Turk J Public Health
Available online at: http://dergipark.org.tr/tjph/
Doi: 10.20518/tjph.1316091

TURKISH JOURNAL OF PUBLIC HEALTH

SHORT REPORT

Heat-wave associated vibriosis in Russia, 2003-2021

Vadim Leonov[1]

[1]MSc, PhD, Södertörn University, Department of Natural Sciences, Technology and Environmental Studies, Stockholm, Sweden

Received: 17.06.2023, **Accepted:** 13.11.2023

Abstract

Objectives: Noteworthy peaks of non-cholera vibriosis occurred in Russia's Rostov and Volgograd regions in 2007 and 2010. The origins of these emergent vibrio cases have not been fully understood. Here, we investigate a possible link between the heat wave event and disease emergence.

Methods: This study employed Pearson correlation and regression analyses to identify the linkage between ambient temperature and Vibrio cases.

Results: The correlation test between the mean summer air temperatures for both regions and the *Vibrio*-infectious cases per year, shows a significant correlation between the mean summer temperature and the infection: r= 0.62 (p=0.023) for the Rostov region and r = 0.78 (p=0.012) for the Volgograd region.

Conclusion: The heat waves in the summers of 2007 and 2010 suggest having facilitated the upsurge of *V. cholerae* non-cholera diseases. The warming tendency has to be considered in predicting outbreaks.

Keywords: Global Warming, Vibrio Infections, Vibrio, Russia

Correspondence: MSc, PhD, Vadim Leonov, Södertörn University, Department of Natural Sciences, Technology and Environmental Studies, Stockholm, Sweden. **E-mail:** 22vale@suni.se, **Phone**: +46733526640.

Cite This Article: Leonov V. Heat-wave associated vibriosis in Russia, 2003-2021. Turk J Public Health 2023;21(3): 412-416.

INTRODUCTION

Non-imported Vibrio infections are rare in the whole of Russia even in territories with suitable for *V. cholerae ctx*- marine climatic conditions and brackish water basins, and the peaks in recorded cases of vibriosis in 2007 and 2010 are noteworthy. The origins of these emergent Vibrio cases in the Rostov and Volgograd regions have not been fully understood. Here, the result of the investigation of a possible link between the heat wave event and disease emergence is presented for Russia. The study is not novel and much more comprehensive research has been conducted in Europe [1-3], Canada[4], and Israel[5], they observed a rise in Vibrio infectious rate in association with high ambient temperature and heat waves. Following these studies, we retrospectively analyzed the Vibrio cases in Russia. This was done to supplement the data on the occurrence of climatic-associated vibriosis in unusual territories to raise awareness among professionals and the public about the consequences of global warming.

METHODS

Infections caused by *V. cholerae* (non-O1/O139 and *V. cholerae* serotype O1 or O139, which are non-toxigenic) and other vibrio species (*V. parahaemolyticus, V. vulnificus,* and *V. alginolyticus)* are not notifiable diseases according to the Russian disease surveillance system. We had to send an official request to the local centers of the Rospotrebnadzor to receive access to the listing of clinically and laboratory-confirmed cases of vibriosis. We only obtained data sets from two neighboring regions where they have voluntarily executed vibriosis active surveillance systems in the Rostov (2003-2011) and Volgograd (2006-2021) regions.

The Rostov (100 967 km^2, 41.5 population per km^2) and Volgograd (112 877 km^2, 22.1 population per km^2) regions have developed infrastructure with a balanced economic structure. Major industries of the Rostov and Volgograd regions are agriculture, food processing, heavy industry, coal, and automobile manufacturing. Both regions lie in the southeastern part of the East European Plain not far from the sea Azov with a hot-summer humid continental climate (Dfa) according to the Köppen-Geiger climate zone classification.[6] The Volga and the Don with their tributaries are the main rivers; there are more than 300 small rivers and other water reservoirs in total. The Rostov region is a coastline along the Taganrog Bay on the Sea of Azov in the southwest. Thus, both regions have favorable geographical conditions for *V. cholerae* and belong to high-risk areas for imported cholera outbreaks in Russia.

We obtained monthly data on surface air temperature in summer and temperature anomalies from local weather stations – Rostov-on-Don airport (34730, 47.23°N, 39.72°E) and Volgograd airport (34560, 48.72°N, 44.50°E) (www.meteorf.gov.ru). Pearson correlation test (r) was used to find an association between *Vibrio* cases and the mean summer air temperature respectively. The annual dynamics of *Vibrio* morbidity were studied using simple linear regression. These statistical analyses were performed in R (version 2023.03.1+446) and Microsoft Excel 2019 was used to produce diagrams.[7]

RESULTS

Between 2003 and 2021, 102 *Vibrio* cases of diarrheal diseases were identified in the capital cities Rostov-on-Don and Volgograd during the summer months of each year.

A more accurate number of such illnesses than the rest of Russia was believed to be recorded in the Rostov and Volgograd regions, partially due to better awareness among the local public health workers and the high probability of cholera outbreaks in these regions. The vast majority of cases were attributed to *V. cholerae ctx*- negative strains, no other species were reported. The datasets contained limited information regarding potential transmission, but it was noted that the majority of cases between 2007 and 2010 were among individuals who reported recreational water exposure.

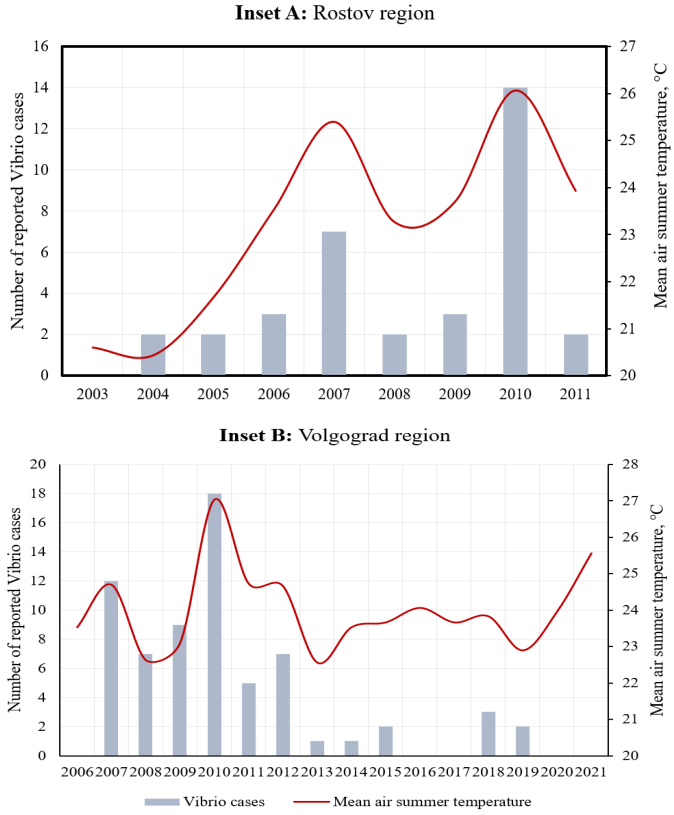

Figure 1. Vibrio cases (all types) and yearly mean summer air temperature in Russia. The chart inset A: The Volgograd region between 2006 and 2021. The chart inset B: The Rostov region between 2003 and 2011

The morbidity trends are not consistent in the annual number of reported *Vibrio* cases for both regions (Fig. 1). After 2007, the number of cases increased every year reaching a peak of 18 and 14 cases in 2010 for the Volgograd and Rostov regions. However, the slopes of the upward trends were insignificant given the small sample size for both regions - the Volgograd region 2005-2010: slope = +3.30 ($p = 0.112$); the Rostov region 2003–2011: slope = +0.75 ($p = 0.185$). Interestingly, 30 cases of vibriocarrier of O1 *V. cholerae* El Tor Ogawa were confirmed in the Rostov region according to the official report from the local authorities in 2005. Following the outbreak years (2007 and 2010), numbers dropped to 2 cases in 2011 for the Rostov region and to 5 cases in the Volgograd region, the former *Vibrio* cases slightly fluctuated between 0 to 3 cases for the rest of the study period.

The yearly number of *Vibrio* cases closely followed the mean air summer temperature. Each surge in *Vibrio* cases coincided with a period of heightened mean summer temperature, which corresponded to heat waves (Fig. 1). We defined heat weaves as a sharp increase more than 4 times the value of temperature anomaly associated with the advection of a warm air mass.[8] There was a pronounced increase in temperature in both cities in the summer of 2007 and 2010. Two severe heat waves occurred in August 2007 and 2010 with maximum temperature anomalies of 4.5 and 4.6 ($p<0.05$) for Rostov-on-Don; 4.9 and 5.4 ($p<0.05$) for Volgograd respectively (Fig. 2). August 2010 was the hottest ever recorded month for the last 500 years in Eastern Europe/Western Russia.[9] The occurrence of these extreme weather conditions may be a consequence of the global warming effects on the South territory of Russia situated mainly in the Pontic–Caspian steppe zone.

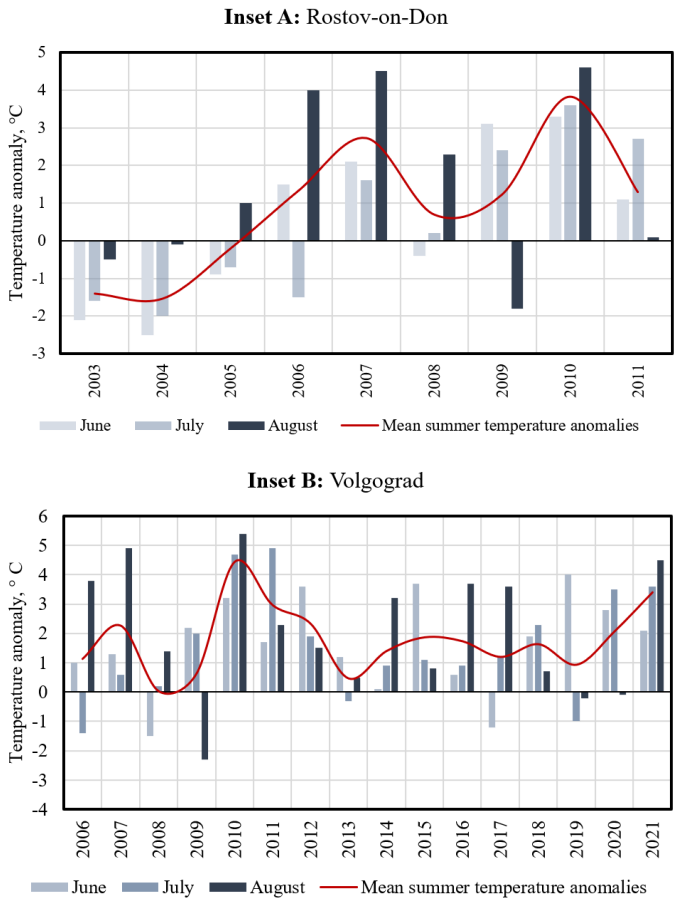

Figure 2. Summer monthly temperature anomalies in Rostov-on-Don airport (2003-2011, A) and Volgograd airport (2006-2021, B) weather stations tious diseases should be taken into account by

The Pearson correlation analysis between the mean summer air temperatures for both regions and the *Vibrio*-infectious cases per year, shows a significant correlation between the mean summer temperature and the infection: r= 0.62 (p=0.023) for the Rostov region and r = 0.78 (p=0.012) for the Volgograd region. We hypothesize that an extreme rise in temperature increases the growth rate of *Vibrio* and the burden of vibriosis.[10] The high temperature might force people to exposure outdoor activities in local water reservoirs and stimulate the blossom of plankton that positively affects on replication and survival of *V. cholerae*. Indeed, within these regions, there are several small rivers with hydrophilous vegetation along the banks, many ponds, and a ravine and gully network as well as artificial water bodies of various sizes[11]. The water estuaries in the vicinity of the Rostov and Volgograd regions are crossed by many river channels, lakes, and bogs that are often used by locals for leisure activities.

CONCLUSIONS

Heat waves and probably other climatic events linked with global warming highly influence the geographical distribution of waterborne pathogens. This relatively new phenomenon in the contemporary epidemiology of infectious diseases should be taken into account by Public Health authorities to improve surveillance systems, particularly in some countries with unusual cases of (re) emerging infectious diseases.

ACKNOWLEDGMENTS

This study has been performed during my scholarship period at Södertörn University, funded by the Swedish Institute. I thank the local centers of Infectious Disease Control and Prevention of the Rospotrebnadzor in the Rostov and Volgograd regions for providing missing initial information on vibriosis for several years after official requests.

Conflicts of Interest: The author declares no conflicts of interest.

Financial Support: There is no funding for the study.

Ethical Declaration: This study was conducted based on administrative register data. According to Russian law, ethics approval is not needed for such research.

Author Contribution: Concept: VL, Design: VL, Supervising: VL, Data Collection and Processing: VL, Analysis and/or Interpretation:

VL, Writing: VL, Critical Review: VL.

REFERENCES

1. Baker-Austin C, Trinanes J, Salmenlinna S, Löfdahl M, Siitonen A, Taylor N, et al. Heat Wave–Associated Vibriosis, Sweden and Finland, 2014. Emerg Infect Dis. 2016; 22(7):1216-1220. https://doi.org/10.3201/eid2207.151996

2. Galanis E, Otterstatter M, Taylor M. Measuring the impact of sea surface temperature on the human incidence of Vibrio sp. infection in British Columbia, Canada, 1992–2017. Environ Health. 2020; 9, 58. https://doi.org/10.1186/s12940-020-00605-x

3. Gildas Hounmanou Y, Engberg J, Bjerre K, Holt H, Olesen B, Voldstedlund M, et al. Correlation of High Seawater Temperature with Vibrio and Shewanella Infections, Denmark, 2010–2018. Emerg Infect Dis. 2023; 29(3):605-608. https://doi.org/10.3201/eid2903.221568

4. Martinez-Urtaza J, Trinanes J, Abanto M, Lozano-Leon A, Llovo-Taboada J, Garcia-Campello M, et al. Epidemic Dynamics of Vibrio parahaemolyticus Illness in a Hotspot of Disease Emergence, Galicia, Spain. Emerg Infect Dis. 2018;24(5):852-859. https://doi.org/10.3201/eid2405.171700

5. Paz S, Bisharat, N, Paz E., Kidar O, Cohen D. Climate change and the emergence of Vibrio vulnificus disease in Israel. Environ Res. 2007;103(3):390-6. doi: 10.1016/j.envres.2006.07.002.

6. RStudio Team RStudio: Integrated Development for R. RStudio, PBC, Boston, MA, 2020 URL http://www.rstudio.com/

7. Beck H, Zimmermann N, McVicar T. et al. Present and future Köppen-Geiger climate classification maps at 1-km resolution. Sci Data. 2018; 5, 180214 https://doi.org/10.1038/sdata.2018.214

8. Bedritsky AI. (Ed.) Russian Hydrometeorological Encyclopedia; Letnii Sad SPB: Moscow, Russia; 2008;1: 336p. [In Russ.]

9. Barriopedro D, Fischer EM, Luterbacher J, Trigo RM, García-Herrera R. The hot summer of 2010: redrawing the temperature record map of Europe. Science. 2011;332(6026), 220–224, doi:10.1126/science.1201224

10. Vezzulli L. Global expansion of Vibrio spp. in hot water. Environ Microbiol. Rep. 2022; 15(2):77-79. doi: 10.1111/1758-2229.13135. 151996

11. Shartova N, Mironova V, Zelikhina S, Korennoy F, Grishchenko M Spatial patterns of West Nile virus distribution in the Volgograd region of Russia, a territory with long-existing foci. PLoS Negl Trop Dis. 2022; 16(1): e0010145. https://doi.org/10.1371/journal.pntd.0010145