**Correlation of Global Health Security index and Joint External Evaluation score with Monkeypox cases and death**

Monkeypox is a zoonotic viral reemerged disease which already recorded 87,775 confirmed positive and 112 death cases. The Global Health Security Index (GHSI) and Joint External Evaluation (JEE) are tools to evaluate a country's health security and preparedness to prevent, detect, and respond to health threats, including the monkeypox infectious disease. A high score on the GHSI and JEE suggests that a country has robust public health systems, which entail a range of institutional arrangements, policies, and activities that work together to protect the health of the population. The GHSI is an analytical tool designed to predict a country's capacity and risk based on its health security competence. It evaluates whether the 195 countries that have signed the Global Health Guidelines comply with 85 sub-indicators across six categories using data from publicly available sources (Johns Hopkins Center for Health Security, 2021). "On the other hand, The Joint External Evaluation (JEE) is an intricate and standardized tool aimed at comprehensively assessing a country's capacity to preempt, detect, and respond to public health threats. The JEE is conducted via a collaborative and multisectoral approach, with an inclusive range of stakeholders from across the government, private sector, civil society, and international organizations. The JEE process is meticulously designed to identify and evaluate a country's strengths and weaknesses in terms of health security preparedness, leveraging a prioritized action plan to address any identified gaps.

This study is undertaken to analyze the correlation between the monkeypox confirmed cases/deaths and GHSI/JEE from the period dated 1 May 2022 to 15 March 2023 from all over the world. The study applied correlation analysis, and simple linear regression analysis to identify the association. To show the relation in a graphical approach, we also showed some scatter plots for all infected countries. The correlation coefficient/regression and p-value of the coefficient/regression model were calculated for all relations. The model can be expressed as in Eq. (1) where are dependent (monkeypox cases/deaths) and independent (GHSI/JEE) variables,

Y = α + βX + ∈ ………………………………………. (1)

Where Y is the monkeypox cases/deaths, α is the intercept, β is the correlation coefficient/regression parameter as slope, X is the GHSI/JEE, and ∈ is the random error, respectively. Coefficients of association assume values ranging from negative correlations (−1) to uncorrelated (0) to positive correlations (+1). Correlation coefficient denoted by r.

If GHSI increases by 1 time, the average total monkeypox cases increase by 0.002 times. The model explained 15.86% of the total variation. Pearson’s correlation coefficient and scatter plot showed a perfect positive linear relationship (r=0.398) between total cases and GHSI (supplementary table 1 and figure 1). If JEE increases by 1 time, the average total monkeypox cases increase by 0.001 times. The model explained 7.13% of the total variation. Pearson’s correlation coefficient and scatter plot showed a perfect positive linear relationship (r=0.267) between total cases and JEE (Supplementary table 2 and figure 1). If GHSI increases by 1 time, the average total monkeypox deaths decrease by 0.90 times. The model explained 33.62% of the total variation. Pearson’s correlation coefficient and scatter plot showed a perfect positive linear relationship (r=0.580) between total cases and GHSI (Supplementary table 2 and figure 1). If JEE increases by 1 time, the average total monkeypox cases increase by 1.07 times. The model explained 36.07% of the total variation. Pearson’s correlation coefficient and scatter plot showed a perfect positive linear relationship (r=0.601) between total cases and JEE (Supplementary table 2 and figure 1).



Figure 1: Scatter plot with regression line between total cases and deaths of MPX with GHSI and JEE.

The GHSI and JEE serve as valuable indicators of a country's health security preparedness and capacity to prevent, detect, and respond to health threats, including monkeypox. By using these tools, policymakers and public health officials can identify gaps in public health systems and develop targeted interventions to improve health security and reduce the impact of monkeypox outbreaks. Countries with stronger public health systems are more likely to have effective surveillance systems and laboratory capacities that facilitate the timely detection and confirmation of monkeypox cases. Additionally, these countries are better equipped to develop and implement appropriate response strategies to contain the spread of the disease and minimize its impact on public health.

Conversely, countries with weaker public health systems may be less prepared to detect and respond to monkeypox outbreaks, which could lead to increased morbidity and mortality. Factors such as inadequate vaccination coverage, insufficient laboratory capacity, and limited response planning could further exacerbate the impact of the disease in such countries. Furthermore, high levels of wildlife trade and consumption can amplify the risk of monkeypox transmission from animals to humans, particularly in regions where cultural and traditional practices revolve around bushmeat consumption. Moreover, countries with high levels of international travel and trade may experience a higher likelihood of importing and exporting monkeypox cases, which could facilitate the global spread of the disease.

However, according to our research, countries with high GHSI or JEE scores had a negative correlation with cases and fatalities of monkeypox. This suggests that these rankings do not sufficiently account for the importance of providing universal health coverage and integrating national response services. Furthermore, it may be necessary to significantly change the indicators and their relative weighting employed in the GHSI and the JEE in the future.