

Cholera and typhoid fever in 19th-century *Bielitzer Zion*

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ABSTRACT This study outlines an analysis of selected anthropo-demographic data of *Der Bielitzer Zion* population from parish registers and historical sources. The analysis focuses on three epidemics: cholera (two) and typhoid fever (one) which took place in mid-19th century in Bielitz. The aim of this paper is to explore the demographic structure of the fatalities due to the epidemics and to propose possible causes of any variations. Analysis shows the divergence in the age structure of deceased parishioners between the normal and epidemic years. Also, similar outbreaks of infection but of different pathogenesis could lead to observable discrepancies in the overall demographics of the deceased. In the case of cholera: more fatal cases were seen in the city, a higher frequency of deaths occurred in Bielitz females, the disease occurred only in the warm months and the outbreaks were of short duration. For typhoid fever: more fatal cases were seen in the peri-urban villages, a higher frequency of deaths occurred in the female of the peri-urban villages and the outbreak was of long duration. Frequencies and mortality rates of the above causes of death were compared with younger, more advanced populations. The similarities between these groups suggest a high socio-economical status of *Bielitzer Zion*.

KEY WORDS: gastroenteric epidemics, biodemography, epidemiology, parish registers

Der Bielitzer Zion (Zion of Bielitz) was a German name used in the 18th and 19th century for a specific town district which was inhabited mostly by members of a Lutheran parish in the city of *Bielitz* (Polish: Bielsko; present Bielsko-Biala) (see Fig. 1). A group of Lutherans who were living and working in rapidly developing 19th century Bielsko would congregate in the Church of The Saviour in the town centre. As a large parish, the Church of The Saviour covered

the majority of Lutherans in the vicinity, not only from the “Zion”, but also from the other town districts (*Saybuscher Vorstadt*, *Niedervorstadt*, *Obervorstadt*) and even quite distant suburban localities (such as: *Ohlsch*, *Nikelsdorf*, *Bistray*, *Batzdorf*, *Kurzwald*, *Franzfeld*, *Ellgoth*) [Kenig 2000, Ryś 2003].

In the mid-19th century epidemics abounded worldwide [Merrill 2009], including for the population of *Bielitz*.



Fig. 1. Austrian map of Bielitz center.

Evidence for this is clearly visible in the causes of death taken from parish registers, such as the Books of Deceased (*Sterbregister*):

- June 1847 - October 1848: typhoid fever (an acute illness caused by invasive infection of the intestines, arising at first mostly from water-borne and food-borne *Salmonella typhi* or *Salmonella paratyphi* bacteria) [pathogenesis e.g., Zaremba & Borowski 2001, Ryan & Ray 2004,

Parry 2005]. First deaths: poor city district (workmen's *Saybuscher Vorstadt*). Epidemic spread for over a year and its indirect cause could be famine in the territory of contemporary southern Poland.

- June 1849 - October 1849 and July 1855 - November 1855: two cholera epidemics (an acute illness caused by infection of the intestines – arising only from the water-borne bacterium *Vibrio cholerae*) [pathogenesis e.g., Zaremba & Borowski 2001, Ryan & Ray 2004, Ramamurthy & Bhattacharya 2010]. First deaths: the *Obervorstadt*, a district with a very high population density. Both outbreaks lasted for a short time and were part of the Third European Cholera Pandemic (1846-1855) [Collins 2003, Ball 2009].

Although the authorities of the Habsburg Empire did not determine the exact number of cholera or typhoid fever incidences and fatal cases in the city and its surroundings, it can be assumed that for the Lutheran parish itself, the values, as presented in Table 1, are at least probable [based on disease pathogenesis and relevant, historical data: *Akta*; Dorsz-Szteke & Maciejewska-Dorsz 1981;

Table 1. Number of fatal cases and supposed incidence during 3 outbreaks (Lutheran Parish)

Outbreak among Lutheran Parishioners	Fatal cases					Minimal supposed incidence (based on average case fatality)		
	Bielitz		Peri-urban villages		Total	Bielitz	Peri-urban villages	Total
	M	F	M	F				
Typhoid fever 1847-48 (fatality rate 20%)	35	31	38	50	154	330	440	770
Cholera 1949* (fatality rate 50%)	62	79	22	23	186	282	90	372
Cholera 1855* (fatality rate 50%)	60	77	9	9	155	274	36	310

* important difference between numbers of fatal cases in Bielitz and the peri-urban villages

Collins 2003; Sadowska 2005; Berner 2007, 2008*a,b*, 2009; Liczbińska 2009].

This paper focuses on three massive epidemics of cholera and typhoid fever which took place in mid-19th century *Bielitz*. The general aim of the study is a comparison of the internal mortality structure of the Lutheran population during these three catastrophic events. It should be mentioned that “city group”, “peri-urban group”, “males group”, “females group” in the study refer only to the Lutheran inhabitants of Bielsko and should not be taken to mean the overall population of the city.

Materials and methods

Lutherans from *Bielitz* left behind parish registers which are entirely unique and valuable as research material. A long period of record-keeping (1782-2010), good maintenance of the parish records and the high proportion of Lutherans in the total population of Bielsko (up to 50%) all provided a good source for the analyses of their bio-historical demography [Gieysztorowa 1976, Herring & Swedlund 2003]. For this particular study a sample of 4,387 recorded deaths (64.3% from *Bielitz*; 35.7% from city

surroundings), covering years 1845-1864 was taken, and standard frequency analyses conducted. Data were corrected for the odd days of the month. In addition, the population size of *Bielitzer Zion* (excluding the peri-urban villages) was estimated on the basis of raw data [Sulimierski *et al.* 1880-1885, Wagner 1938, Kenig 2000] and historical demography methods [Gieysztorowa 1976]. Statistical significance was determined using non-parametric tests.

Results

Generally, throughout the epidemic years more females died than in normal years (Tabs. 2, 3). Typhoid fever particularly affected the older age-group of males in the city and older females in the peri-urban villages. In contrast, both cholera outbreaks affected mainly the females in the city. The cholera epidemics appear to be more prevalent in younger age-groups (especially that in 1855), which were more mobile [as in Szczecin: Dorsz-Szteke & Maciejewska-Dorsz 1981]. Among the few death causes selected for this study (Tab. 2), typhoid fever appears to also have been present in mainly males during the

Table 2. Selected causes of death in *Bielitzer Zion* (parishioners from the city and peri-urban villages) during epidemic and non-epidemic years [percentages of the total number of deceased]

Death causes	“Epidemic years” (1847-49, 1855)				“Non-epidemic years” (1845-46, 1850-54, 1856-64)			
	Bielitz		Peri-urban villages		Bielitz		Peri-urban villages	
	M	F	M	F	M	F	M	F
Cholera	13.17	16.44	5.50	5.34	0.71	0.65	1.33	1.33
Typhoid fever	4.53	4.21	6.63	8.41	1.36	0.98	1.74	1.33
Infectious disease	2.74	2.21	2.27	2.59	3.80	4.73	7.15	6.74
Tuberculosis	3.79	3.90	4.37	3.72	7.77	6.19	4.90	4.70
Other	25.29	23.71	30.58	30.58	37.75	36.07	36.16	34.63
TOTAL	49.53	50.47	49.35	50.65	51.39	48.61	51.28	48.72

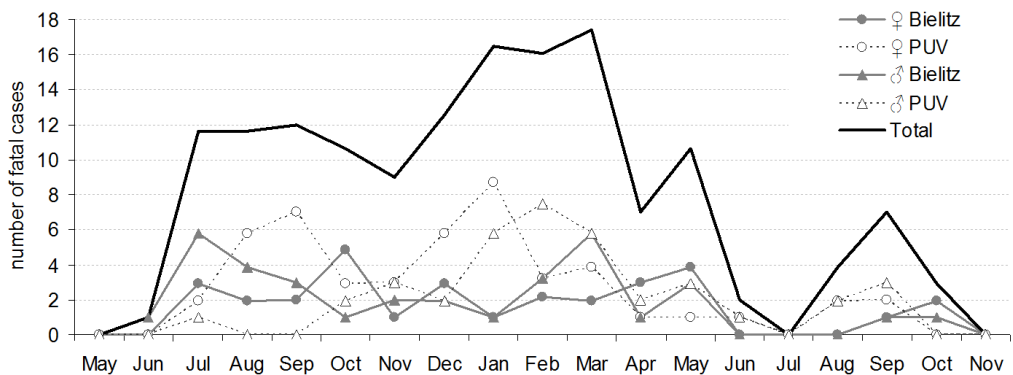
Table 3. Selected causes of death per year in *Bielitzer Zion* (city parishioners) during the epidemic and non-epidemic years (disease-specific mortality rates; population size $N = 5900$)

Death causes	Mortality rate per 1000					
	“epidemic years” (1847-49, 1855)			“non-epidemic years” (1845-46, 1850-54, 1856-64)		
	Males	Females	Total	Males	Females	Total
Cholera	5.30	6.61	11.91	0.14	0.13	0.26
Typhoid fever	1.82	1.69	3.52	0.26	0.19	0.46
Infectious disease	1.10	0.89	1.99	0.74	0.92	1.66
Tuberculosis	1.53	1.57	3.09	1.51	1.21	2.72
Other	10.17	9.53	19.70	7.36	7.03	14.40
TOTAL	19.92	20.30	40.21	10.02	9.48	19.50

non-epidemic years. Infectious diseases such as smallpox, measles, whooping cough, etc. are seen to be rather more prevalent in the non-epidemic years, and affected mostly peri-urban villages. Mortality inflicted by tuberculosis, which seemed to be lower during the epidemic years and rather more frequent in the normal years, is an artefact caused by the increased mortality resulting from epidemic causes. In fact, disease-specific mortality rates (Tab. 3, available only for the city) show comparable tuberculosis mortality rates for the epidemic and non-epidemic years.

In mid-19th century *Bielitz* and surroundings, the typhoid fever epidemic lasted a long period but it was not severe (Fig. 2). Its broad peak was present from summer 1847 to late spring 1848. Also, the death distribution suggests that the epidemic occurred mainly among females in the rural peri-urban villages (Tab. 2). The shape of the curve (Fig. 2) suggests a scattered source of infection and resembles a typical “host-to-host” epidemic [Merrill 2009].

Both cholera outbreaks were short, severe and related to the summer warm months (Figs. 3, 4). Additionally, in 1849 as well as

Fig. 2. Typhoid fever (1847-1848) in *Bielitzer Zion* and Peri-urban villages (PUV).

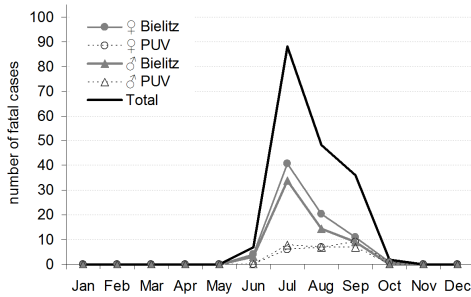


Fig. 3. Cholera (1849) in *Bielitzer Zion* and Peri-urban villages (PUV).

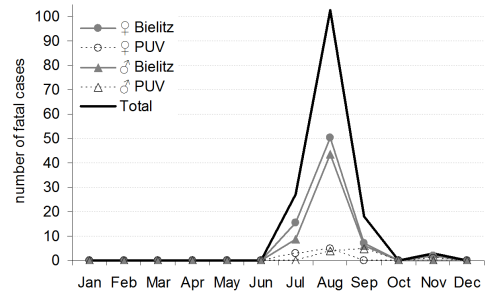


Fig. 4. Cholera (1855) in *Bielitzer Zion* and Peri-urban villages (PUV).

in 1855 there was a higher frequency of female deaths from *Vibrio cholerae* in the city (Tab. 2). The peri-urban villages seem to be only slightly affected by the cholera epidemics. The shape of curve suggests a central

source of infection and resembles a “common source” epidemic type [Merrill 2009].

The age and sex distribution of the fatal cases (Tab. 4) suggests that there were epidemiological differences between typhoid

Table 4. Age and sex distribution of fatal epidemic cases in *Bielitzer Zion* (percentages of deceased parishioners from the city and peri-urban villages).

Fatal epidemic	Generally*	Bielitz		Peri-urban villages	
		Males	Females	Males	Females
Typhoid fever 1847-48					
Age: 0-14.9	11.7	1.5	10.6	5.7	5.7
15-44.9	41.6	30.3	15.2	13.6	25.0
45+	46.7	21.2	21.2	23.9	26.1
TOTAL	100.0	53.0	47.0	43.2	56.8
Cholera 1849					
Age: 0-14.9	28.6	14.2	14.9	17.8	8.9
15-44.9	37.6	14.2	22.7	20.0	20.0
45+	33.9	15.6	18.4	11.1	22.2
TOTAL	100.0	44.0	56.0	48.9	51.1
Cholera 1855					
Age: 0-14.9	38.7	19.0	17.5	38.9	16.7
15-44.9	31.5	13.1	18.2	5.6	27.8
45+	29.6	11.7	20.4	5.6	5.6
TOTAL	100.0	43.8	56.2	50.0	50.0

* important difference between general age distribution of typhoid fever and both cholera outbreaks

fever and cholera in the group of city Lutheran parishioners and surroundings. An important difference in overall frequency of cholera cases between the city and peri-urban villages was observed, but not for the overall frequency of typhoid fever cases. Although the other variables (such as sex / age differences between epidemic-affected cases as well as place of origin) showed some differences, none were statistically significant.

Discussion

Analysis of the general mortality structure in the epidemic years suggests a minor influence of typhoid fever on the city population in comparison to cholera. This short study also shows an observable divergence in the age structure of the deceased parishioners between the normal and epidemic years. The non-epidemic years' mortality structure for the city and its surroundings is common for comparable historical early-industrial populations (Fig. 5; e.g., Haines [1976], Lee & Marschalck [2000]). The distribution of deceased individuals in the epidemic years for *Bielitz* and peri-urban villages is not statistically significant and is distinguishable from the normal period.

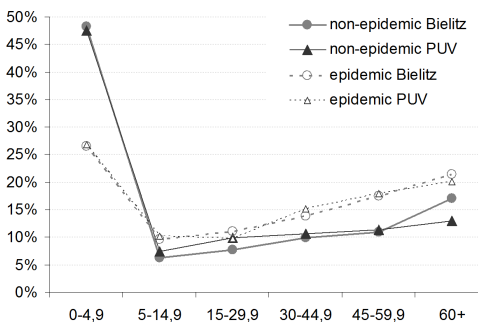


Fig. 5. Mortality profile during epidemic and non-epidemic years (PUV).

The age structure of the deceased, both in *Bielitz* and peri-urban villages, is strongly shifted to the older age-groups during the epidemic years. A lower fraction of child deaths in these years may be partly the outcome of the higher frequencies of deaths in older age-groups. This distribution may be more illustrative of a living population structure [Paine 2000].

The analysis also indicates that outbreaks of similar infection sources but of different pathogeneity could lead to discrepancies in the structure of deceased individuals (Tab. 4).

During the epidemic years about 22.2% of deaths were caused by cholera and 11.2% by typhoid fever. Conversely, during the normal years this was 1.8% and 2.6%, respectively. The latter value is comparable with data from other cities, e.g., Poznań (1855-1874) [Liczbińska 2009], where typhoid fever accounted for 2.4-5% of causes of death. However, in the non-epidemic years cholera as a cause of death in Poznań was more than three times as frequent (4.8-6%) [Liczbińska 2009] than in Bielsko, which could have been caused by geographical and populational differences between these cities (the closed, fortified city of Poznań vs. the wide open city of Bielsko with its more affluent Lutheran parishioners).

Additional analysis of other infectious diseases and tuberculosis (Tabs. 2-3) were also performed - to determine the reliability of the analyses used in this study. Overall, tuberculosis accounted for 12,5% of causes of death in Bielsko and its peri-urban villages, which is comparable with that of the Lutheran parish in Poznań (12.9%) [Liczbińska 2009] and the late 19th century upper-class population of Kraków (~15%) [Bernier 2008a]. In addition, infectious diseases (including tuberculosis) during the non-epidemic years in the analyzed

city's population accounted for 26.2% and for 29.2% in peri-urban villages. These numbers correlate positively with the data from late-19th century Kraków and Lwów (26.9% and 28.1%, respectively) [Berner 2007, 2008a].

Comparisons of the mortality rates for Bielsko itself (Tab. 3) with other 19th century cities show a similar cholera mortality rate (11.9‰) during the epidemic periods, e.g., Szczecin (1831): 9‰ [Dorsz-Szteke & Maciejewska-Dorsz 1981] and Hamburg (1892): 13.4‰ [Briggs 1961]. The mortality rate for typhoid fever which was 3.5‰ during the epidemic years and 0.5‰ during the non-epidemic years differ from the epidemic years in Łódź (1912): 1.3‰ [Sadowska 2005] and the non-epidemic years in Poznań (1890): 0.25‰ [Akta]. A possible explanation for the twofold higher typhoid fever mortality rates in mid-19th century Bielsko might be the then limited medical knowledge of disease prevention compared with the late 19th century. The mortality rate for infectious diseases (including tuberculosis) in the non-epidemic period in Bielsko (5.1‰) is comparable with late-19th century Lwów (1894): 5.5‰ [Berner 2007]. The non-intuitive lower mortality rate finding for the earlier population could be explained by the higher social status of the analyzed parishioners group.

A higher frequency of dying females in the population during epidemics of cholera compared with the higher frequency of dying males in the non-epidemic years was observed. This might be explained by the general lower mobility of women in traditional communities [Good *et al.* 1996] and a thus greater likelihood to contract food/water-borne infection from a contaminated source. Another explanation might be the presence of a higher proportion of females in this particular population. Conversely,

in other 19th century communities (e.g., Szczecin, Kent) [Dorsz-Szteke & Maciejewska-Dorsz 1981, Collins 2003] cholera epidemics affected mainly males.

The higher frequency of cholera related fatal cases in the city could be related to higher population density, as this produces a greater likelihood for contamination of the limited water sources used by the large number of individuals [Herring & Swedlund 2003, Kaniecki 2004]. The incidence of cholera in peri-urban villages may be explained by historical sources (some of non-*Bielitz* inhabitants worked in the city, e.g., in the textile industry, as workmen or housemaids [Kenig 2006]). A noticeably higher frequency of deaths among *Bielitz* females caused by cholera may be an effect of lower female mobility (e.g., as traditional housewives, mothers with sick children, housemaids) and their involvement in water/food home provision [Djeddah *et al.* 1988]. The occurrence of disease during the warm months and the short duration of outbreaks are probably explained by the pathogenetic characteristics of cholera (*Vibrio cholerae* sensitivity to low temperatures; severity of cholera) [Herring & Swedlund 2003, Ramamurthy & Bhattacharya 2010].

The higher frequency of fatalities due to typhoid fever in the peri-urban villages may be an effect of prolonged contact with livestock and of lower standards of hygiene, especially in food processing [Collins 2003, Beyene *et al.* 2008]. The higher frequency of deaths among peri-urban village females could, as with cholera, be related to their lower mobility and home provisioning activities. Conversely, the higher frequency of deaths among the group of *Bielitz* males, especially of working age, may be an effect of their greater daily migration between town districts or villages (day-workmen, transport of goods) and more frequent use

of public inns [with contaminated food and drinks, as in Sathe *et al.* 1983, Collins 2003]. The broad peak of fatal cases between 1847 and 1848 could be explained on the one hand by the prolonged pathogenesis of typhoid fever and, on the other hand, by so-called “hunger Typhus” [Soja 2008], which was an effect of the famine in 1846-1847 leading to lower eating standards. Also, a weakened immune system in the winter due to malnutrition [Rau 2005] should not be discounted. The low severity of the typhoid fever epidemic might be explained by a high survivorship rate [its fatality rate in 19th century communities seldom exceeded 25%; Collins 2003, Sadowska 2005] and was thus not accounted for in parish death registers. In addition, the low frequency of incidence in the youngest age-group may be the outcome of typhoid fever non-specific pathogenesis (cause of death unrecognized as typhoid fever, such as septic shock, inflammations or consumption – especially among children) [Collins 2003], as recent studies show the highest incidence of this illness in specifically the 5–14 yrs age-group [Feng-Ying *et al.* 2000, Parry 2005].

Final remarks

This article has focused on three epidemic instances of cholera and typhoid fever which took place in mid-19th century *Bielitz*. As a densely populated, bustling city with limited water supply [Sulimierski *et al.* 1880-85], the population of Bielsko provides a good example of the manner in which the outbreaks spread during the time of intense industrialization. The period of analysis was chosen non-randomly, as the epidemic cases broke out shortly before widespread understanding of cholera and typhoid fever etiology and introduction

of sanitation, water supplies and sewage systems [Perzanowski 1958, Haines 1976, Kaniecki 2004]. Thus, the chosen cases are one of the most recent examples of relatively unmonitored cholera and typhus outbreaks in a European city.

The aim of this article was to explore the bio-demographic structure of cholera and typhoid fever fatal cases, examine the divergence in the proportions between sex, age and origin (town, peri-urban villages) due to the epidemics of the groups and compare with other available data. It is proposed that possible causes of observed variances could be associated with the socio-cultural background of the analyzed group and the epidemiology of the selected diseases. Frequencies and mortality rates of selected causes of death were comparable with that of younger, more advanced populations, thus suggesting a high status for the protestant group. Notwithstanding the fact that the Lutheran parishioners was a representative sample of the whole *Bielitz* population (in the term of numbers), extrapolation of the epidemiological outcomes for the other groups with different social and confessional status is not advised [e.g., Dillingham 1965]. Further study on the Roman Catholic and Jewish population in 19th century *Bielitz* could be of interest.

Notes

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Streszczenie

Bielski Syjon stanowił grupę luteran wyznania ewangelicko-augsburskiego, żyjącą w dziewiętnastowiecznym *Bielitz*, Bielsku (dzisiaj: Bielsko-Biała), jak również był dzielnicą miasta zamieszkiwaną głównie przez protestantów (Fig. 1). Celem artykułu było przybliżenie wybranych informacji o stanie bio-demograficznym wspomnianej populacji w kontekście analizy danych metrykalnych parafii oraz źródeł historycznych. Zagadnienie badawcze stanowią trzy epidemie: dwie cholery oraz jedna duru brzusznego, które miały miejsce w połowie XIX wieku. Analizie poddano strukturę demograficzną populacji zmarłych, przyczyny zgonów (Tab. 2, 3) oraz zróżnicowanie pomiędzy przypadkami cholery i duru brzusznego w aspekcie różnych zmiennych (płeć, wiek, pochodzenie: miasto lub okoliczne wioski; Tab. 2, 4), a następnie zaproponowano możliwe przyczyny obserwowanych różnic.

Praca obrazuje dostrzegalną zmienność pomiędzy strukturą wieku zmarłych parafian w latach normalnych i epidemicznych (Fig. 5). Dodatkowo, zwraca uwagę na obserwowalne różnice w strukturze demograficznej zmarłych w wyniku dwóch rodzajów epidemii (Tab. 4), takie jak wyższa częstość przypadków cholery w mieście (Fig. 3-4; Tab. 1), wyższa częstość zgonów wśród mieszczańek (Tab. 2), krótkie okresy trwania wspomnianych katastrof, czy występowanie ich podczas miesięcy letnich (Fig. 3-4). W przypadku epidemii duru brzusznego obserwowano wyższą częstość zgonów w otaczających Bielsko wioskach, w szczególności wśród kobiet (Fig. 2; Tab. 1), czy długi okres trwania katastrofy (Fig. 2). Uzyskane w wyniku analizy wybrane częstości przyczyn zgonów oraz wskaźniki śmiertelności (dla cholery, duru brzusznego, chorób infekcyjnych, gruźlicy) porównano z danymi dla innych, dziewiętnastowiecznych populacji. Grupa bielskich protestantów w połowie XIX wieku mogła charakteryzować się stosunkowo wysokim statusem społecznym, jako że uzyskane wartości odpowiadają charakterystycznym dla populacji z ostatniej dekady dziewiętnastego stulecia.