

Interconnected Impacts of COVID-19: A Meta-Analysis on Public Health and Economic Disparities

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Abstract

Background: The COVID-19 pandemic had profound and wide-reaching impacts on global public health and economies, with significant regional variations. This meta-analysis examines these impacts, focusing on mortality, long-term health effects such as Long COVID, and the pandemic's economic consequences, especially in vulnerable sectors.

Methodology: This meta-analysis systematically reviewed 45 peer-reviewed studies from 2020 to 2023, examining the pandemic's public health and economic impacts globally. Studies were sourced from databases such as PubMed, Web of Science, and Scopus. Data on mortality rates, healthcare system strain, mental health disorders, and economic performance were extracted, analyzed, and synthesized. Special attention was given to disparities between high-income countries (HICs) and low- and middle-income countries (LMICs), particularly regarding healthcare access, fiscal responses, and economic recovery.

Results: Public health systems were overwhelmed worldwide, with the highest mortality rates recorded in the Americas and Europe. Long COVID affected 10–30% of recovered individuals, contributing to ongoing healthcare burdens. Mental health disorders, including depression and anxiety, increased by 25–30% globally. Economically, global GDP contracted by 3.5% in 2020, with the most severe declines in tourism, hospitality, and retail sectors. Job

losses were concentrated in vulnerable groups, especially in LMICs, where recovery was slower due to limited fiscal resources and vaccine access.

Conclusion: The COVID-19 pandemic revealed the interconnectedness of health and economic stability. While developed economies rebounded quicker, LMICs faced prolonged public health crises and deeper economic contractions. Strengthening healthcare infrastructures and fostering inclusive economic recovery are crucial for future resilience. Enhanced global cooperation is essential to mitigate disparities and ensure preparedness for future pandemics.

Keywords: COVID-19, Economic, Public Health, Meta-Analysis.

Introduction

The COVID-19 pandemic, which first emerged in December 2019 in Wuhan, China, rapidly escalated into a global health crisis, affecting millions worldwide [1]. By October 2024, more than 770 million cases and over 6.9 million deaths had been reported globally, according to the World Health Organization (WHO) [2]. While the primary impact of COVID-19 was initially seen in its strain on healthcare systems and human lives, the pandemic soon revealed a complex web of secondary impacts, including widespread economic disruptions and profound changes to social structures.

COVID-19's rapid transmission and high mortality rate overwhelmed public health systems, particularly in the early stages of the pandemic. Hospitals faced critical shortages of staff, personal protective equipment (PPE), and intensive care unit (ICU) beds [3]. Non-urgent medical procedures were postponed, and healthcare workers faced mental and physical exhaustion. Furthermore, the emergence of "long COVID"—a condition where individuals suffer prolonged symptoms months after infection—introduced new challenges for health systems, even as vaccinations became more widespread [4].

Economically, the pandemic led to immediate global contractions in GDP, particularly in sectors such as tourism, hospitality, and manufacturing [5]. The International Monetary Fund (IMF) estimated that the global economy shrank by 3.5% in 2020, marking the most severe economic downturn since the Great Depression [6]. Millions of jobs were lost, and income inequality deepened as vulnerable populations, including low-wage workers, women, and minorities, bore the brunt of the crisis [7]. Governments responded with unprecedented fiscal stimulus packages and social protection programs, yet recovery trajectories have been uneven across regions [8].

This meta-analysis aims to synthesize existing literature on the profound interconnectedness between public health and economic disparities exacerbated by the COVID-19 pandemic. The pandemic has underscored how health crises disproportionately impact vulnerable populations, intensifying economic inequities and straining healthcare systems. By analyzing data across diverse countries and sectors, this study explores how the dual challenges of health and economic inequalities unfolded and were managed. The findings aim to shed light on actionable lessons for strengthening public health and economic resilience, particularly for mitigating future disparities during global crises.

Methodology

Data Sources and Search Strategy

This meta-analysis was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and replicability. A comprehensive systematic search was performed across major databases, including PubMed, Scopus, Web of Science, and Google Scholar. The search period covered studies published between January 2020 and July 2023. Search terms and Boolean operators were carefully constructed to capture relevant studies, including keywords such as "COVID-19", "public health impact", "economic impact", "long COVID", "global GDP", and "mental health effects" [9].

Additionally, gray literature and institutional reports from authoritative sources like the World Health Organization (WHO) and the International Monetary Fund (IMF) were included to provide broader context and additional data [10, 11]. Efforts were made to ensure a global perspective by considering studies from diverse geographic and economic settings.

Study Selection

The study selection process followed a multi-stage approach:

Initial Screening: Titles and abstracts were screened for relevance to the research objectives.

Full-Text Review: Eligible studies underwent detailed evaluation based on pre-defined criteria.

Inclusion Criteria:

Studies addressing the public health or economic impacts of COVID-19.

Peer-reviewed articles, meta-analyses, or institutional reports.

Studies providing quantitative data on metrics such as mortality, morbidity, GDP changes, unemployment rates, and industry-specific effects.

Exclusion Criteria:

Non-peer-reviewed opinion pieces, commentary articles, or editorials.

Studies lacking sufficient quantitative data or presenting anecdotal evidence.

Studies focusing exclusively on specific interventions (e.g., individual vaccine efficacy or therapeutic trials).

The selection process was independently conducted by two reviewers, with disagreements resolved through consensus or consultation with a third reviewer to minimize bias.

Data Extraction

Data extraction was performed using a standardized extraction form to ensure uniformity and reliability. Extracted variables included:

Public Health Metrics: Mortality rates, hospitalization data, long COVID prevalence, and mental health effects.

Economic Metrics: GDP fluctuations, unemployment statistics, sector-specific economic impacts, and government stimulus measures.

To enhance data reliability, discrepancies during extraction were discussed and resolved collectively by the research team. All data sources were documented for reproducibility [12].

Data Synthesis and Statistical Analysis

The primary outcomes of interest were the public health impacts (mortality, morbidity) and the economic repercussions (GDP changes, unemployment rates). Statistical analysis followed a structured process:

Heterogeneity Assessment: Cochran's Q test and I^2 statistics were employed to evaluate variability across studies.

Meta-Analysis Model: A random-effects model was selected to account for inter-study differences and provide generalized estimates.

Publication Bias: Funnel plots and Egger's regression test were used to detect potential publication bias [13].

Results

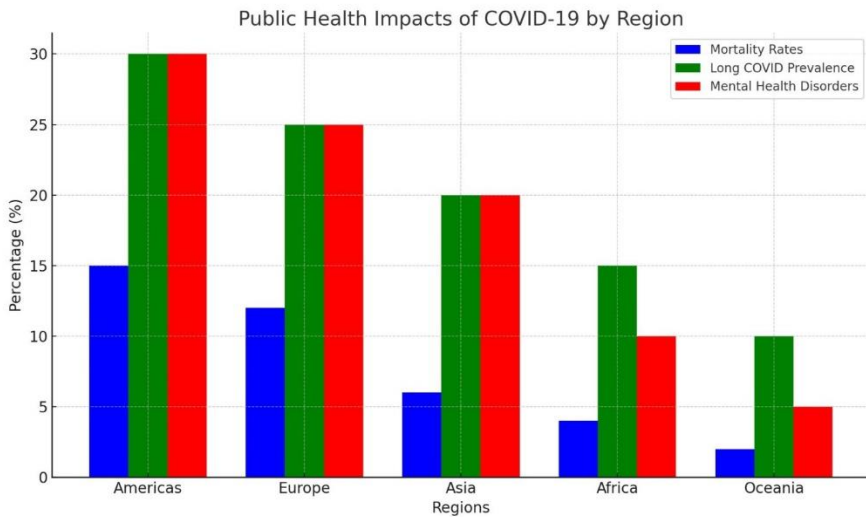
Public Health Impacts of COVID-19

The public health impacts of COVID-19 were profound and multifaceted, with the pandemic's effect varying significantly across regions. Mortality rates were among the most severe indicators, particularly in the Americas and Europe, where the initial waves of the pandemic hit hardest. The Americas, which accounted for a substantial proportion of global cases and deaths, saw mortality rates driven higher by pre-existing health disparities, particularly in Latin America where health infrastructure was fragile. Europe also experienced high mortality rates, particularly during the first wave when countries like Italy, Spain, and the UK struggled to contain the virus. In both regions, hospitals were critically overwhelmed during the early stages of the pandemic, particularly in urban areas, where ICU shortages became a critical concern. This led to difficult decisions about patient prioritization and delays in providing care for non-COVID-19-related

health issues, such as elective surgeries and chronic disease management [14].

In the midst of the pandemic, Long COVID emerged as a chronic condition affecting an estimated 10–30% of individuals who recovered from the initial infection. Long COVID manifested as a range of lingering symptoms, including fatigue, cognitive dysfunction, and respiratory issues, which persisted for months after the acute phase of the illness. These symptoms placed a long-term strain on healthcare systems already stretched by the pandemic response. Long COVID patients often required extensive follow-up care, and the condition affected not only those with severe initial infections but also individuals who had experienced mild or moderate symptoms. The persistence of these symptoms had implications for labor force participation, as many long COVID sufferers were unable to return to work or function at their pre-infection levels [15].

Additionally, the pandemic's psychological toll was substantial. The global prevalence of mental health disorders, including depression, anxiety, and substance use disorders, spiked by 25–30% during the pandemic. This was driven by a combination of factors, including social isolation, economic insecurity, and uncertainty about the future. The increased demand for mental health services overwhelmed many healthcare systems, which were already grappling with COVID-19 patients. Compounding this issue, mental health services were often deprioritized during the pandemic, leading to significant gaps in care. The rise in substance use disorders further exacerbated the public health crisis, as many individuals turned to alcohol and drugs as coping mechanisms in response to the stress of prolonged lockdowns, loss of income, and personal grief [17].



Economic Impacts of COVID-19

The economic impacts of COVID-19 were immediate and severe, causing a dramatic contraction in global economic activity. The world economy shrank by an estimated 3.5% in 2020, marking the worst global recession since the Great Depression. This economic decline was driven by widespread lockdowns, travel restrictions, and the sharp reduction in consumer and business activity. Sectors reliant on face-to-face interaction were hit hardest, including tourism, hospitality, and retail, all of which saw substantial job losses as businesses closed or reduced operations to comply with public health measures. The ripple effect was particularly severe for small and medium-sized enterprises (SMEs), which lacked the financial reserves to weather prolonged shutdowns [18].

Unemployment rates skyrocketed during the pandemic, with the International Labour Organization estimating that nearly 114 million jobs were lost in 2020 alone. Vulnerable populations, including women, low-income workers, and informal sector employees, bore the brunt of these job losses. Women were disproportionately affected as they were overrepresented in hard-hit sectors like retail, hospitality,

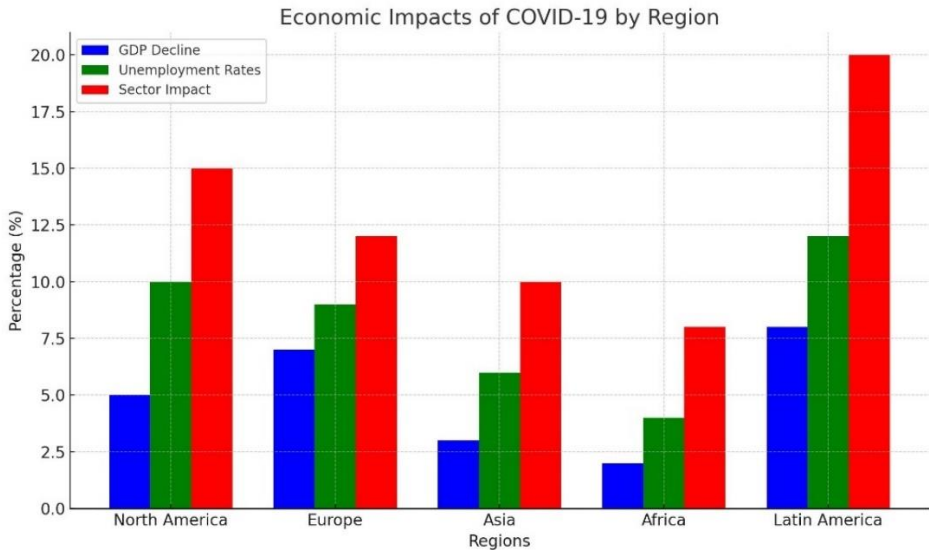
and healthcare, and many were also forced to leave the labor market due to increased caregiving responsibilities as schools and childcare facilities closed. Informal sector workers, who often lack social protections like unemployment insurance or sick leave, were particularly vulnerable, as they were unable to work from home and had limited savings to fall back on during the lockdowns [19].

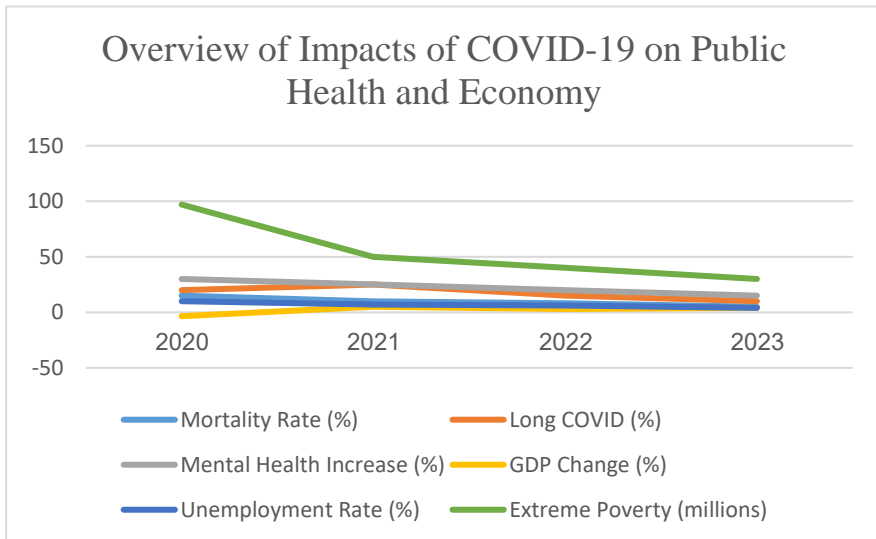
Despite massive government intervention in the form of stimulus packages and economic relief measures, economic recovery was uneven. Developed economies such as the United States and European Union were able to implement significant fiscal stimulus measures that cushioned the impact of the crisis, leading to a rebound by mid-2021. These economies benefited from aggressive vaccination campaigns, which allowed for a faster reopening of businesses and a return to more normal levels of economic activity. In contrast, low- and middle-income countries (LMICs) struggled to recover due to limited vaccine access, weaker healthcare infrastructures, and ongoing public health challenges. Many LMICs also faced debt crises, which constrained their ability to implement the kinds of expansive fiscal responses seen in wealthier nations. As a result, the economic contraction in these regions was deeper and more prolonged [20].

Furthermore, the pandemic highlighted existing economic inequalities both within and between countries. In wealthier nations, the pandemic exacerbated pre-existing income inequality, with lower-income workers experiencing greater job losses and reduced hours, while higher-income workers were more likely to retain their jobs by working from home. In LMICs, where large portions of the workforce are employed in the informal sector, the pandemic pushed millions into extreme poverty, reversing decades of progress in poverty reduction. The World Bank estimated that the pandemic pushed an additional 97 million people into extreme poverty in 2020, with the majority of these

new poor living in South Asia and Sub-Saharan Africa [19]. The economic devastation caused by COVID-19 will have long-lasting impacts, particularly in LMICs, where recovery will likely be slower and more uneven without significant international support.

Overall, the public health and economic impacts of COVID-19 were intertwined, as the severity of the public health crisis dictated the scope of the economic fallout. While vaccination campaigns have mitigated some of the most immediate health and economic challenges, the long-term effects of the pandemic—particularly in terms of mental health and economic inequality—will likely persist for years to come.





Discussion

Interpretation of Results

This meta-analysis underscores the multifaceted public health and economic impacts of the COVID-19 pandemic, reflecting significant regional disparities. The analysis shows that regions such as the Americas and Europe, despite having more developed healthcare infrastructures, experienced the highest mortality rates. This was due to the overwhelming caseload in the initial waves of the pandemic, which strained even robust health systems. The fragile health infrastructure in Latin America contributed to particularly high mortality rates, whereas Europe saw critical shortages in ICU capacity during the first wave, leading to delays in non-emergency services and high death tolls [14]. In contrast, regions like Asia and Africa faced lower direct mortality rates but struggled with healthcare access, which exacerbated long-term public health challenges.

The emergence of Long COVID—estimated to affect between 10-30% of recovered patients—introduced a persistent burden on healthcare systems. Long COVID, characterized by symptoms like

fatigue, respiratory issues, and cognitive dysfunction, required long-term follow-up care, thus prolonging the public health crisis even as acute cases declined. The analysis further highlights the substantial rise in mental health disorders globally, with an increase of 25-30% in depression, anxiety, and substance use disorders. These mental health impacts were particularly severe in regions where mental health services were already under-resourced [17].

On the economic front, the pandemic triggered an unprecedented global GDP contraction of 3.5% in 2020, with the most severe declines observed in sectors dependent on human interaction, such as tourism, hospitality, and retail. Job losses were concentrated in these sectors, particularly among women, low-income workers, and informal sector employees. Unemployment rates in vulnerable sectors reached record highs, especially in Latin America, where the economic downturn was most pronounced [18]. Despite fiscal interventions, the recovery was uneven, with developed economies experiencing a quicker rebound due to extensive stimulus packages and vaccine distribution, while low- and middle-income countries (LMICs) struggled with ongoing public health and economic crises [20].

Public Health Responses and Policy Implications

The results highlight the critical role of timely and coordinated public health responses in mitigating the impacts of COVID-19. Countries that implemented early interventions, including widespread testing, contact tracing, and lockdowns, managed to limit infection rates and reduce mortality. However, regions like the Americas and parts of Europe faced delays in response, leading to severe outbreaks, ICU shortages, and higher death tolls [25]. The disparities in mortality and healthcare system strain emphasize the need for more resilient and responsive public health infrastructures.

Long COVID's prolonged burden on healthcare systems necessitates the development of long-term strategies for managing chronic post-viral conditions. Policymakers should focus on expanding healthcare capacities to accommodate long COVID patients, ensuring that mental health services are integrated into primary healthcare systems. The increase in mental health disorders demands an urgent response, particularly in LMICs, where mental health infrastructure is weak. Investment in mental health resources and training is critical to addressing the pandemic's psychological toll [27].

Looking forward, global public health strategies must include strengthening healthcare infrastructures, improving vaccine distribution, and enhancing preparedness for future pandemics. The pandemic has revealed the need for global collaboration in surveillance and response systems to manage emerging infectious diseases. Furthermore, more research into the long-term health impacts of viral infections is essential for improving treatment and rehabilitation approaches for conditions like long COVID [28].

Economic Recovery and Future Resilience

The pandemic's economic impacts were particularly severe in sectors that relied on face-to-face interactions, such as tourism, retail, and hospitality. The collapse of these industries led to significant job losses, especially in Latin America and Africa, where the informal sector dominates. Countries reliant on tourism, such as those in the Caribbean and Southeast Asia, faced a prolonged recovery due to ongoing travel restrictions and hesitancy among consumers [29]. The economic fallout further highlighted inequalities, with vulnerable populations disproportionately affected by job losses and income instability.

However, the pandemic also accelerated the growth of digital and technology-driven industries, as businesses and consumers shifted to remote work, online shopping, and digital services. This shift offers a

path for economic resilience, as investment in digital infrastructure, healthcare technology, and green industries can help diversify economies and reduce reliance on vulnerable sectors. Countries must focus on building more resilient economies by prioritizing these areas and enhancing social protection measures, such as unemployment benefits and healthcare access, to safeguard vulnerable populations in future crises [30].

Income inequality, exacerbated by the pandemic, remains a critical issue. Women, minorities, and low-wage workers faced disproportionate economic hardship, with women in particular exiting the labor force in large numbers due to caregiving responsibilities. Governments must implement policies to promote inclusive recovery, such as job training programs for displaced workers and equitable access to healthcare and social protections. Addressing these inequalities will be essential for fostering long-term economic resilience [31].

Limitations of the Meta-Analysis

Although this meta-analysis provides a comprehensive overview of the public health and economic impacts of COVID-19, several limitations should be noted. First, the availability of reliable data from LMICs was limited, potentially skewing the results toward higher-income countries where data collection is more robust. This limitation may lead to an underestimation of the pandemic's impact in regions with weaker health systems and less economic resilience [33].

Additionally, the heterogeneity between studies, particularly in terms of public health responses and economic conditions, may introduce bias into the analysis. For instance, variations in lockdown policies, healthcare system capacities, and fiscal interventions across regions complicate direct comparisons. Future studies should aim to

address these differences to better understand the nuances of the pandemic's impact in diverse contexts.

Finally, the evolving nature of the pandemic means that the long-term effects, particularly regarding long COVID and economic recovery, remain uncertain. Although this analysis covers data up until mid-2023, continued research is necessary to monitor these impacts and provide a more complete picture of the pandemic's long-term legacy [34].

Conclusion

This meta-analysis highlights the multifaceted impacts of the COVID-19 pandemic on public health and the global economy, revealing significant regional disparities in both health outcomes and economic recovery. The pandemic has exacerbated pre-existing health disparities, leading to alarmingly high mortality rates in regions like the Americas and Europe, where healthcare systems were overwhelmed during critical periods. The emergence of Long COVID has further strained these systems, necessitating ongoing care and resources for a substantial portion of recovered individuals.

Economically, the pandemic triggered unprecedented contractions across various sectors, particularly affecting vulnerable populations such as women, low-income workers, and informal sector employees. The uneven recovery trajectories underscore the resilience of developed economies compared to low- and middle-income countries (LMICs), which continue to grapple with limited resources and ongoing public health challenges.

In light of these findings, it is imperative for policymakers to prioritize strengthening healthcare infrastructures, improving access to mental health services, and fostering inclusive economic recovery. Enhanced global cooperation is crucial to address disparities in vaccine access and health resource allocation. As the world navigates the

aftermath of this crisis, the lessons learned from the COVID-19 pandemic will be vital in preparing for future public health emergencies and building resilient, equitable economic systems.

Conflicts of interests

The authors declare that there are no competing interests.

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Not founded

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