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SHORT RESEARCH COMMUNICATION | COVID-19 VACCINATION

COVID-19 Early Vaccination Rates and Gross Domestic Product Per Capita

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ABSTRACT

Coronavirus disease – 2019 (COVID-19) vaccination is a crucial part of a multi-faceted public health response, and possibly, the best hope for ending the pandemic. In this ecological study, we examined the relationship between Gross Domestic Product (GDP) per capita and early vaccination rates across the world. Spearman's correlation analysis was utilized to assess the strength and direction of the relationship between countries' COVID-19 vaccination rates and GDP per capita. We observed that countries with high vaccination rates had higher GDP per capita (Spearman's ϱ=0.35, p-value=0.01). Our study provides valuable insight into the association of GDP per capita and the early distribution of the COVID-19 vaccination.

Key words: • COVID-19 • Coronavirus • Vaccination • Gross Domestic Product • GDP Per Capita • Vaccination Rates

1. Introduction

Coronavirus disease 2019 (COVID-19), one of the most devastating pandemics in human history, has resulted in over two million deaths globally as of January 12, 2021.[1] Vaccination is a crucial part of a multi-faceted public health response, and potentially, the best hope for ending the pandemic. Fortunately, a few efficacious COVID-19 vaccines have been approved for emergency use, while several others are undergoing clinical trials.[2] The first COVID-19 vaccine was administered in the United Kingdom on December 8, 2020. Since then, many nations have been making efforts to achieve universal vaccination for their citizens.

Research has shown a correlation between Gross Domestic Product (GDP) per capita and national health outcomes.[3] Therefore, we would expect that rich countries may have high immunization rates because of their economic advantage. Due to increasing globalization, herd immunity against COVID-19 is required worldwide to effectively control the pandemic.[4] However, developing nations

may struggle to achieve this fundamental public health goal. In this ecological analysis, we examine the relationship between GDP per capita and early global vaccination rates. We hypothesize that countries with a higher GDP per capita will have higher rates of early vaccination due to improved access to healthcare among developed countries, in comparison to developing and resource-restricted settings. If this hypothesis were to be held true, then there would be a need for the World Health Organization (WHO) collaborative program to reinforce mobilization of more resources to allocate vaccines to developing countries.

2. Methods

The worldwide vaccination information for the study was obtained from the 'Coronavirus (COVID-19) Vaccinations' website, which gathers the vaccination information from each country's government communication channels, and publishes the updated data on a daily basis.[2] We utilized the latest information available for each country up to January 12, 2021. We used the term "early vaccination" given that vaccinations commenced only recently. We obtained information on Gross Domestic Product (GDP) per capita for each country from the 'GDP ranking by country' website.[5] The latest information for the GDP per capita was available for the year 2019 and thus used for this study. We presented information on vaccination rate for each country by GDP per capita using choropleth plots. Furthermore, we conducted Spearman's correlation analysis to assess the strength and direction of the relationship between countries' COVID-19 vaccination rates and GDP per capita. We used the Spearman's correlation instead of Pearson's product moment correlation because of the ranked nature of the data, and the monotonic relationship between GDP per capita and vaccination rates in the raw data. Lastly, we conducted log-linear regression between GDP per capita and vaccination rate. All analyses were conducted using R version 3·5·1 (R Core Team, Vienna, Austria, 2018), R Studio Version 1·1· 423 (R Studio Team, PBC, Boston, MA, 2020) and Tableau version 2020.1 (Salesforce, Mountain View, CA, 2020). No ethical approval was required for this study as the data were obtained from publicly available sources which did not contain any personally-identifiable information.

3. Results

As of January 12, 2021, 46 countries had initiated COVID-19 vaccination. The vaccination rates for countries and their GDP per capita are presented in figure 1. We observed that Israel with GDP per capita of $46, 670.82 had the highest vaccination rate of 22.07%, followed by United Arab Emirates (UAE), (GDP per capita: $45, 410.69, early vaccination rate: 11.80%); Bahrain (GDP: $23, 923.13, early vaccination rate: 5.44%); United Kingdom (GDP per capita: $43,117.57, early vaccination rate: 4.15%); and the United States of America (USA) with a GDP per capita of $67, 063.27 and early vaccination rate 2.72%). It was observed that the countries with high vaccination rates had higher GDP per capita (Spearman's ϱ=0.35, p-value=0.01). This implies that vaccination rates of the countries were related to their corresponding GDP per capita, and the result was statistically significant despite the relatively small sample size. The result from the log-linear regression model revealed that the association between GDP per capita and vaccination rate was marginally significant (p-value=0.05).

4. Discussion, Conclusion, and Implications for Translation

Given the unprecedented global impact of COVID-19, the administration of COVID-19 vaccination is a high global health priority. Our study observed that as of January 12, 2021, 46 countries started distributing the vaccination. Israel had the highest vaccination rate. Our results upheld our hypothesis showing an association between GDP and vaccination rates. Countries with higher GDP per capita had higher COVID-19 vaccination rates. This is in line with a 2017 analysis by the World Health Organization that reported that high-income countries had the highest potential of achieving ≥ 90% national coverage of the certain vaccinations.[6]

While the early distribution of the vaccination depicted higher COVID-19 vaccination rates in countries with high GDP per capita, we cannot

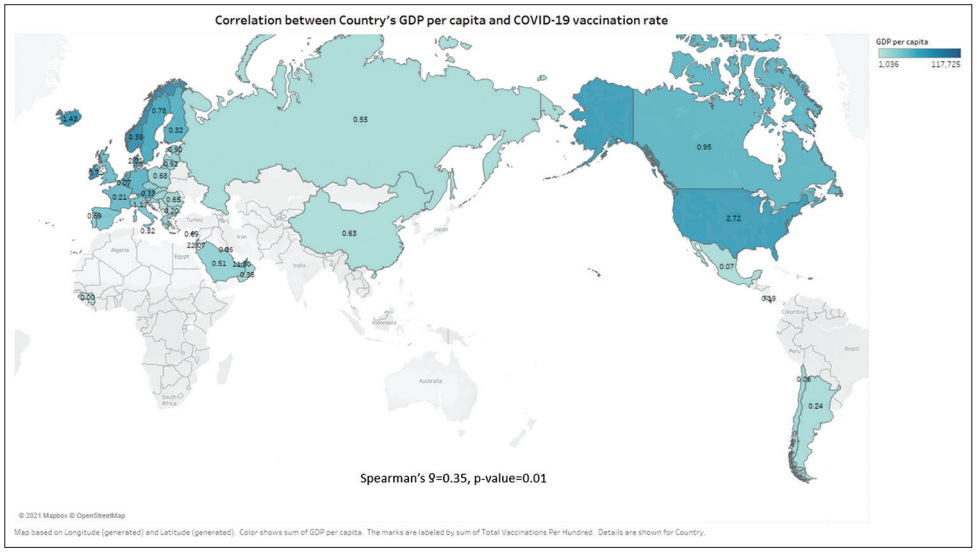

Figure 1: Correlation between Country's GDP per capita and COVID-19 vaccination rates

assume this trend will follow suit in the future distribution of vaccines. Organizations such as The Global Alliance for Vaccines and Immunizations (GAVI), dedicated to increasing immunization rates in low-income countries, can potentially impact the future trends of the distribution of the COVID-19 vaccination.[7] Other factors, such as mistrust in vaccinations, should be analyzed in future studies to determine the role of non-GDP per capita factors in COVID-19 vaccination rates. Overall, our study, being the first study to our knowledge to analyze GDP per capita and COVID-19 vaccination rates, provides valuable insight into the association of global GDP per capita with the early distribution of the COVID-19 vaccination. This highlights the preliminary disparity in access to healthcare between developed and developing countries and comprehensive global picture regarding vaccination distribution and acceptance will be clear only with passage of time.

Compliance with Ethical Standards

Conflicts of Interest: *None.* ***Financial Disclosure:*** *None.* ***Funding/Support:*** *None.* ***Ethics Approval:*** *None as the study was performed on publicly available data.* ***Acknowledgements:*** *None.* ***Disclaimer:*** *None.*

Key Messages

- As of January 12, 2021, 46 countries had initiated vaccination distribution.
- Israel had the highest vaccination rate of 22.07%, followed by United Arab Emirates (UAE) (11.80%), Bahrain (5.44%), United Kingdom (4.15%) and the United States of America (USA) with a vaccination rate 2.72%).
- Countries with high vaccination rates had higher GDP per capita (Spearman's ϱ=0.35, p-value=0.01).

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