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The Association between US states GDP and COVID-19 deaths

What we now call the COVID pandemic was primarily centered in Washington and New York at the beginning of the US crisis; however, the outbreak quickly spread throughout the country, primarily affecting the Northeast and South before early fall of 2020, where cases began to shift to the Midwest and West (Hallas, et al.). Now, two years into the pandemic, all states have and continue to experience the wrath of this virus with over 960,000 COVID related deaths and nearly 80 million COVID confirmed cases reported nationwide with some states facing more serious consequences than others (*Johns Hopkins*). As a result, understanding the relationship between development levels of the 50 states (using GDP as an indicator), and spread of an infectious disease (using reported COVID-19 cases) is crucial to understand the differences among states in observed COVID related issues.

This leads us to ask the question: Do states with a higher Gross Domestic Product (GDP) have a significant difference in COVID reported cases than those with lower GDP from January 2020 to February 2022? In answering this question, we are trying to determine whether a state's GDP or higher economic growth is associated with the increase in COVID-19 cases. An observational study found a linear, positive association between total GDP (in millions of USD) and total confirmed cases of COVID-19 (during January 1 to May 31, 2020) on a logarithmic scale of 28 European countries with a regression coefficient of 0.7156 ($P < 0.001$) (Aycock). A similar observational study done in China on its 30 provinces also reveals GDP (in trillions of yuan) was positively associated with cumulative COVID-19 cases (up to February 16, 2020) with the β coefficient of 97.8709 ($P < 0.01$) (Mo, et al.). Both these studies show higher GDP nations or provinces are associated with more

COVID cases and suggest economic growth and urbanization create many more opportunities to facilitate the spread of COVID-19 (Mo, et al.).

Furthermore, even though COVID cases have been remediated by the scientific ingenuity of the COVID vaccines, many experts are still surprised by how fast the virus evolved creating the many variants including Delta and Omicron (Runwal). Consequently, understanding if an association exists for GDP of US states and COVID cases or not would allow the government, both state and federal, to better target and provide the appropriate responses for each state based on its specific needs.

Our data comes from the Centers for Disease Control and Prevention (CDC) on "United States COVID-19 Cases and Deaths by State over Time" <https://data.cdc.gov/Case-Surveillance/United-States-COVID-19-Cases-and-Deaths-by-State-o/9mfq-cb36>. This data was sourced from the National Center for Health Statistics. Our project is an observational study because the data is collected with the collaboration with other public and private health partners on patient medical records and death certificates, and was not collected with any specified controls (NCHS Fact Sheets). Due to the lack of controls, this is an observational study that aims to determine and comment on associations between variables rather than imply causality.

In addition to our primary investigation of the association between all the US states' GDP and COVID-19 cases, we will be analyzing potential confounding variables that can result in the reported COVID case counts. These include factors such as gender, socioeconomic background, age group, political affiliation of the state's governor, duration of the lockdown period (stay at home orders), and duration of mask mandates. This will thus allow us to better determine whether or not a state's GDP is significantly associated with COVID cases, once we control for these other variables.

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