

REVIEW 1

The article “Climate and Disease: the connection between temperature values and precipitation rates and the probability of death due to waterborne and airborne diseases in historical urban space (the evidence from Poznań, Poland)” by Liczbińska et al. is an important contribution to the growing number of European historical climate–health studies. It is especially welcome as most, to date, concerns regions of western Europe rather than central Europe. Indeed, a disproportionate number concerns conditions in the United Kingdom that, due to an early Industrialisation, is far from representative for 19th century Europe as a whole.

Thank you.

Major comments:

The article focus too much, in its Introduction, on climatic health treats arising from high temperatures. There are numerous health threats, especially in the past, also arising from cold temperatures. The treat of cold temperatures should, in my opinion, be given an equal weight to treat of warm temperature in the background section. Especially in the historical climate–health studies literature, numerous examples of increased mortality following anomalously cold condition can be found that are presumably also highly relevant for Poland. Some suggestion of references to include are found below. I think the article needs to be better placed in a larger research context as many key works appears to be missing from the reference list.

Thank you very much for the review and for this suggestion. In the paper we have focused on high temperatures since they are associated with epidemics of waterborne diseases. Meanwhile in the case of airborne diseases, the relationship with high temperatures is not so obvious. To focus on cold waves/ low temperatures in the Introduction is justified and we will do it in the review. We can also refer to our results, interpreting the influence of lower temperatures on the probability of death due to waterborne and airborne diseases. All literature suggestions provided by the Reviewer will be added in the review.

In addition, I am a bit sceptical that that the living conditions in 19th century Poznań really were as poor as suggested by Liczbińska et al. This should be critically discussed as there is a huge disagreement among (economic) historians about the standards of living among the working poor in different parts of pre-industrial and early industrial Europe. Poland, admittedly, had relatively low standards of living compared to northwestern Europe, but I’m still not convinced that they actually were as poor as the article gives the impression of. To cite modern economic historical literature would be helpful to support the statements.

The creation of a fortress surrounded by walls significantly inhibited Poznań's spatial development. The city gradually felt the lack of free space, and by the end of the 19th century it was suffocating in the surrounding walls. At that time, most European cities were experiencing a period of urban development and dynamic modernization. Poznań by contrast suffered from shortages in terms of infrastructure: until the mid-1860s, it did not have a modern water supply system, and only at the end of the century a sewage system was constructed. The city was also often plagued by floods of the Warta River and epidemics. The overcrowded city, with very dense buildings, also posed a risk of fires. In 1838, the authorities issued regulations regarding development, fire safety and health conditions. The technical and sanitary standards of the streets also left much to be desired. Only in the mid-19th century did road investments begin, sidewalks were laid, and gutters were built. The second half of the 19th century was

difficult for the city. Famine, echoes of wars fought in Europe, epidemics, crop failures and elementary disasters led to a decline in the population size. In 1863, there was a significant outflow of Poznań inhabitants to the Kingdom of Poland (Polish lands under the Russian partition) where they participated in the January Uprising (1863). The population growth in 1850 was 0.7 per 1,000 inhabitants, while in 1899, it was 6.1 per 1,000 inhabitants only. In the years of the most severe cholera epidemics, i.e., in 1852, 1855, and 1866 the population growth was at the level of -41.7, -7.83, and -17.9 per 1,000 inhabitants, respectively. The values of population growth above 10 per 1,000 was recorded only after 1900. Migrations were the main factor dynamizing the city's demographic dynamics. After 1867, the barriers preventing the influx of people from the countryside and all fees for permanent registration were abolished and the demand for labour increased. With the development of industry, there was a slow revival of the city's economic activity. Poznań became an attractive destination for people looking for work, mainly from villages of the Greater Poland region. Due to the lack of free space in the already overcrowded City Centre, the migrants settled on the outskirts of the city. The poorest and most dilapidated district of Poznań was the one located on the right bank of the Warta River. The population there lived mostly in overcrowded tenant house outbuildings under undignified conditions. The level of sanitation was very poor in these areas. For example, water was drawn from shallow wells, which were often tainted with harmful sewage from cesspits, gutters, and rubbish sites. During the cholera epidemic of 1866, the Case Fatality Rate in the city was 59%, which means that 59% of people infected with cholera had a fatal outcome, while only 41% recovered.

Craftsmen and white-collar workers predominated in the fortress, while unskilled workers outside it. The latter constituted the poorest part of Poznań society. The salary of unskilled workers ranged 500- 600 marks per year: a man earned 1.6 marks a day, a woman 1.0 marks. These salaries did not provide them with a minimum subsistence. After paying the rent, a worker had less than 1 mk per day to support the whole family. The illiteracy rate was 86%.

Minor comments:

Title: The title is far too long. It needs to be shortened, preferably by half.

Our proposal is: **Climate and Disease in urban space (the evidence from 19th c. Poznań, Poland)**

Line 13: This part of the sentence does not read well. Furthermore, "other diseases" is too vague.

We agree with the Reviewer's remark. A better solution would be to replace third category "other diseases" with "other causes of death" and provide examples.

Lines 12, 16, 39 and other places: Better to write "temperature levels" and "precipitation amounts".

Thank you for your suggestions. They will be implemented.

Line 16: In English, "block" rather than "quarter" are normally used in this context. The suggestion will be implemented.

Lines 25–29: I would consider another introduction. The climate adaptation is, besides genetic (which takes a very long time), also social and cultural (and to some extent

even socio-political). If the introduction is not changed this needs to be more clearly stated.

Thank you for this suggestion. We fully agree with this remark. The Introduction section will be re-edited, and changes will be implemented according to the Reviewer's suggestion.

Line 53: Not only warm temperature. Weather conditions are also shaped by cold temperatures.

We agree with the Reviewer's suggestion. This part will be re-edited.

Both high and low temperatures have a significant effect on health. In our work we have received effects of lagged temperature on waterborne and airborne diseases (Figs 8 and 9, respectively). We did not receive low temperature effect on waterborne diseases (fig 8), as was expected (low temperature; left part of Figs 8 and 9).

The probability of deaths due to waterborne disease generally increases with lagged monthly average and at high temperatures, ~ above 15°C, it increases even more quickly. There are no surprises at low temperatures (the probability of the waterborne diseases is the lowest in the lowest temperatures, as expected a priori). On the other hand, for airborne diseases (Fig 9), we received the highest probability at, say middle temperatures (local maximum of the effect curve at around 12 centigrade – when the temperatures are not too low and not too high, probably mostly Fall and Spring). Then the probability decreases as the temperature increases. When the temperature decreases from 12°C downwards, the probability of deaths due to airborne disease first decreases (and decreases to local minimum at around the freezing point), with further decrease of temperature, the airborne disease probability tends to increase, but since there were not so many data with very low temperatures (not so many extraordinarily cold years), the super-cold temperature effect is estimated with very high uncertainty (very wide 95% confidence intervals about the estimate) to be safely interpretable.

Lines 56–58: Not really relevant even to cite as the present article concerns Europe. We agree with this suggestion; it should be removed.

Line 62: Please consider to use another word than “reasonably” here. We agree with this suggestion; it will be re-edited.

Lines 112–114: I would like to see more exact numbers here.

Poor urban ecology influenced mortality level. In Poznań Infant Mortality Rates were very high to the end of the 19th century. Particularly high IMRs, amounting to more than 300 deaths per 1,000 live births, were observed here in the 1850s-1870s, when Poznań was hit by epidemics of infectious diseases, including cholera in 1852, 1855 and 1866. A gradual improvement in city infrastructure was noted in the 1890s, after the construction of the sewage system, and finally in 1900 when the fortification walls were demolished, which ultimately improved ecological conditions in the city. It is worth mentioning that in the 19th century infectious diseases hit Poznań very often. Particularly dangerous were epidemics of cholera, repeating in 1831, 1837, 1848, 1852, 1855 and 1866. They caused massive and rapid changes in population numbers within a short period of time. There were also outbreaks of measles (in 1857, 1861 and 1869), scarlet fever (1863 and 1874), and smallpox (1871). Life expectancy at birth fluctuated over time and in the years 1875-1884 and 1885-1894 was below 30 years: 29.8 yrs., 28.6 yrs., respectively. A significant improvement was observed in the

decades: 1895-1904 and 1905-1913, 40.03 yrs. and 39.5 yrs., respectively (authors' calculations based on Prussian Statistical Yearbooks).

The city often suffered from Warta floods. In the 19th century the city saw the swollen Warta waters 16 times, 10 events being great floods, of which as many as 7 were classified as of 3rd or 4th category. They rose to even the most elevated sites in Poznań located more than 57 metres above sea level, while the river discharge amounted to 1,000 m³/s or more (e.g., 1,720 m³/s during the flood lasting from 4 March to 30 April 1855 (Kaniecki 2004)).

Line 218: Different citation style than elsewhere.
This will be re-edited.

Line 223: I think "fungi" is too vague. There exists many different type of fungi.
Our intention was to list pathogens responsible for infectious diseases, i.e., infectious agents including microorganisms such as bacteria, viruses, fungi, and prions. We did not specify pathogenic fungi in this context.

Line 280: The number of inhabitants per square kilometre is not adding up with other information about the same thing in the article. Please, double-check this information. We have written that "at the end of the 19th century there were almost 8,000 inhabitants per km² enclosed within the walls" (line 280). In 1896, the area of the city was 943.4 ha, i.e., almost 9.5 km². At that time the city had a population of 73,293 (After Galloway, Patrick R., 2007, "Galloway Prussia Database 1861 to 1914"). Our calculations demonstrate that there were over 7,700 people per 1 km². Our calculations are similar to the numbers provided by Statistics for the City of Poznań (ed. by Kruszka 2008; p. 53), in the light of which there were 7,700-7,800 people per 1 km² within the fortress. Since the area of the city had not changed until 1900, in the 1860s there were more than 5,600 people per km², and in the 1870s - more than 6,400 people per km². Up to 12 people lived in one room.

Historians emphasize that the city was "virtually suffocating within the walls". After the fortress was demolished in 1900, suburban quarters were incorporated into the city. The urban area expanded to 3,300 hectares and the population density decreased to 3,500 per km².

Line 304 and other places: Please provide a distinction between "workers" and "labourers".

The term worker is a very broad definition comparing with the term labourer. According to Britannica Dictionary, a word "worker" is referred to a person who does a specified type of work or who works in a specified way. A word "labourer" refers to a person who does unskilled physical work: a daily labourer; according to Longman Dictionary, someone whose work needs strength rather than skill.

Lines 308–309: I am highly sceptical too that the conditions were so bad (except in exceptional circumstances). If this indeed is true – which I do not entirely rule out – it should be supported by more modern (post-Communic period) scholarship.

Apart from information on hygiene, sanitation, and ecological conditions, provided as a response to earlier comments, we would like to add some information on working conditions in the city. The working day lengthened and conditions in factories deteriorated along with the city industrialization. In many artisans workshops a twelve-hour working day, often extended to 16 hours, was in force practically until the outbreak

of the First World War. Health and safety in industry and transport left a lot to be desired. Many factories and workshops failed to install protective devices, thus causing an increase in the number of accidents at work. Poor living conditions and malnutrition were additionally to blame for the deteriorating poor health condition of employees. In 1900 nearly 45% of the Poznań population lived in one-room dwellings, often cramped, damp and unheated, one room being sometimes shared by 5 to 12 people. The modern water supply system, opened in 1866, effectively contributed to the improvement of sanitary conditions in the city and was systematically developed with the increase in the number of inhabitants and dwellings. In the years 1889-1913 its length grew from 29 to 176 km. Even so, this was very little compared with Berlin, where the water supply network was nearly six times longer (661,246 metres, Vögele 1999).

All the graphs: They need to be improved and provided as proper vector graphics. The resolution is very poor. Their size and dimensions also need to be streamlined. The font size in the graphs is, in general, too large.

Graphs will be changed in the review.

Suggested references:

Thank you. We are going to implement this literature in the review.

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