%, respectively. Thus, compared with infant mortality, the contribution of summer months is somewhat lower, while the contribution of other months is levelling. As to the spring months, the highest number of deaths – 10% was registered in May. In winter, February stands out (7.1%), and – September and October (4.8% each) – in autumn.

The maximum share of deaths among children aged 5-9 years is registered in summer – 37%, while deaths in spring, winter and autumn account for 23%, 22% and 18%, respectively (Fig. 2).

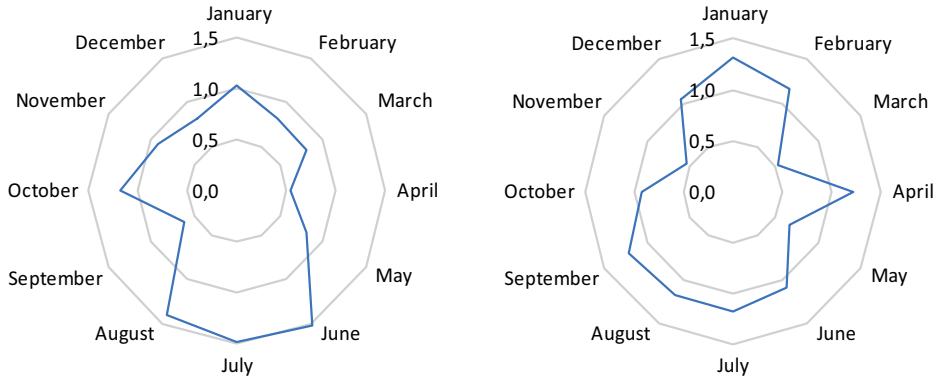

Figure 2. Seasonal indices of mortality among children aged 5-9 (left) and children aged 10-14 (right) in the Pokrovsky parish (1877-1897), both sexes. *Source:* author's calculations based on parish registers.

Seasonal fluctuations in mortality among children aged 10-14 are more evenly distributed: 29% of deaths in summer and winter, and 22% and 20% in autumn and spring, respectively (Fig. 2).

Distribution of deaths among adult population (over 15 years) were balanced throughout the months of the year, with a light increase in the indicator in August (Fig. 3). Therefore, the seasonal factor is not playing the leading role any longer. Unlike children, adults are more resistant to infectious and cold-related diseases, but most importantly, they are not dependable upon parental care and support.

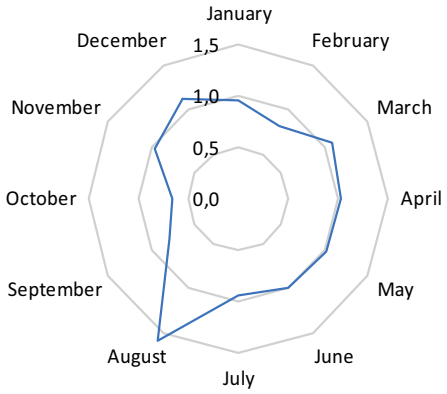

Figure 3. Seasonal indices of mortality among population over 15 years in the Pokrovsky parish, 1877-1897, both sexes. *Source:* author's calculations based on parish registers.

The author has also attempted to estimate seasonal distribution of deaths by individual social class. A total of 2,524 infant deaths were recorded in the Pokrovsky parish (Table 1). Representatives of the clergy, and unspecified or unknown social classes were not included in the seasonal analysis due to insignificant size of each group with their combined share equaling to 3.9%. Death distribution largely depends on the number of births in social classes. The lowest infant mortality rate was typical for the upper classes (348‰), followed by the military (402‰), peasants (406‰), petty bourgeoisie (446‰).

Table 1. Distribution of births and infant deaths, infant mortality rate (IMR) in the Pokrovsky parish by social class, 1877-1897

Social class	Number of deaths (abs.)	Share of deaths (%)	Number of births (abs.)	Share of births (%)	IMR, ‰
Petty bourgeoisie	1506	59.7	3379	57.2	446
Peasants	491	19.5	1209	20.5	406
Military	351	13.9	873	14.8	402
Upper classes (nobles, officials, merchants)	77	3.1	221	3.7	348
Other	99	3.9	221	3.7	448
Total	**2524**	**100**	**5903**	**100**	

Source: author's calculations based on parish registers.

The number of deaths among children aged 1-4 in the parish equaled to 871 for the entire period under study including the share of children of petty bourgeoisie adding up to 56%, peasants – 27.4%, military – 12.6%, nobles, officials and merchants – 2.1%. Similarly, the seasonal analysis of infant mortality did not include children of the clergy, unspecified and unknown social classes with their combined share of 1.8%.

Comparison of all social classes with the peasants (Fig.4), shows that the mortality peak among peasant children aged 1-4 falls on July, in contrast to the June peak characteristic of all other social classes. In his work on the Novgorod governorate F.V. Gilyarovsky (1866) explains this by the fact that the «grown-up» peasant children who were able to eat on their own and already out of the watchful supervision by their parents could get reach of green berries and especially mushrooms often resulting in death.

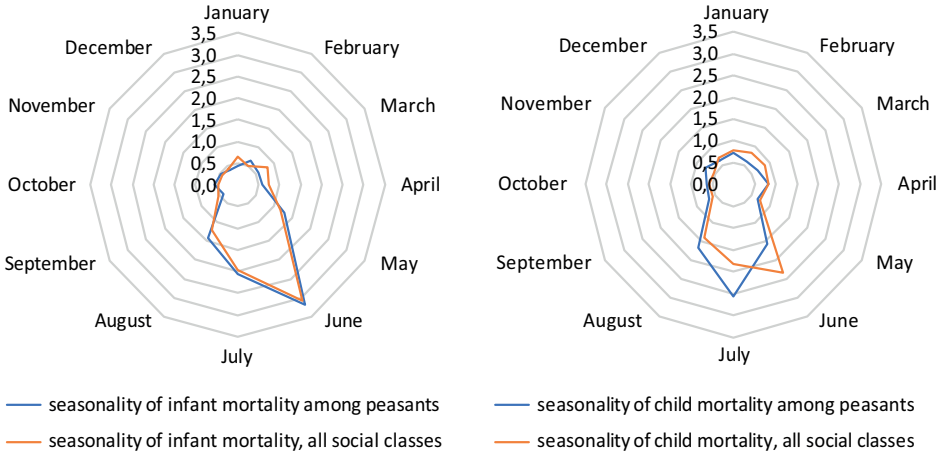

Figure 4. Seasonal indices of infant mortality (left) and child mortality (right) among peasants in the Pokrovsky parish (1877-1897), both sexes. *Source:* author's calculations based on parish registers.

Lines of seasonal fluctuations in mortality among all social classes and the petty bourgeoisie (Appendix 1) are almost the same, since petty bourgeoisie was the largest group in the parish. Typical seasonal lines are also characteristic of the military (Appendix 2), suggesting similarity in their demographic behaviour with the bourgeoisie.

The equally high infant mortality rates among the upper classes in June and July (Fig.5) call for a further investigation, as well as expansion of the time series and territorial coverage, since a small number of observations with a monthly distribution can affect the result.

In general, summer and winter peaks indicate a continued role of exogenous causes of death.

Seasonal fluctuations in infant mortality is partly due to seasonal fluctuations in fertility. According to our data, peaks in seasonal fluctuations in births are registered in October (1.14), May (1.11) and June (1.09), while the mortality peaks fall on June (3.08) and July (1.97). Thus, there is an overlap with June; mortality seasonal indices equaled to 0.46 and 1.19 in October and May, respectively.

Next, the author has attempted to assess seasonal fluctuations in causes of death. Diarrhea was the leading cause of death among infants across all social classes, followed by rodimets (seizures), smallpox, measles, cough and weakness. (Table 2).

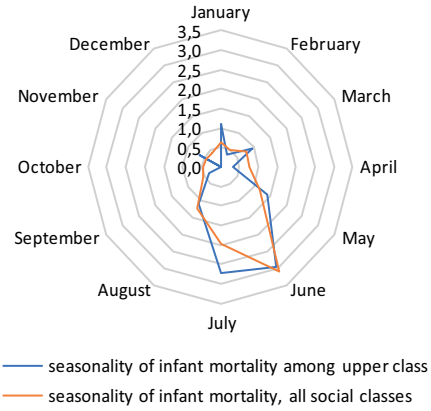

Figure 5. Seasonal indices of infant mortality in upper classes (nobles, officials, merchants) in the Pokrovsky parish, 1877-1897, both sexes. *Source*: author's calculations based on parish registers.

Table 2. Leading causes of death among infants in the Pokrovsky parish, by social class, average for 1877-1897, both sexes, %

Military	%	Petty bourgeoisie	%	Officials, nobles, merchants	%	Peasants	%	Unspecified	%
Diarrhea	66.3	Diarrhea	62.3	Diarrhea	64.1	Diarrhea	60.5	Diarrhea	60.6
Rodimets (seizures)	11.1	Rodimets (seizures)	12.3	Rodimets (seizures)	10.3	Rodimets (seizures)	15.5	Rodimets (seizures)	22.5
Smallpox	4.0	Weakness	5.4	Cough	6.4	Smallpox	5.1	Measles	2.8
Cough	3.7	Cough	2.9	Weakness	5.1	Weakness	3.3	Scrofula	2.8

Source: author's calculations based on parish registers.

According to one point of view, the diagnosis of rodimets (seizures) was made when it was not possible to accurately determine the disease, however, in the last third of the XIX century it aquired its own distinctive symptoms. Medial historians believe that death "from rodimets", i.e. from a native relative, was embedded in DNA, and if the baby did survive it meant a natural selection. According to Gilyarovsky (1866), "rodimets (siezures)" was attributed to "nervous disorders". In most cases, the disease manifested as epilepsy with body shaking, foaming at the mouth and lost of consciousness. Frights, shakings, bruises, as well as parasites and worms could contribute to this disease. In general, a wider range of causes than indicated in the parish registers was considered as "rodimets (seisures)".

Interestingly, smallpox was more common among children of the military (mostly of those on indefinite leave and retired) and peasants, since these groups were more likely to deal with animals.

Figure 6 shows that diarrhea peaks in June. A summer infectious nature of diarrhea is due to gastrointestinal diseases that are associated with improper food storage. The problem was aggravated by the fact that, for instance, peasant women had to go to field work leaving their children with "a chew" (chewed bread wrapped in a piece of cloth) for the whole day. In hot weather, the use of cow horns and cow teats resulted in having worms in them (Gilyarovsky, 1866). The infectious nature of the disease can also manifest in the autumn-spring period, for example, cough peaked in November and March, making it possible to attribute this cause of

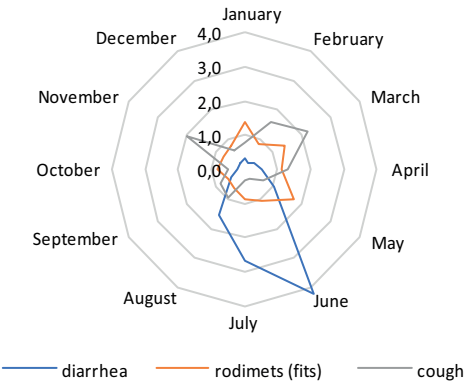

Figure 6. Seasonal indices of some causes of death (diarrhea, rodimets (siezures), cough) among infants, all social classes, both sexes. *Source:* the author's calculations according to registers of the Pokrovsky parish (1877-1897).

death to exogenous one. Speaking in terms of the modern International Classification of Diseases of the 10th revision, cough as a symptom may be characteristic of respiratory diseases such as influenza and pneumonia. The analysis of mortality from "rodimets (seizures)" failed to identify any seasonal fluctuations suggesting a possible endogenous etiology of this disease.

Conclusion

In Barnaul in 1877-1897, infant mortality still strongly depended on the time of year with the maximum peak in summer, in June in particular; only at the age of 10-14 years do seasonal fluctuations in mortality begin to level out with a subsequent even distribution throughout the year. Population of older ages of the Pokrovsky parish is characterized by an almost even distribution of deaths throughout the year. Therefore, according to our data, the seasonal factor passes from the picture as individuals grow up.

Differences in seasonal fluctuations in infant mortality by social class have been considered as well. The maximum number of deaths among peasants was registered in July compared with all social classes with a peak in June. In the upper classes, the highest numbers of deaths were almost evenly distributed between June and July, calling for a further investigation due to the small number of observations.

Seasonal mortality analysis by cause of death showed that summer peaks were due to infectious diseases, while winter peaks were associated with cold-related diseases, suggesting a continued role of exogenous causes of death. The leading causes of infant mortality across all social classes included diarrhea and rodimets (seizures). Seasonal fluctuations in the leading causes of death (diarrhea, rodimets (seizures), cough) in children of all social classes showed a summer peak in mortality from diarrhea (dysentery), spring-winter peaks of mortality from cough and lack of seasonal fluctuations in deaths from rodimets (seizure), the latter is probably due to the fact that the nature of this cause is endogenous.

Seasonal fluctuations in mortality by class group are not fundamentally different. It can be assumed that the demographic transition was still in its early stages and yet to be evenly developed in the upper classes, although their infant mortality rates had already been the lowest, reflecting their forefront position in demographic modernization.

As M. Sakamoto-Momiyama notes, as mortality rates decrease, deaths are being redistributed from summer to winter due to a gradual development of health care, emergence of new medicines, and improvement of living standards (Sakamoto-Momiyama, 1980). Although we are witnessing a gradual trend towards lower infant mortality rates examplefied by the Pokrovsky parish, summer peaks remain relevant to all social classes. The obtained results and conclusions about seasonal fluctuations in infant and child mortality are consistent with pre-revolutionary studies and few modern research. The Russian climatic diversity, socio-economic differences within the country, as well as different remoteness from the European part of Russia as a center of innovations can account for the fact that estimates, in particular for the Pokrovsky parish in Barnaul, could differ from studies on seasonal fluctuations in the Russian European regions. For example, mortality peaks in some cities and settlements of the Novgorod governorate in the second half of the XIX century (Gilyarovsky, 1866) were registered in July, while in Barnaul the peak was in June. The hypothesis about different methods of calculations should not be neglected either: while the author calculates seasonal fluctuations using seasonal indices, which level out differences in the number of days in months, other researchers could analyze the usual distribution of absolute values with months with 31 days accumulating more deaths. Analysis of seasonal fluctuations in demographic processes in the Russian Empire in the pre-transition demographic period requires extension of the time series and expansion of territorial coverage.

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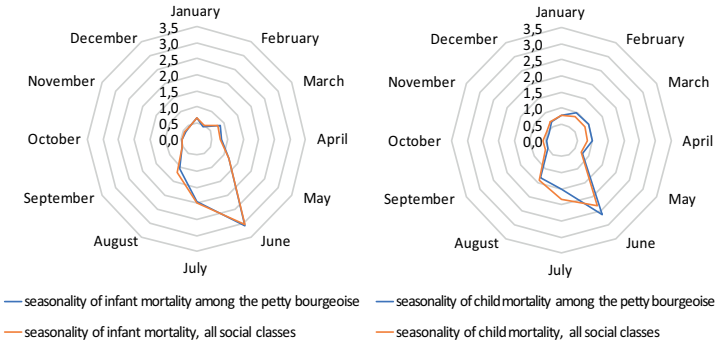
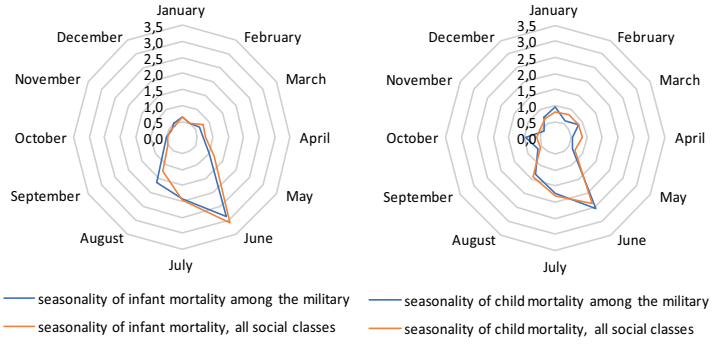
Appendix 1



Seasonal indices of infant mortality (left) and child mortality (right) among the petty bourgeoise in the Pokrovsky parish (1877-1897), both sexes. *Source:* author's calculations based on parish registers

Appendix 2



Seasonal indices of infant mortality (left) and child mortality (right) among the military in the Pokrovsky parish (1877-1897), both sexes. *Source:* author's calculations based on parish registers