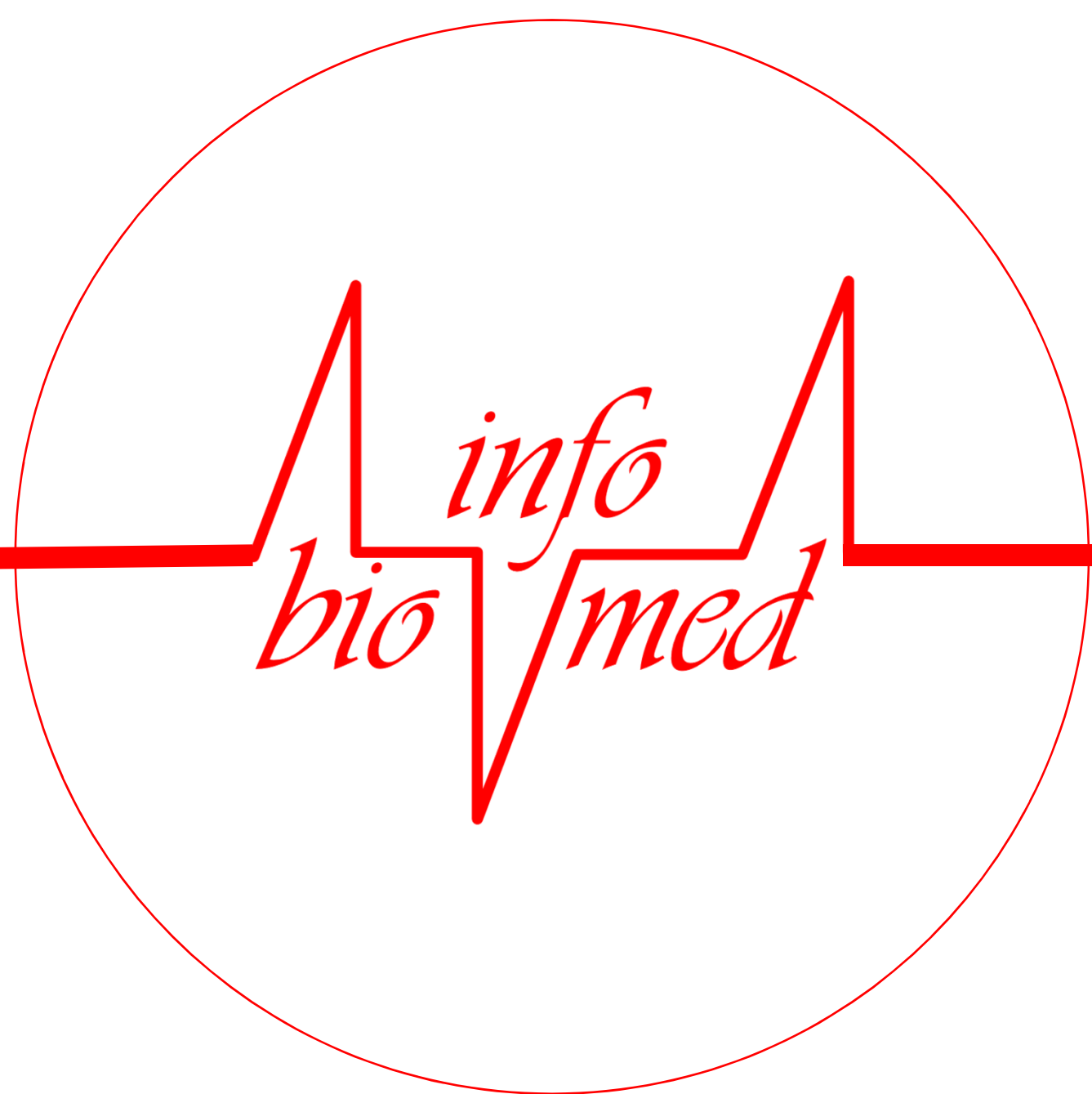


Relations between Inpatient Health Establishments' Capacity, Mortality Rates and Blood Donation Activity in Bulgaria Using Correlation and InterCriteria Analysis



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Abstract

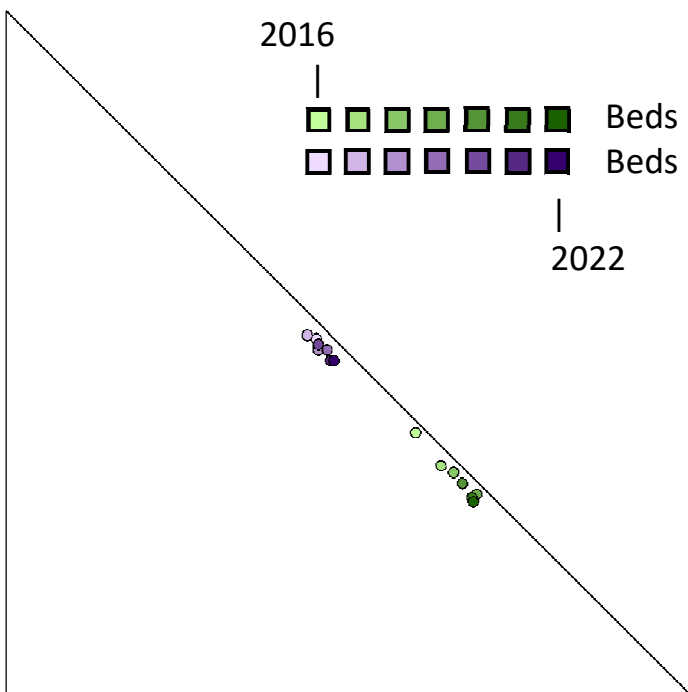
The present paper aims to reveal linkages between the data regarding the inpatient health establishments that are allowed to operate with blood and blood products, data regarding the blood donation and blood transfusion capacity and mortality rates in Bulgaria. The adopted data driven approach employs correlation analysis and the intuitionistic fuzzy sets based InterCriteria Analysis to draw comparisons and yield some important conclusions on national and regional level and outlie relevant trends from the period 2016–2022 year.

Impatient Health Establishments vs Blood donation rates

The number of beds in inpatient health establishments and blood donation activity rates can be related in a few ways.

- The number of hospital beds can indicate the demand for blood in that area.
- Areas with more hospital beds may result in higher public awareness and more active participation in blood donation campaigns.
- In times of emergencies or natural disasters, the number of available hospital beds may impact the need for blood donations to treat the injured, showcasing a relationship between hospital capacity and blood donation activity.

These general considerations seem well reflected in the available data from our study, specifically the indicators number of beds in Multiprofiled IHEs per 1000, number of beds in Specialized IHEs per 1000 and blood donation rates per 1000:



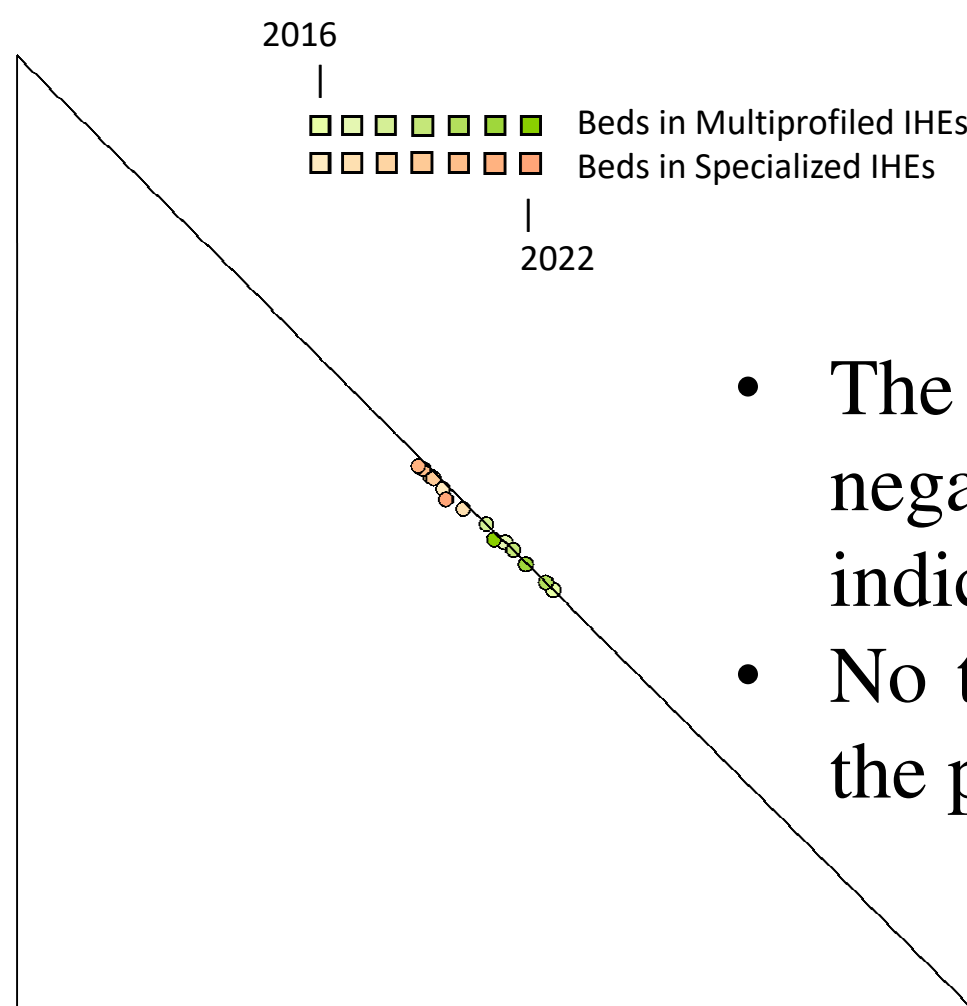
- Weakly positive ICA consonance for the M-IHEs with positive trend over time;
- Dissonance for the S-IHEs with positive trend over the period of seven years.

Impatient Health Establishments vs Mortality rates

Access to adequate healthcare facilities and services improves the likelihood of survival for individuals who need medical treatment.

- In areas with fewer hospital beds or limited access to healthcare services, mortality rates may be higher due to delays in receiving necessary medical care.
- The quality of care provided in healthcare establishments of larger capacity can also impact mortality rates.

Notably, mortality rates can be influenced by various factors, including the overall health of the population, prevalence of certain diseases, availability of preventative care, and socio-economic factors. Therefore, even the presence of a correlation between inpatient health establishments and mortality rates cannot warrant causation between both, as there are likely many factors that contribute to overall health outcomes.



- The ICA research carried shows weakly negative to no correlation for both indicators;
- No traceable trend in any of both over the period of seven researched years.

Acknowledgements

With regards to data collection, the first and second authors are grateful for the support provided by the Bulgarian National Science Fund under Grant No. KP-06-N72/8/2023 “Intuitionistic fuzzy methods for data analysis with an emphasis on the blood donation system in Bulgaria”. With regards to the methodology of In-terCriteria Analysis and data interpretation, the third author is grateful for the sup-port, provided by the Bulgarian National Science Fund under the Grant KP-06-N22/1/2018 “Theoretical research and applications of InterCriteria Analysis”.

Data Collection Methodology

Data from the National Statistical Institute: number of inpatient health establishments eligible to operate with blood and blood products (multiprofiled hospitals and specialized hospitals), total numbers of beds therein, number of beds per 1000 population, mortality rate (per 1000).

Data from the blood donation information system: total numbers of blood donations, numbers of individual blood donors, litres of donated blood and number of blood donations per 1000 population: for the 28 administrative regions of the Republic of Bulgaria in each of the years from the period 2016–2022.

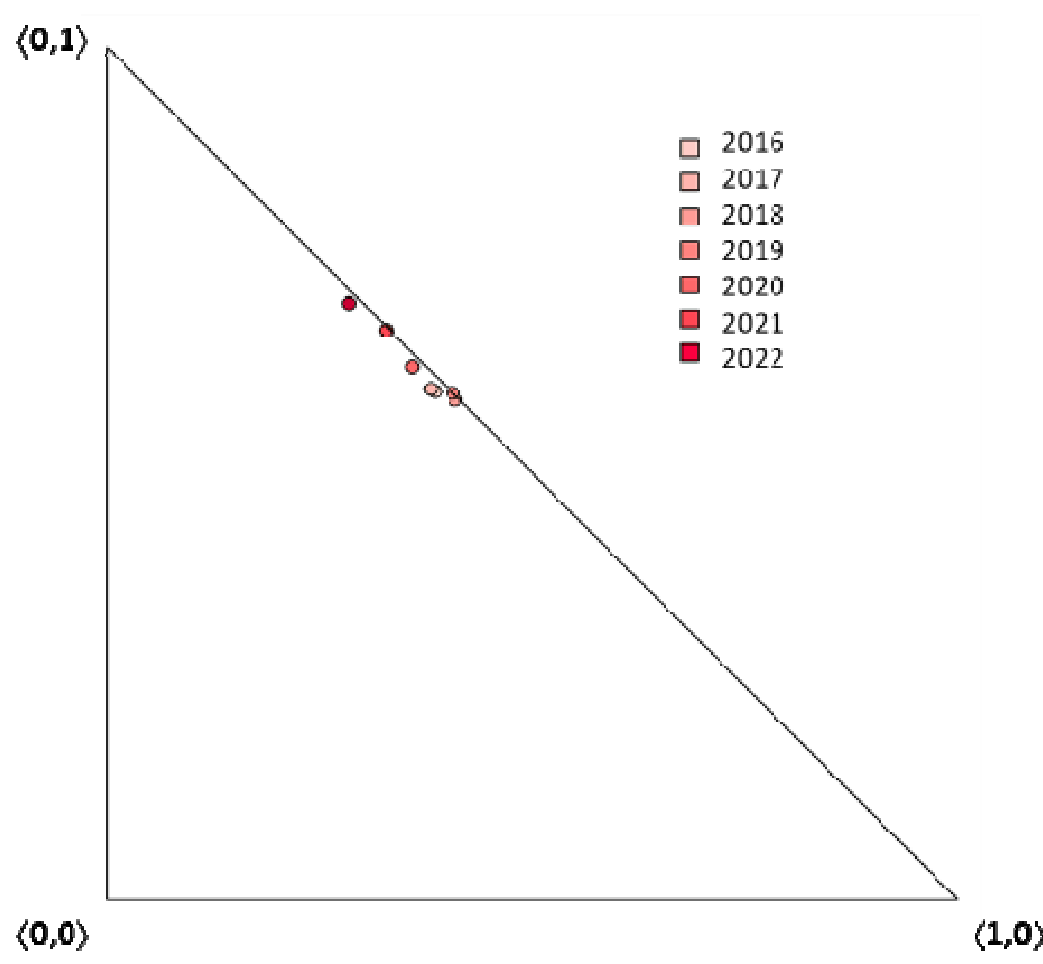
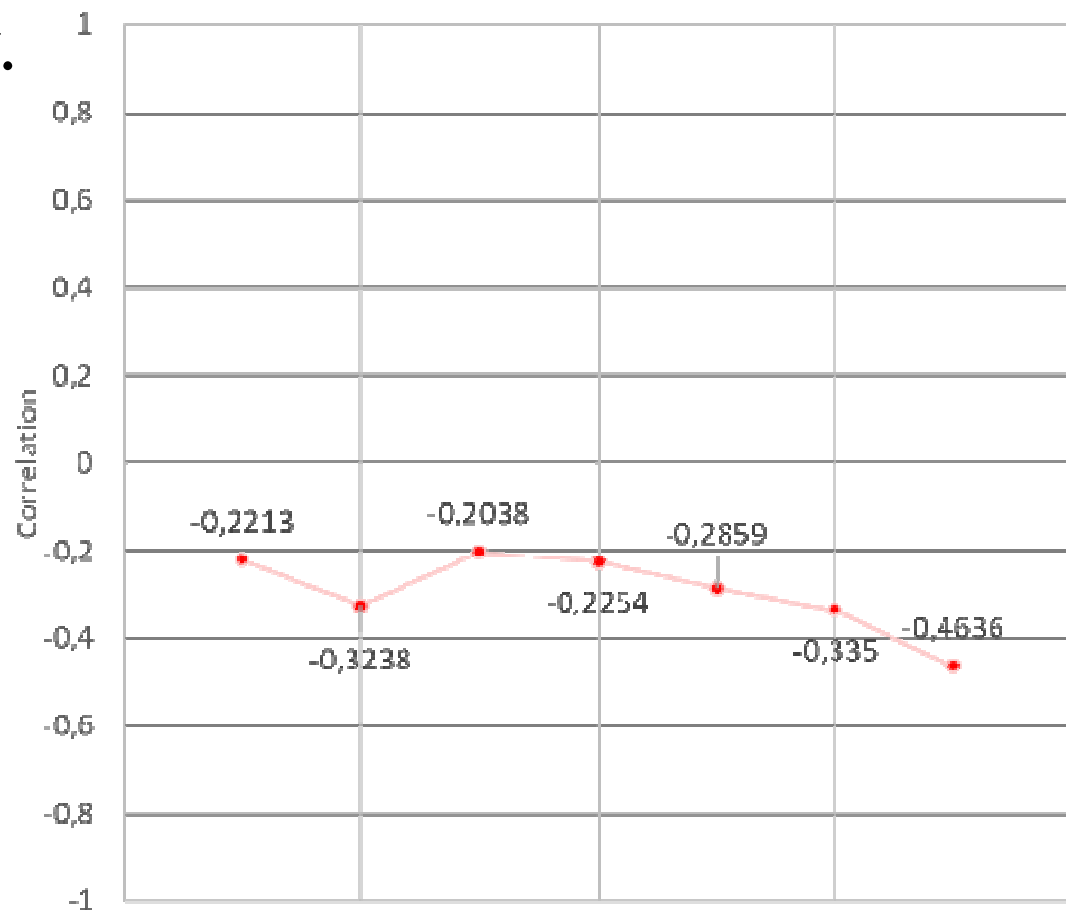
Blood donation rates vs Mortality rates

Blood donation rates can have a significant impact on mortality rates:

- By increasing blood donation rates, the availability of blood for transfusions can be improved, which is crucial for treating various conditions like accidents, surgeries, and certain diseases. When blood is readily available, patients in need are more likely to receive timely and appropriate care, reducing the risks and levels of mortality.
- Regular blood donation benefits the donors themselves. It can help reduce the risk of various health conditions by lowering iron levels in the body. Donating blood also stimulates the production of new blood cells for replenishment, which can have a positive impact on overall health and well-being.
- Blood donors benefit from the obligatory testing for HIV, hepatitis B and C and syphilis, as they receive the results for free shortly after the donation and can thus monitor their own health status. Therefore, overall, higher blood donation rates are associated with better healthcare outcomes and can contribute to lower mortality rates in a population.

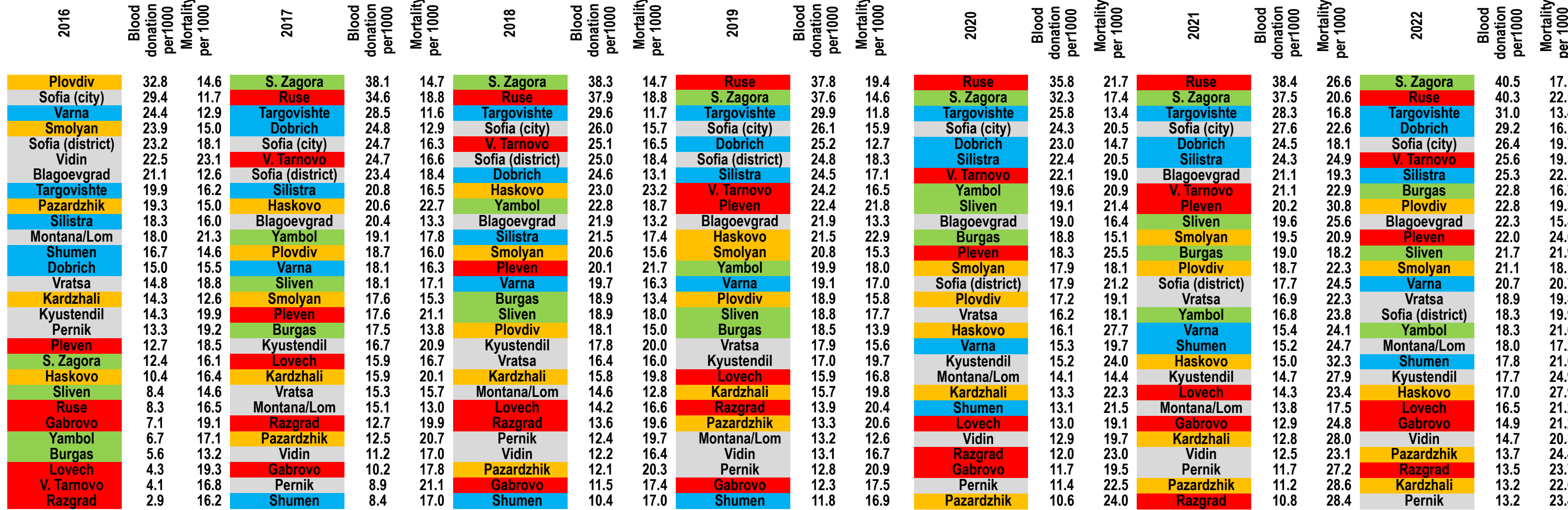
Based on the collected data for Bulgaria for the period 2016–2022, blood donation rates and mortality rates exhibit changes in the correlation from weakly negative in the years 2016–2019 to moderately negative in the years 2020–2022, i.e., higher rates of blood donation activity is correlated with lower rates of mortality.

	2016	2017	2018	2019	2020	2021	2022
COR	-0.2213	-0.3238	-0.2038	-0.2254	-0.2859	-0.3350	-0.4636
ICA	(0.39,0.60)	(0.38,0.60)	(0.41,0.58)	(0.41,0.59)	(0.36,0.62)	(0.33,0.67)	(0.29,0.70)

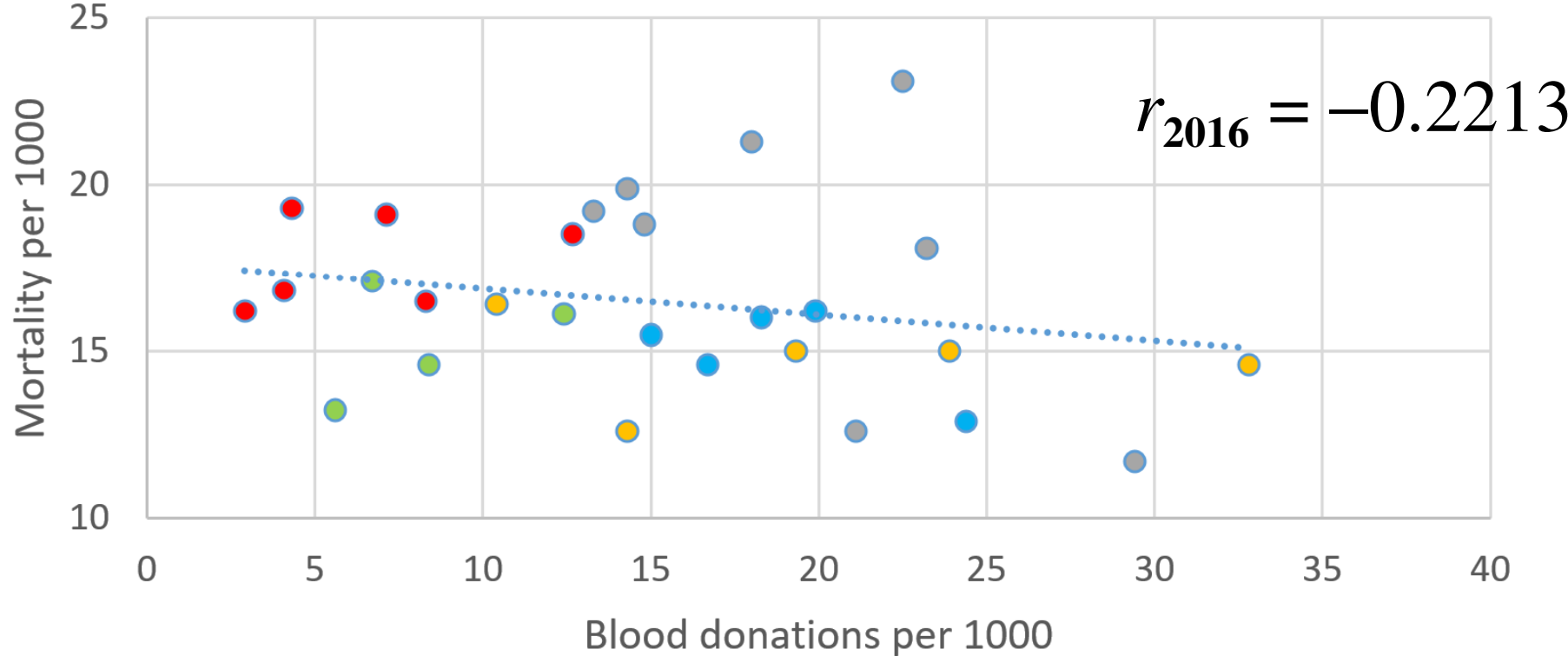


Blood donation rates can have a significant impact on mortality rates:

- Higher blood donation rates improves the availability of blood for transfusions, which is crucial for treating various conditions like accidents, surgeries, and certain diseases. When blood is readily available, patients in need are more likely to receive timely and appropriate care.
- Regular blood donation benefits the donors themselves: It can help reduce the risk of various health conditions linked with high iron levels. Donating blood stimulates the production of new blood cells for replenishment, which can have a positive impact on overall health and well-being.
- Blood donors benefit from the obligatory testing for HIV, hepatitis B and C and syphilis, as they receive the test results after the donation and have an extra free source of information about their own health status. Regular blood donors tend to be mostly health conscious, maintaining healthy habits that make them eligible for donation. Therefore, overall, higher blood donation rates are associated with better healthcare outcomes and can contribute to lower mortality rates in a population. These data are further elaborated on a regional level.



2016: Blood donations vs Mortality per 1000 people



2022: Blood donations vs Mortality per 1000 people

