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Analysis of the lifespan of Hungarian and German male pharmacists born between 1800 and 1904

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Abstract: *No historical demography studies are available in the literature on the lifespan of pharmacists, with the exception of a comparative study of the lifespan of Hungarian male pharmacists and doctors born between 1800 and 1925. Consequently, no international comparative study has been performed on the lifespan of pharmacist populations of different countries.* ***Aims:*** *We aimed to conduct a comparative historical demographic study on the lifespan of Hungarian and German male pharmacists born between 1800 and 1904.* ***Results:*** *Regarding the comparative analysis of the two populations, the first statistically significant change point in lifespan trends occurs in 1840. Between 1840 and 1899 the average lifespan was higher in Germany, and only in the last 5-year period (between 1900 and 1904) the average lifespan was higher in Hungary. In the period between 1875 and 1885, in the lifespan categories of ≥ 40 - <50 years and ≥ 50 - <60 years, mortality rates of pharmacists was higher in Hungary.* ***Conclusions:*** *The average lifespan of German male pharmacists born between 1840 and 1899 was higher than the average lifespan of their Hungarian Colleagues (in some 5-year interval it was statistically significantly higher). However, no significant increase of the average lifespan of male pharmacists born between 1800 and 1904 could have been demonstrated in either countries in this period of history, despite the fast technological-scientific development, including general healthcare services. The middle class social status, including e.g. the lack of heavy physical work and unhealthy working environment with relatively higher living standards seem to be more important specific positive determinants of lifespan in both of these populations, than the general technological-societal development, which might have had more significant positive influence among more deprived social layers.*

Introduction

A comparative historical demographic study on the lifespan of Hungarian male doctors and pharmacists born between 1800 and 1925 has been recently conducted. Opposite trends in the average lifespan of the Hungarian doctors and pharmacists have been demonstrated from the end of the 19th century; the lifespan of pharmacists grew to 75 years of age in the first quarter of the 20t^{h} century, while that of the doctors decreased to slightly more than 67 years of age. Hungarian doctors born between 1920 and 1924 lived approximately as long as their colleagues born more than 100 years earlier, between 1810 and 1814. The comparative mortality rates show, that it was caused by an increased mortality of doctors aged between 40 and 60 years. These data supported the literature accounts of a significant gradual reduction of lifespan of Hungarian doctors born between 1885/1889 and 1925. These observations are compatible with the burnout syndrom theory, owing to the fact that the reduction of lifespan of Hungarian doctors coincides with the start of the era of mass health care service fuelled by the expansion of health insurance (1).

In order to be able to better interpret the dynamics of lifespan data of Hungarian pharmacists, we performed an international comparative historical demographic study of Hungarian and German pharmacists born between 1800 and 1904.

Methods

The lifespan data of Hungarian pharmacists (n=325) were obtained from the regularly up-dated, on-line *Lexicon of Famous Hungarian Pharmacists* of the Hungarian Society for the History of Pharmacy (written by *László Szmodits*) (2), together with further data from the personal communication of *László Szmodits*.

We included in our analyses male professionals only who, to the best of our knowledge, passed away due to natural causes (i.e. female professionals and those who committed suicide or became victims of wars, the Holocaust or accidents were excluded). Only pharmacists born and died in the territory of Hungary were included in the study.

The lifespan data on German pharmacists (n=902) were obtained from the Biography Collection of German Pharmacists (Deutsche Apotheker-Biographie) published up to now in four volumes (3, 4, 5, 6), with the last volume published in 1997 (6).

Since, according to our experience, at least 90 years should be waited from the last year of births included in the historical demographical analysis to avoid any significant bias caused by the high number of survivals (the proportion of individuals >90 years of age is very small in this period of history), we decided to perform our analysis from 1800 to 1904, i.e. with an upper limit 93 years earlier than the year of publication (1997) of the last published volume of Deutsche Apotheker-Biographie. Only pharmacists born and died in the territory of Germany were included in the study.

Neither the Hungarian, nor the German data are representative. We restricted our analyses to famous or at least well-known Hungarian and German pharmacists. Accordingly, age groups below 40 years of age are very under-represented. No precise definition can be given to the term 'famous', because our sample includes pharmacists from many different fields, from professional public life to theoretical research, university education and everyday professional practice. Due to the lack of representative data, it is not known, to what extent our data are biased.

Statistical methods

Data in *Table 1*. presenting descriptive statistics of lifespan for each country, were calculated in a breakdown of date of birth grouped into time intervals of 5 years. N and mean values, and 95% confidence intervals (CIs) of the mean are presented for each time interval, along with the slope of the linear regression (representing the trend in the given interval) and the P-value testing of the null hypothesis of no

trend at all. The two slopes and P-values for testing the equality of slopes were calculated within a linear model, estimating the interaction between country and year of birth. They were interpreted descriptively, and no adjustment for multiplicity was made. A direct comparison between the two countries was performed by calculating differences between mean lifespans (90% CI) for each time interval of 5-year length.

In order to evaluate long term trends, a piecewise linear regression was fitted to the lifespan of each country, with knots at each of the 20 year-long periods (1820, 1840, 1860, 1880, 1900). These knots were pre-defined, and within the full model added slopes (compared to the first period 1800-1820) were estimated for each time interval, in addition to the interaction between the added slope and country. In the restricted piecewise regression model for time intervals with a non-significant interaction term, equal slopes were assumed, and the corresponding interaction terms were left out from the model.

Mortality rates for each country were estimated and short-term fluctuations were smoothed out by calculating moving averages for 5-year intervals, by country and by categories for age at death.

All calculations were performed in SAS version 9.4.

Results

Descriptive statistics of lifespan for each 5-year intervals is presented in *Table 1*.

P-values in *Table 1.* can be interpreted descriptively as effect sizes for slopes. In case of individual slopes they represent increasing or decreasing trends (depending on the sign of the slope), whereas the global P indicates whether there was a difference between trends in the two countries.

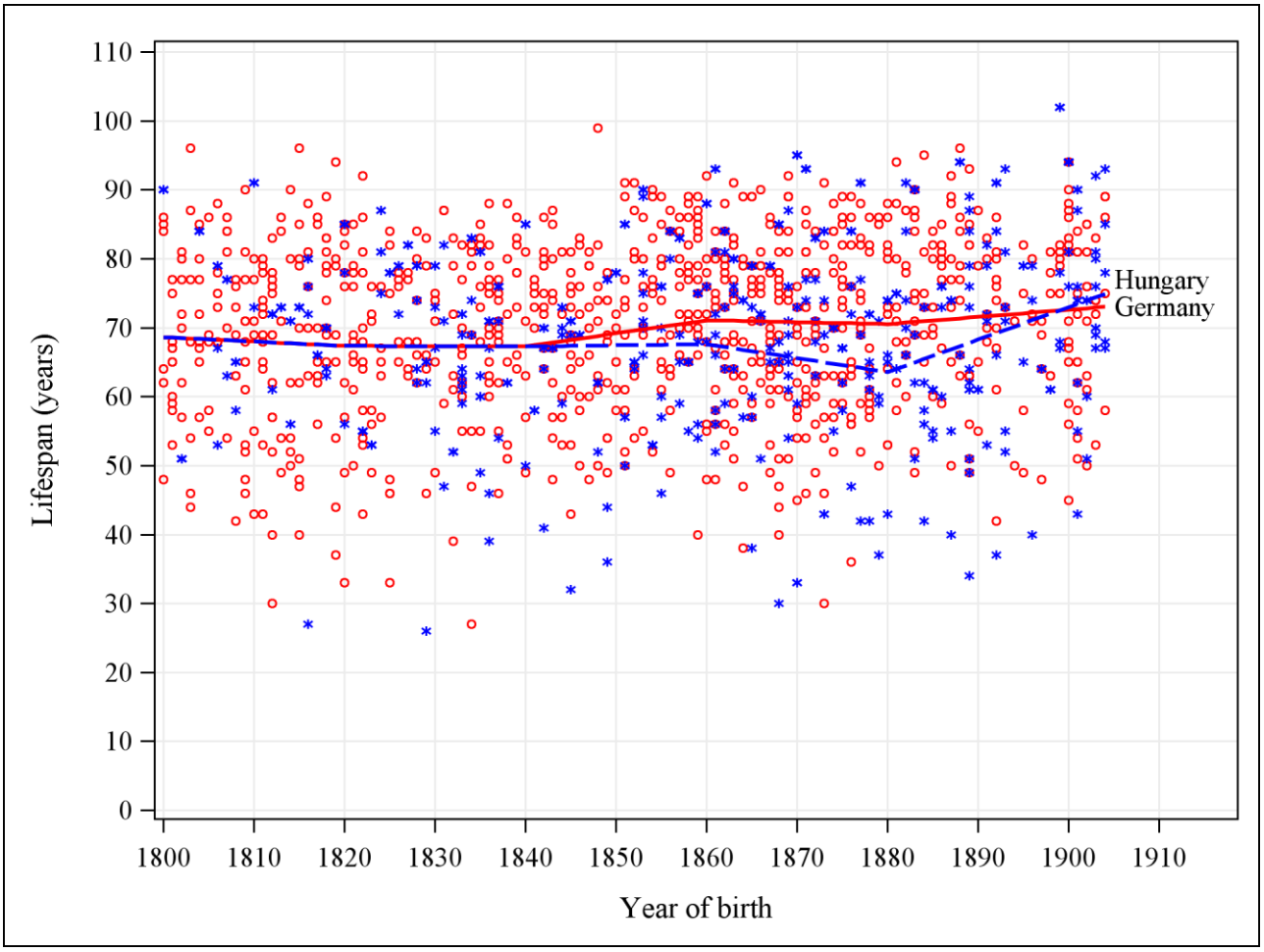
Fitted piecewise regression lines are presented in *Figure 1*.

Table 1. *Descriptive statistics of lifespans of Hungarian and German pharmacists (in years), in a breakdown of intervals of birth between 1800 and 1904*

Interval of birth	Germany					Hungary					Glob.P[d]
	N	Mean	CI[(a)]	b[(b)]	P[(c)]	N	Mean	CI[(a)]	b[(b)]	P[(c)]	
1800-1804	42	69.1	65.4 - 72.8	0.53	0.720	3	75.0	22.8 - 127	-1.50	0.740	0.886
1805-1809	36	69.1	64.9 - 73.3	-1.85	0.191	7	66.0	57.3 - 74.7	-2.06	0.709	0.393
1810-1814	45	66.3	62.2 - 70.4	-0.31	0.849	8	69.1	59.5 - 78.8	-4.85	0.110	0.270
1815-1819	41	70.5	65.9 - 75.2	0.51	0.752	9	65.7	53.7 - 77.6	-0.70	0.884	0.941
1820-1824	42	67.3	63.2 - 71.3	-0.93	0.562	9	72.3	61.8 - 82.9	1.64	0.514	0.682
1825-1829	30	67.7	62.9 - 72.6	2.03	0.235	11	67.5	57.0 - 78.1	-6.80	0.030	0.048
1830-1834	28	66.3	60.8 - 71.8	-1.06	0.548	18	66.8	61.8 - 71.7	0.54	0.798	0.806
1835-1839	46	71.0	68.0 - 74.1	-0.18	0.883	13	61.5	54.1 - 68.8	1.00	0.753	0.941
1840-1844	36	70.4	66.8 - 74.0	-0.55	0.712	13	64.6	58.0 - 71.2	0.91	0.679	0.856
1845-1849	47	67.8	64.4 - 71.2	-0.31	0.808	9	56.9	44.2 - 69.5	-1.56	0.525	0.791
1850-1854	42	72.2	68.6 - 75.8	2.57	0.062	16	69.6	63.0 - 76.1	1.70	0.530	0.143
1855-1859	53	74.7	71.8 - 77.5	1.07	0.280	17	66.0	60.3 - 71.7	-0.60	0.722	0.522
1860-1864	62	69.5	65.7 - 73.3	-1.70	0.221	24	71.0	66.3 - 75.6	-1.29	0.581	0.405
1865-1869	67	71.1	68.2 - 74.0	-0.38	0.744	26	65.8	60.6 - 71.0	1.34	0.379	0.643
1870-1874	56	67.2	63.8 - 70.6	0.86	0.537	20	66.9	58.5 - 75.2	0.01	0.996	0.825
1875-1879	53	70.7	67.3 - 74.1	-1.22	0.389	20	63.8	57.2 - 70.3	-2.39	0.259	0.364
1880-1884	44	74.2	70.7 - 77.7	0.56	0.664	21	66.7	60.8 - 72.6	-1.16	0.539	0.752
1885-1889	41	75.1	71.4 - 78.9	-0.51	0.731	24	65.8	59.3 - 72.2	1.89	0.300	0.549
1890-1894	23	71.5	66.6 - 76.3	-2.14	0.407	17	70.9	63.0 - 78.7	1.13	0.744	0.669
1895-1899	23	71.8	67.5 - 76.2	2.80	0.108	11	70.6	60.4 - 80.9	2.49	0.267	0.151
1900-1904	45	72.7	68.9 - 76.5	-0.30	0.841	29	75.1	70.1 - 80.0	-0.55	0.759	0.935

a) The 95% CI of mean; b) Slope of the linear regression; c) P-value corresponding to the null hypothesis b=0; d) P-value corresponding to the null hypothesis of equality of the two slopes for the two countries

Figure 1. *Piecewise trends for each country, for 20-year long intervals (restricted piecewise regression framework)* [(a)]

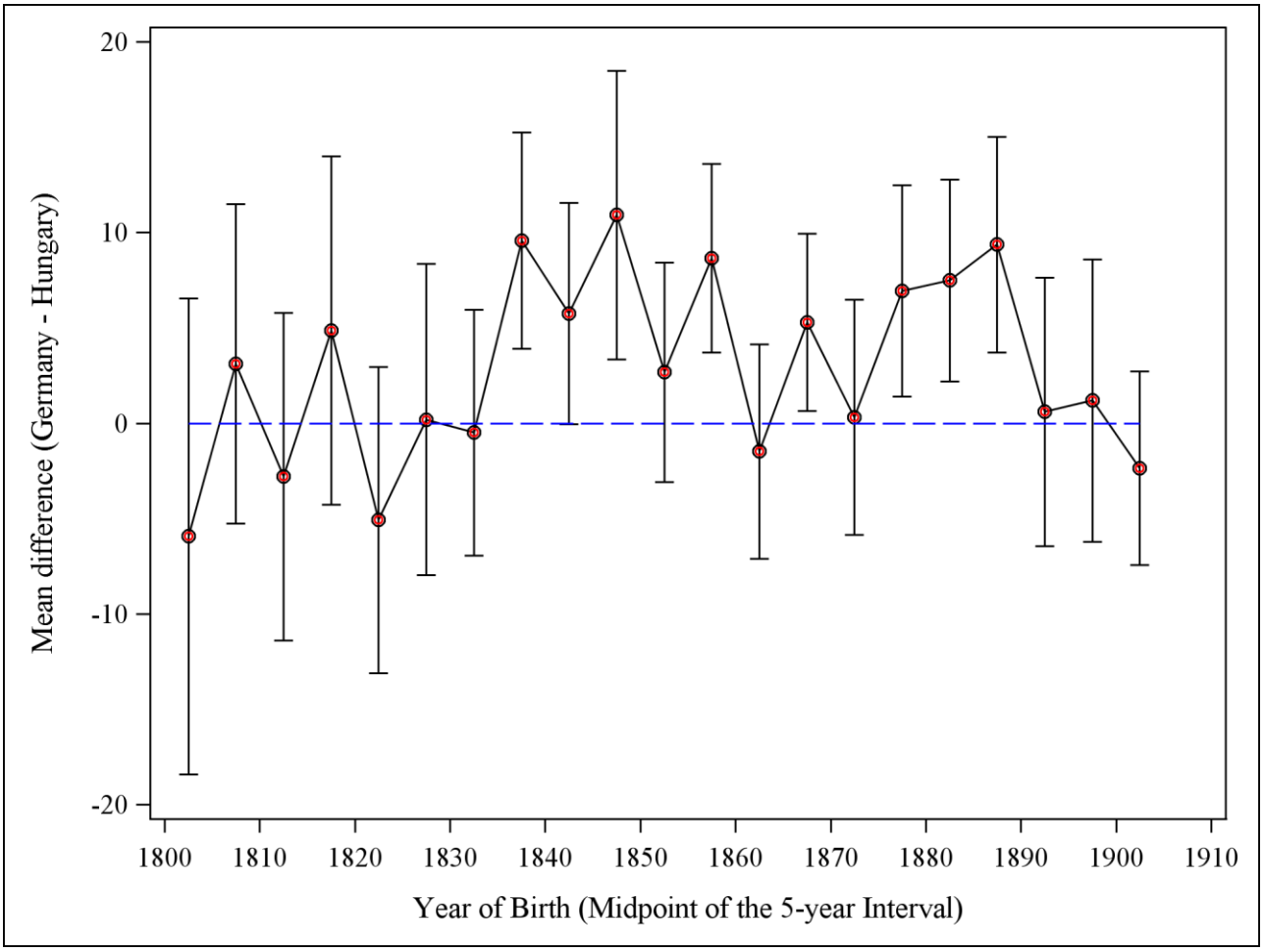


(a) Except the last interval which is 24 year long, from 1881 to 1904

Mean differences in lifespan (90% CI) between the two countries are presented in *Figure 2*.

If the slopes have a constant sign for more periods of 5 years then a long term trend can be seen. Alternating signs indicate random variation with no clear trend. No difference can be seen between the two countries in terms of mean lifespan (for instance, in the 1825-1829 period they were almost equal, means were 67.7 and 67.5 years in Germany and Hungary, respectively).

Figure 2. *Difference between mean ages of pharmacists (90% CI), Germany versus Hungary*



Results of the full piecewise regression model are summarized in *Table 2*. As indicated by the P values, differences between the slopes belonging to the two countries were statistically significant in the periods 1840-1860 and 1880 to 1904. Therefore only these interaction terms were left in the restricted model, assuming equal slopes for the other periods.

Table 2. *P values of the full piecewise regression model*

Effect	**P value**
Country	0.794
Common slope for all data, for the whole period 1800-1904	0.893
Slopes by country for the whole period 1800-1904	0.793
Added slope for the period after 1820	0.669
Added slope for the period after 1840	0.065
Added slope for the period after 1860	0.030
Added slope for the period after 1880	0.010
Interaction term between the added slope and country after 1820	0.292
Interaction term between the added slope and country after 1840	0.049
Interaction term between the added slope and country after 1860	0.077
Interaction term between the added slope and country after 1880	0.034

Coefficients of the restricted models are presented in *Table 3*. As indicated by the P values of the restricted model, the first statistically significant change point in trends occurs in 1840. Between 1840 and 1899 the average lifespan was higher in Germany, and only in the last 5-year period (between 1900 and 1904) the average lifespan was higher in Hungary.

Table 3. *Coefficients estimated within a restricted piecewise regression model framework*

Coefficient	**Estimate**	**SE**	**P value**[a]
Intercept	183.30	221.57	0.408
Common slope for all data, for the whole period 1800-1904	-0.063	0.122	0.604
Added slope for the period after 1820	0.062	0.195	0.751
Added slope for the period after 1840	0.143	0.161	0.375
Added slope for the period after 1860	-0.509	0.161	0.002
Added slope for the period after 1880	0.884	0.222	<0.001
Added slope for Germany, after 1900	0.404	0.104	<0.001
Added slope for Germany, after 1880	-0.837	0.255	0.001

(a) P-value for testing the null hypothesis of a coefficient equal to 0

Annual mortality rates (smoothed by moving average) are presented by categories of lifespans, for both countries in *Figures 3-7*.

Figure 3. *Mortality rates (moving averages for 5-year intervals) for the lifespan category of ≥ 40 and <50 years of age*

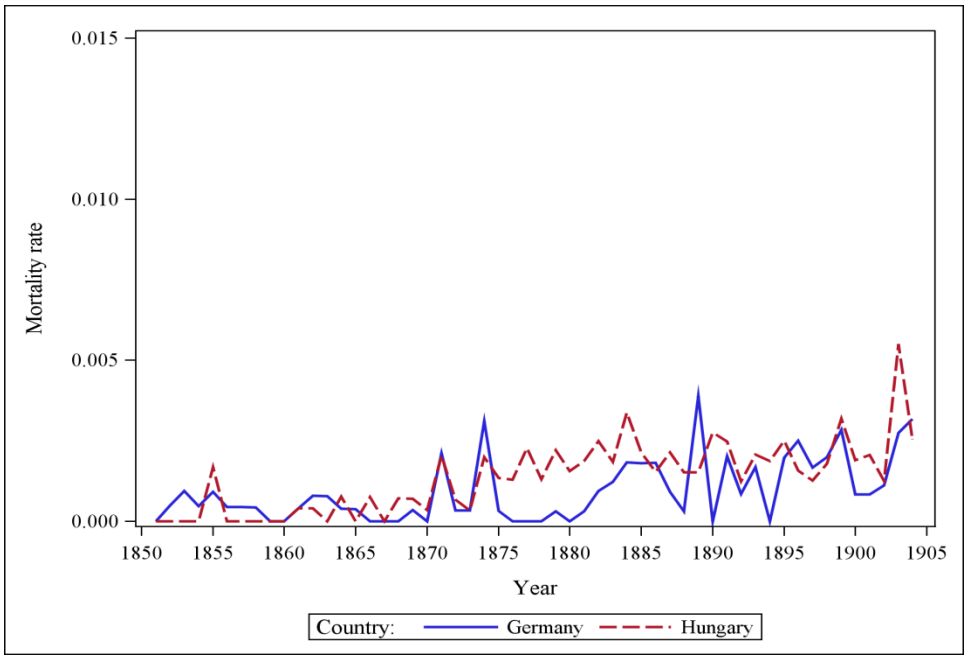


Figure 4. *Mortality rates (moving averages for 5-year intervals) for the lifespan category of ≥ 50 and <60 years of age*

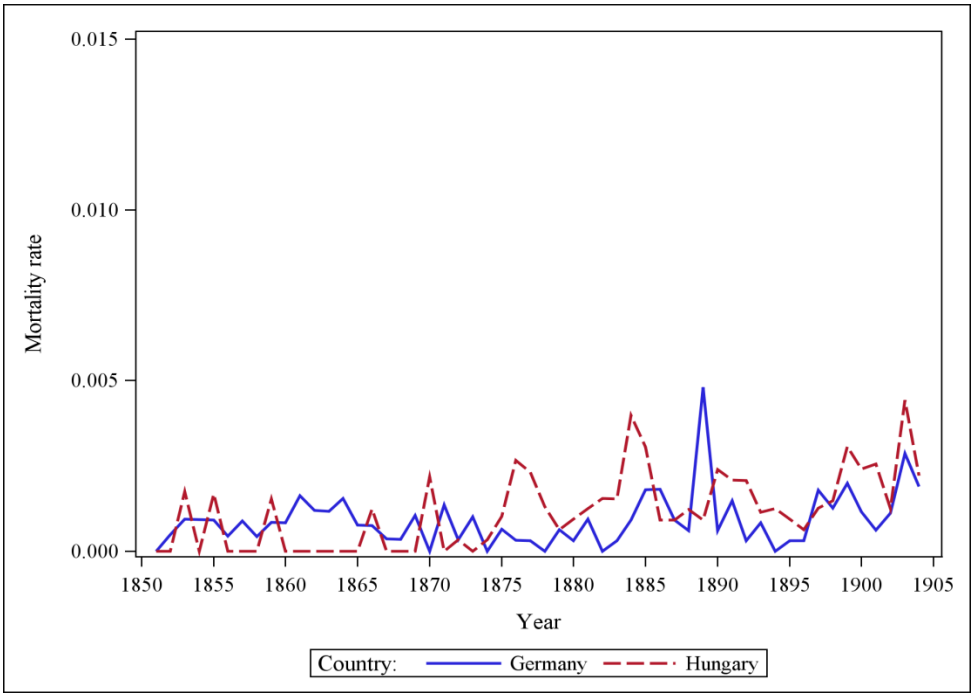


Figure 5. *Mortality rates (moving averages for 5-year intervals) for the lifespan category of ≥ 60 and <70 years of age*

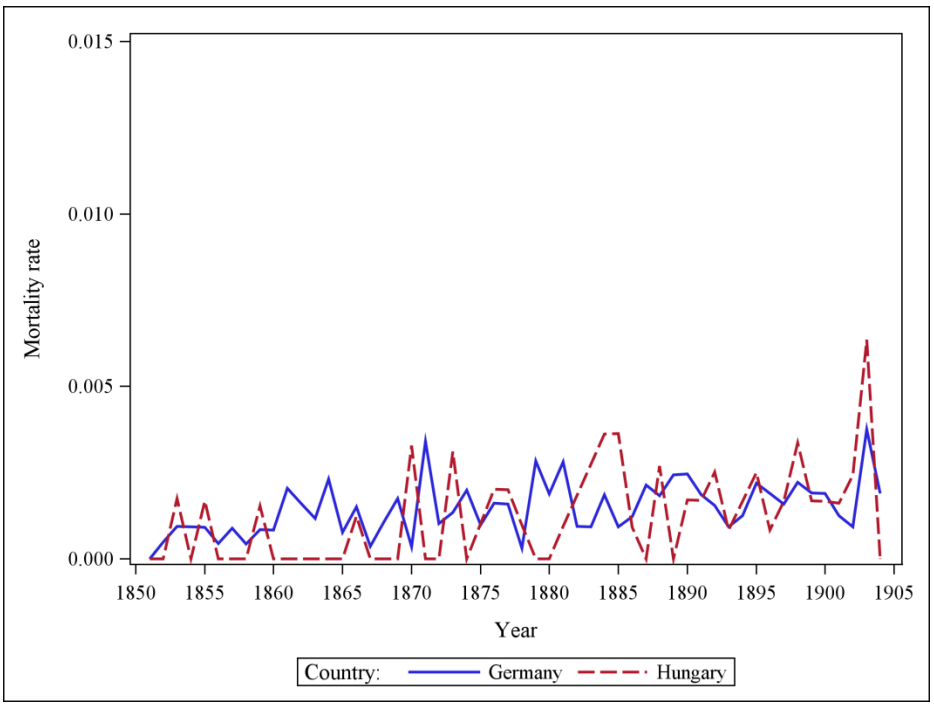


Figure 6. *Mortality rates (moving averages for 5-year intervals) for the lifespan category of ≥ 70 and <80 years of age*

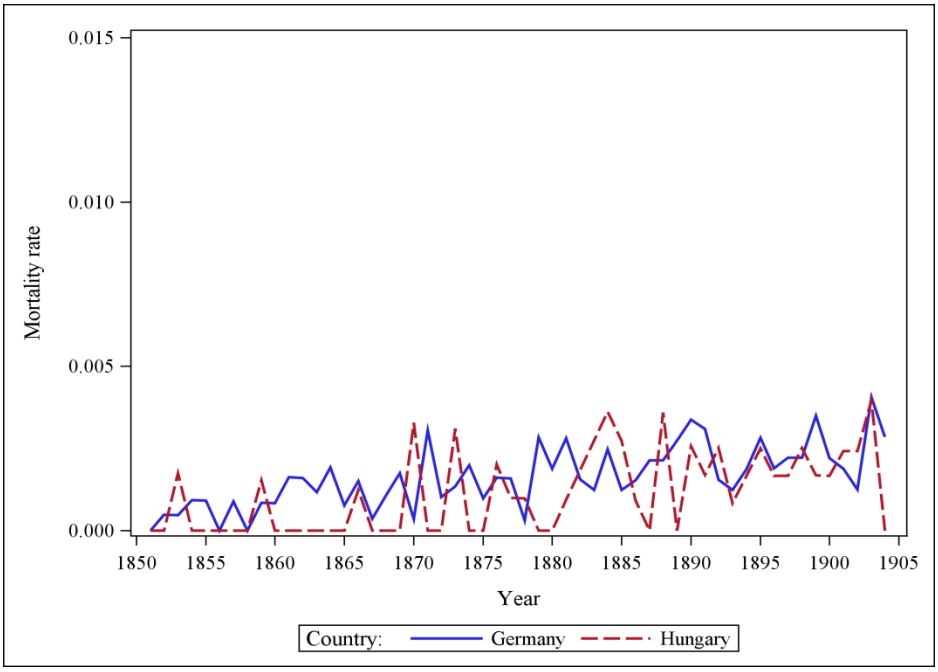
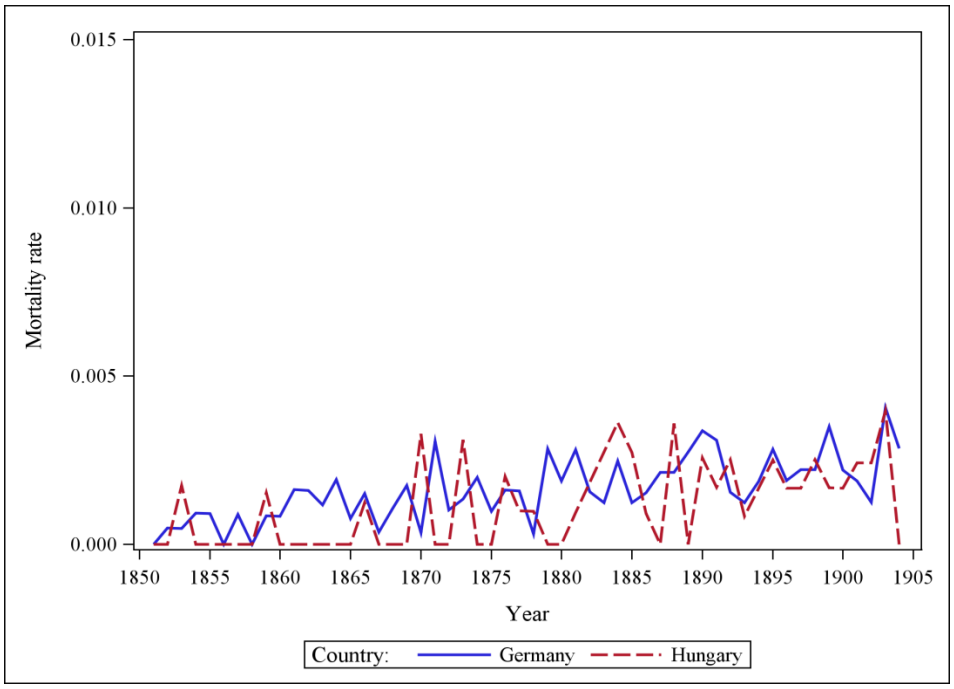


Figure 7. *Mortality rates (moving averages for 5-year intervals) for the lifespan category of ≥80 years of age*



Figures 3.-4. suggest that between 1875 and 1885 there is a higher mortality rate for Hungarian pharmacists in the younger lifespan categories (between 40 and 59 years).

Discussion

We have performed the first comparative historical demographic study in the literature on the lifespan of Hungarian and German pharmacists (n=325 and n=902, respectively) born between 1800 and 1904.

Regarding the comparative analysis of the two populations, the first statistically significant change point in lifespan trends occurs in 1840. Between 1840 and 1899 the average lifespan was higher in Germany, and only in the last 5-year period (between 1900 and 1904) the average lifespan was higher in Hungary. The data suggest similarity between annual mortality rates in the two countries, except in the period between 1875 and 1885 for the lifespan categories of ≥ 40 - <50 years and ≥ 50 - <60 years, where mortality rates of pharmacists born in this period were higher in Hungary.

Conclusions

The average lifespan of German male pharmacists born between 1840 and 1899 was in general higher than the average lifespan of their Hungarian Colleagues (in some 5-year interval it was statistically significantly higher). However, no significant increase of the average lifespan of male pharmacists born

between 1800 and 1904 could have been demonstrated in either countries in this period of history, despite the fast technological-scientific development, including general healthcare services. The middle class social status, including e.g. the lack of heavy physical work and unhealthy working environment with relatively higher living standards seem to be more important specific positive determinants of lifespan in both of these populations, than the general technological-societal development, which might have had more significant positive influence among more deprived social layers.

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