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Assessing the indirect effects of COVID-19 on healthcare delivery, utilization and health outcomes: a scoping review

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Background: The COVID-19 pandemic and global efforts to contain its spread, such as stay-at-home orders and transportation shutdowns, have created new barriers to accessing healthcare, resulting in changes in service delivery and utilization globally. The purpose of this study is to provide an overview of the literature published thus far on the indirect health effects of COVID-19 and to explore the data sources and methodologies being used to assess indirect health effects. **Methods:** A scoping review of peer-reviewed literature using three search engines was performed. **Results:** One hundred and seventy studies were included in the final analysis. Nearly half (46.5%) of included studies focused on cardiovascular health outcomes. The main methodologies used were observational analytic and surveys. Data were drawn from individual health facilities, multicentre networks, regional registries, and national health information systems. Most studies were conducted in high-income countries with only 35.4% of studies representing low- and middle-income countries (LMICs). **Conclusion:** Healthcare utilization for non-COVID-19 conditions has decreased almost universally, across both high- and lower-income countries. The pandemic's impact on non-COVID-19 health outcomes, particularly for chronic diseases, may take years to fully manifest and should be a topic of ongoing study. Future research should be tied to system improvement and the promotion of health equity, with researchers identifying potentially actionable findings for national, regional and local health leadership. Public health professionals must also seek to address the disparity in published data from LMICs as compared with high-income countries.

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Introduction

The World Health Organization announced a cluster of cases of coronavirus-related pneumonia in Wuhan, China on 9 January 2020. Just over 2 months later, on 11 March, COVID-19 was named a pandemic.[1] Since then, COVID-19, the disease caused by SARS-CoV-2, has changed the world in innumerable ways. By the end of March, many countries around the world had closed their borders and announced national containment measures including stay-at-home orders, curfews, public transportation closures and movement restrictions.[2] The implementation of nationwide lockdowns and travel restrictions undoubtedly prevented many deaths from COVID-19. However, restrictions also created barriers that prevented people with medical conditions unrelated to COVID-19 from accessing healthcare.[3,4] In addition, warnings about COVID-19 incited fears among the public who worried that any clinic or hospital visit could result in them contracting the virus.

One way to capture the number of deaths caused by COVID-19 is by calculating excess mortality, defined as the number of deaths from all causes (all-cause mortality) during a crisis minus the expected number of deaths over a given period based on historical trends.[5] Excess mortality is useful because it captures deaths due to COVID-19 that were not officially categorized as COVID-19-related (e.g. deaths from COVID-19 that occurred at home or prior to receiving a diagnostic test). However, a substantial proportion of these excess deaths are likely due to medical conditions unrelated to COVID-19 that went undiagnosed or untreated during the pandemic. These are known as indirect deaths. Changes in health service delivery or utilization and in non-COVID-19 health outcomes can

be termed 'indirect health effects' of the pandemic. Figure 1 illustrates how health service availability (services offered), utilization and delivery contribute to indirect effects, including excess mortality. Health service utilization is moderated by economic, geographic, immigration status, gender, racial, ethnic and cultural barriers that affect patients' access to and interaction with the health system.

Epidemics and pandemics of this magnitude have been shown to have widespread effects on health systems.[6] Indirect effects lead not just to deaths but to a wide range of morbidity resulting from the lack of preventative care, delays in diagnosis of new diseases and disruptions to treatment of chronic conditions. The impact can be particularly damaging to already fragile health systems in low- and middle-income countries (LMICs). For example, it has been estimated that the 2014–15 Ebola epidemic in West Africa caused a 50% reduction in access to healthcare services including vaccinations and maternal and child health visits.[7] The epidemic shocked the health-care system in Guinea so profoundly that these indicators still had not returned to pre-epidemic levels as of February 2017, nor were they on a path that suggested this would happen soon thereafter.[8] These findings demonstrate widespread epidemics' potential to produce indirect effects with both short- and long-term consequences for health outcomes.

The purpose of this article is to provide a scoping review of the literature on the indirect health effects of the COVID-19 pandemic published thus far. We explore the current data on how COVID-19 has impacted health service delivery and utilization globally, affecting multiple health outcomes. We also appraise the data sources and methodological approaches used to measure the indirect health effects of the COVID-19 pandemic, as well as the geographic
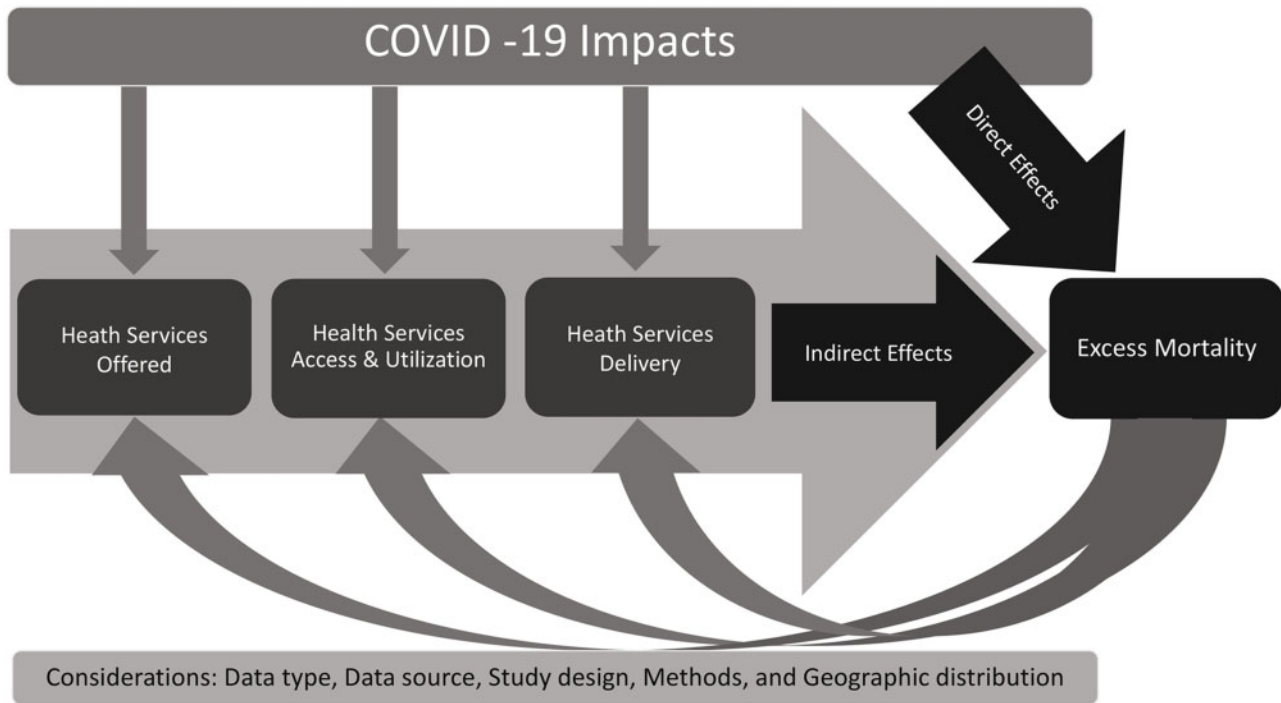
Figure 1 Schematic of the impact of COVID-19 on health systems and how this contributes to indirect effects and excess mortality

distribution of published studies. To our knowledge, this is the first literature review of the indirect health effects of COVID-19 globally and across multiple fields of health.

Methods

Given the evolving nature of this pandemic, we decided to pursue a scoping review rather than a systematic review as our methodology of research. We adapted the scoping review framework proposed by Arksey and O'Malley.[9]

Research question

This study used a two-part guiding research question: (i) What data sources, study designs and methods have been used to investigate the indirect effects of the COVID-19 pandemic on health service delivery and utilization across various health domains and (ii) What are the advantages and disadvantages of different methods of evaluating the indirect health effects of the pandemic? For the purposes of this study, we defined indirect health effects as identified changes in the accessibility, delivery, utilization, or outcomes associated with healthcare services.

Identification of relevant studies

We conducted an initial literature search over a period of 3 days from 22 to 24 June 2020 using two electronic databases: Medline/ PubMed and Google Scholar. These databases were selected to identify articles on a wide range of indirect health effects, focusing on biomedical literature. Search terms were developed to identify indirect effects across a range of health domains (Supplementary appendix SA1). Our initial search yielded 6119 results. After this initial review of the literature, the search terms were refined, and we conducted a second review in Medline/PubMed, Google Scholar and the Scopus database from 10–19 August. This final iteration of search terms yielded a total of 14 807 articles. A PRISMA flow diagram depicting this process is shown (figure 2).

Selection process

A preliminary search was conducted prior to initiating the scoping review to determine the inclusion criteria and establish consistency between the two reviewers (A.N. and L.C.). Next, two reviewers completed first and second pass searches of the databases, screening first by title and abstract. Articles meeting inclusion criteria were then screened for appropriateness by a second reviewer (C.R. and B.B.). Reviewers subsequently read the full text of the included articles, briefly summarized key findings, and categorized the studies by methodology and data source (A.N., L.C., C.R. and B.B.). Preprint articles were excluded. Citations were managed via the Zotero citation management software.

Inclusion criteria

We included peer-reviewed studies that fell within the following health categories: cancer, cardiovascular health (including cardiac disease, stroke and peripheral vascular disease), diabetes, communicable diseases, maternal health, sexual and reproductive health, surgical emergencies and child health. Our goal was to determine what data exist at this point regarding the impact of the pandemic on healthcare utilization and, where available, health outcomes, therefore we only included studies with quantitative findings. We excluded modelling studies that were purely predictive, as well as studies that attempted to apply findings from data collected prior to the pandemic to the current context. Furthermore, we excluded clinical guidelines and commentaries if they did not include primary data.

We excluded studies on the indirect effects of COVID-19 on the psychological, social, economic, and environmental dimensions of health. Although these determinants of health are crucial categories of indirect effects, the breadth and complex nature of research in these areas deserves its own review. The relationship between indirect health effects and socioeconomic inequity was not an explicit focus of this review; nonetheless, it is a critical area of investigation. As appropriate, we highlight instances of inequity from the included studies.
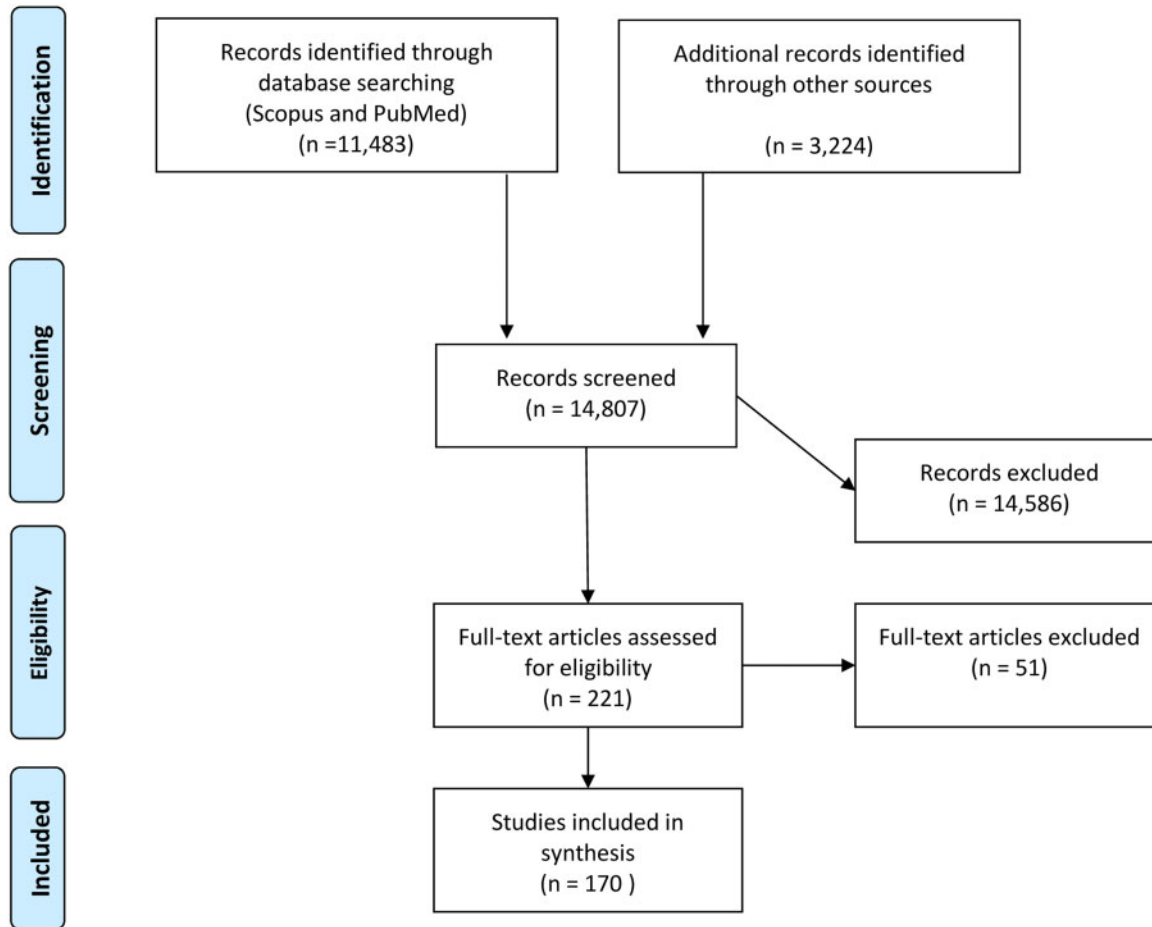
Figure 2 PRISMA flow diagram

Results

A total of 170 articles were included in the final scoping review. A complete list of included studies is available in Supplementary appendix SA2. Through our review of the literature, we identified two dominant methodologies for assessing indirect health effects: observational analytic (retrospective comparisons of data from the COVID-19 lockdown period with data from previous months or years) and observational descriptive (surveys or cross-sectional studies with no comparison). Studies were categorized as comparing the COVID-19 time period with the same weeks or months in previous years (labelled as 'year-to-year' comparisons), comparing the COVID-19 time period with earlier weeks or months within 2020 ('pre/post' comparisons), cross-sectional surveys, or other. Studies categorized as 'other' either presented findings with no prior data for comparison or the methodology was not clear.

The majority ($n = 99$, 58.2%) of studies reviewed used the year-to-year methodology, while fewer studies used pre/post ($n = 33$, 19.4%), survey ($n = 31$, 18.2%) or other ($n = 7$, 4.1%) study designs. The most commonly used data source was medical records from a single facility ($n = 79$, 46.5%). Other data sources included national-level health information systems and registries ($n = 23$, 13.5%), regional registries or multicentre data ($n = 38$, 22.4%) and surveys ($n = 30$, 17.6%). Papers included in the scoping review are categorized in figure 3 by health category, methodology and data source.

The preponderance of studies published on the indirect health effects of COVID-19 fell into the cardiovascular category ($n = 79$, 46.5%). The categories with the fewest articles included in this review were maternal health ($n = 6$, 3.5%) and diabetes ($n = 7$, 4.1%). This is possibly because data on cardiovascular diseases such as stroke and MI are widely tracked and have meaningful short-term outcomes. In contrast, it will take years to fully evaluate the impact of the COVID-19 pandemic on outcomes related to cancer or preventative measures such as immunization. Additionally, many high-income countries (HICs) have well-established referral networks for cardiovascular conditions, as well as disease-specific registries to track this type of data. Findings from a selection of studies included in this review are described in Supplementary appendix SA3.

Key substantive findings

During the COVID-19 pandemic, healthcare utilization for non-COVID-19 conditions has decreased almost universally. Nearly, all studies reviewed demonstrated this reduction in utilization across both high- and lower-income countries, and irrespective of the degree of COVID-19 outbreak within that country or region. Remarkably, these decreases occurred not only for routine services, such as child health visits or immunizations, but also for emergency conditions, such as myocardial infarction (MI) and stroke, as well as chronic, urgent conditions, such as cancer. Studies assessing health service utilization, or the number of patients who presented to a facility for a given condition, represented the majority of the included publications; a minority of reviewed studies (24.1%) measured health outcomes. At times, particularly via survey approaches, a subjective decrease in service availability or accessibility was discussed, typically by either healthcare providers or service users.[10–15] However, these patterns in service delivery were generally not rigorously quantified.

The causes of decreased healthcare utilization during the COVID-19 pandemic remain unclear. For instance, it is unknown whether the finding of fewer hospital presentations for myocardial infarction or stroke was due to decreased disease incidence, decreased healthcare-seeking behaviour or other causes. One hypothesis is that lower
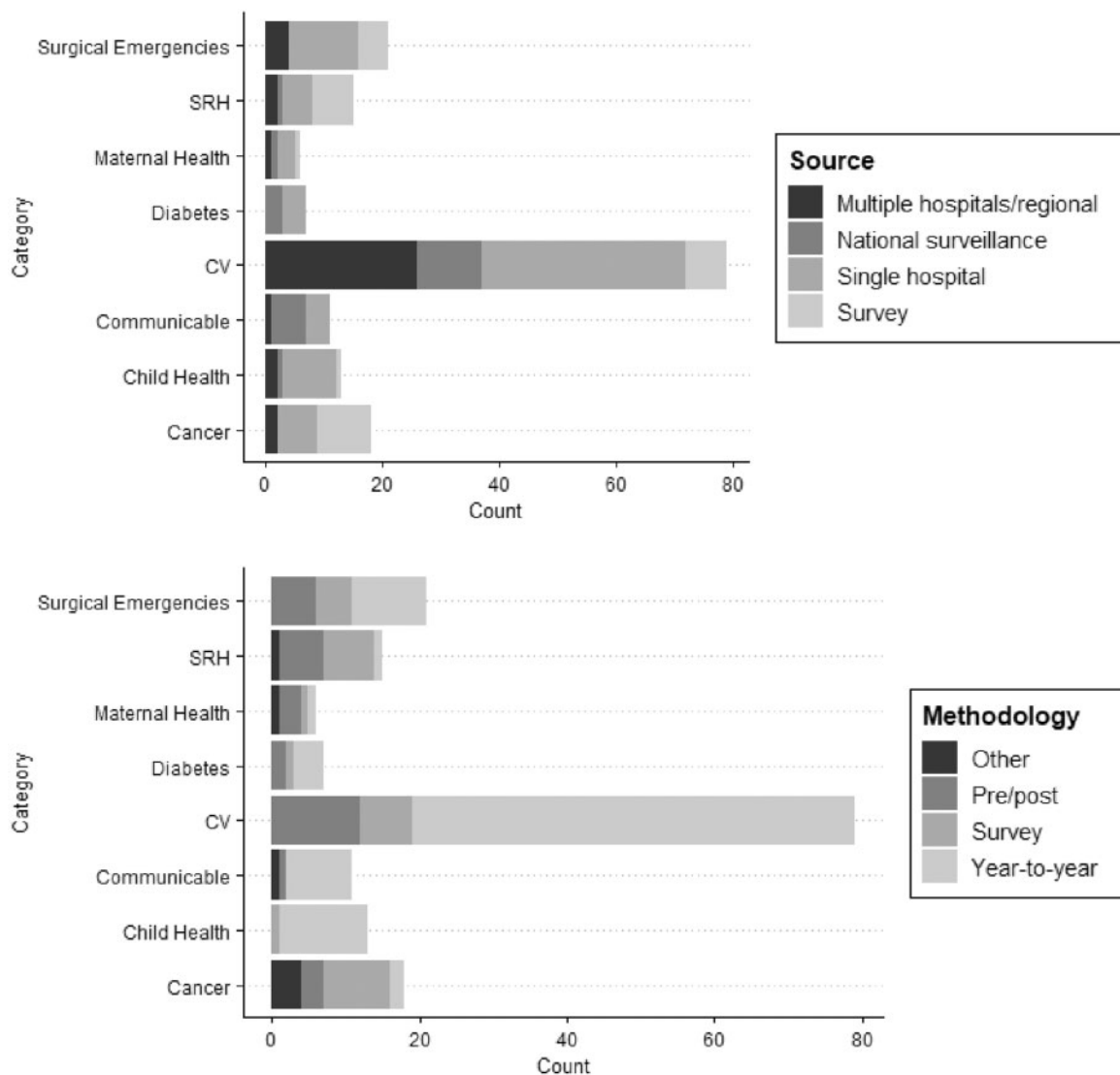
Figure 3 Articles reviewed by (a) health category and methodology and (b) health category and data source

healthcare utilization reflects an increased number of people dying at home from untreated, non-COVID-19 diseases. For example, a study in the USA suggested that excess mortality in Boston, Massachusetts could be related to the decrease in hospitalizations for acute cardiovascular conditions if more people are dying at home rather than seeking care.[16] Other potential explanations mentioned by authors included reduced health facility hours due to national lockdowns and curfews, reduced human resource availability within healthcare facilities, and hesitancy to seek care due to fears of contracting the virus. Decreased service utilization may also reflect the increasing use of telemedicine, a form of service delivery which may not have been captured by data collection. Alternately, it is possible that shifting environmental and social factors could have contributed to decreased rates of certain diseases.

Despite the global nature of the COVID-19 pandemic, the majority of studies in our review assessed indirect health effects in HICs in North America and Europe. Of the articles reviewed, only one-third (35.4%) included data from an LMIC as classified by the World Bank. Although countries were in varying stages of the pandemic during the time period covered by this review, most countries initiated some form of lockdown in March 2020.[17] Therefore, one would expect the impacts of the pandemic to be seen across national contexts, though perhaps to a greater degree in countries with more local transmission. Furthermore, many LMICs that COVID-19 has severely impacted have so far not been the focus of much research

on the pandemic's indirect effects, in particular India and countries in Latin America and Africa. These differences may be explained, in part, due to inequity in data availability and research funding in LMICs as compared with HICs. Figure 4 depicts the distribution of articles on indirect health effects by country as compared with the global distribution of COVID-19 cases. The process used to create this figure is described in Supplementary appendix SA4.

Methodological approaches

Many of the studies identified in our review employed an observational analytic approach via a retrospective cohort design, with the same months in either prior years ('year-to-year') or pre-COVID-19 lockdown months within 2020 ('pre/post') as the comparison time period. These approaches each have strengths and weaknesses. Studies that compared the pre- and post-COVID-19 period within 2020 (usually defined as before and after lockdown) neglect seasonal variations that could influence healthcare service patterns or health-seeking behaviours. However, this method minimizes temporal differences that could alter healthcare service trends over multiple years. Conversely, year-to-year comparisons may be affected by temporal differences, including long-term changes in hospital resources or capabilities, but control for seasonal effects. Finally, studies that use an observational descriptive design, such as cross-sectional surveys, as their primary methodology are efficient due to their rapid creation and ease of data collection but are subject to recall bias or
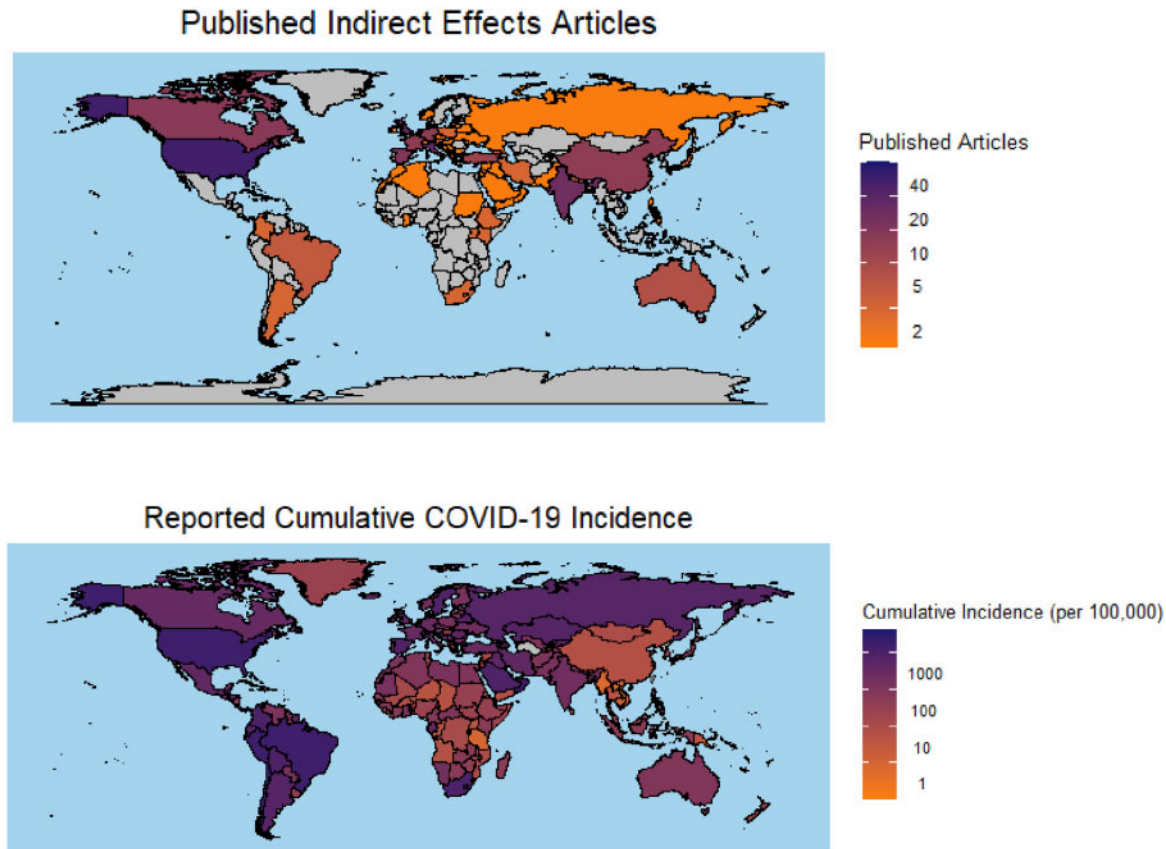
Published Indirect Effects Articles

Reported Cumulative COVID-19 Incidence

Figure 4 Map of the global distribution of (a) indirect effects articles and (b) cumulative incidence of COVID-19

respondent error. For example, clinician reports about changes in health services after the onset of the pandemic may be influenced by personal perceptions. Surveys also focused on subjective health service accessibility and availability, rather than objective measures of utilization or health outcomes.

Data sources

The reviewed studies used a wide range of data sources, including national demographic surveillance information, regional disease-specific registries, facility-level data and surveys. Assessing indirect effects at these multiple levels of health systems helps garner the most comprehensive and accurate depiction of the pandemic's impacts. For example, data analyses of single hospital or clinic records provide a snapshot of the impact of COVID-19 on a particular location, whereas national hospital databases can corroborate if those findings represent changes in healthcare service delivery and utilization more broadly. Several studies included in this review drew data from disease-specific registries for stroke and cardiac arrest. Such registries act as an intermediate source between individual facilities and national-level data that aggregate data across multiple facilities.[18–22]

Finally, LMICs often have a national health information system to which facilities regularly push data on numerous health indicators, from the subdistrict to national level.[23] However, depending on available resources, data quality and completeness may be compromised. In addition, there may be discrepancies between rural and urban areas in the quality and quantity of available data. Universal healthcare systems with comprehensive electronic databases can allow for simplified collection of data across hospitals, clinics and other lower level facilities. Such systems may enable conclusions about the indirect effects of COVID-19 to be drawn on a population level.

Discussion

Continued study of the indirect health effects of the COVID-19 pandemic will be critical to understanding its impact on long-term health outcomes and to mitigating the effects of the pandemic moving forward. As previously noted, most studies in this review demonstrated a decrease in healthcare service utilization across multiple health conditions globally without delineating possible reasons for this decline. Future studies should consider examining why these indirect effects occurred and propose solutions to improve equitable healthcare access, delivery, and outcomes moving forward. Some of this work has been done with surveys of health workers and patients to understand their perceptions of reduced medication access, delayed diagnostics, transportation barriers and other issues; such methods have been used particularly for HIV, sexual and reproductive health, and cancer care.[11–13,24,25] However, research on the indirect effects of COVID-19 has not yet rigorously measured changes in workforce, supplies, demand, access, and quality to understand how and why the pandemic has so drastically impacted health systems.

In addition, much of the research on the indirect effects of COVID-19 presented here focuses on individual facilities or regional hospital networks or registries. Collecting data at higher levels of the health system, such as national health information systems, can demonstrate more robust and generalizable findings if similar effects are seen across multiple geographic regions. Such cross-cutting trends were seen in the US Center for Disease Control and Prevention's analysis of the National Syndromic Surveillance Program, which captured data from a nationally representative sample of emergency departments and showed a decline in emergency department visits across all geographic regions.[26,27]

Excess all-cause mortality figures that are disproportionate to the number of documented COVID-19 deaths suggest that indirect health effects have led to increased mortality. However, there is currently a

paucity of published data on health outcomes for specific diseases, with most studies focusing on healthcare delivery and utilization.[28,29] Some fields have shown early outcome findings: for instance, a study aggregating data from nine hospitals in Nepal found a rise in institutional stillbirth rate and neonatal mortality.[30] In addition, a number of studies on cardiovascular and surgical emergencies measured in-hospital mortality and other complications.[31–33] In contrast, data in the peer-reviewed literature on outcomes related to HIV, tuberculosis, cancer, and child health (vis-a-vis immunization, nutrition and other long-term care) remain limited. The pandemic's impacts on chronic conditions and preventative services may take years to demonstrate, as was seen in Guinea after the 2014–15 Ebola epidemic.[8] Future research should focus on measuring patient-centred outcomes, such as clinically significant morbidity and mortality, rather than primarily system metrics like utilization.

As this review demonstrates, there has thus far been a relative paucity of published research on the indirect health effects of COVID-19 in LMICs. This may be attributable to a number of factors, including resource limitations which interfere with data collection, analysis and publication. In addition, countries were in varying phases of the pandemic in the time period covered by this review, which may have contributed to the disparity in publications, although several studies demonstrated decreased healthcare service utilization even when COVID-19 transmission was low. For example, a study in Uganda demonstrated a 29% decrease in facility deliveries and an 82% increase in maternal mortality in March 2020 compared with January 2020, even though there had been fewer than 50 confirmed cases in the country at that time.[2,34] This suggests that lockdown restrictions and fear generated by the pandemic may have caused decreased service utilization, regardless of the degree of local transmission. Where available, we recommend addressing the data disparity between HICs and LMICs by using existing national health information systems, such as the open sourced web-based health information system software DHIS2, currently in use by ministries of health in 72 LMICs, 58 of these at a national scale.[35] Additionally, these existing data sources often include maternal, neonatal, and child health information, which was relatively under-represented in this review.

In addition to variability in access to high-quality data globally, COVID-19 has also demonstrated inequities in health outcomes along racial, ethnic and socioeconomic lines. A number of papers have shown an increased burden of COVID-19 cases and mortality in racial and ethnic minorities.[36] It is likely that populations with low socioeconomic status and poor access to healthcare at baseline will also be disproportionately impacted by the indirect health effects of COVID-19. Although our search strategy was not specifically designed to capture studies about differences in indirect health effects along racial, ethnic, or socioeconomic lines, very few of the papers included in this review made any note of such inequities. Understanding and addressing the indirect health effects of COVID-19 experienced by vulnerable groups and the social determinants that drive such disparities is essential for further research.

This study has several limitations. First, research on COVID-19 has been generated with unprecedented speed and volume. This scoping review is not intended to be comprehensive and may have missed studies of indirect health effects not identified by our search strategy or not falling within the health categories established. Future studies may systematically review issues raised in this article. Additionally, this study reviewed only English-language publications, which may have skewed our findings towards papers from HICs. As the study of the COVID-19 pandemic's indirect effects is new and evolving, methodological approaches were not previously standardized; therefore, we categorized approaches as seemed most logical, and future reviews may build on this to identify a new 'gold standard'. Finally, some data on the indirect health effects of COVID-19 in LMICs may currently exist primarily in 'grey literature', such as non-governmental organization or government reports, and therefore may have been missed in this review.

We recommend that future work should examine COVID-19's indirect effects longitudinally, particularly as the pandemic's economic reverberations affect health-seeking behaviour and healthcare service delivery over the coming months and years. Importantly, future research should be tied to system improvement, with researchers identifying potentially actionable findings for national, regional and local health leadership. For example, key indicators, or composite indicators, of disruptions in health service delivery and outcomes could trigger a multilevel health system response to examine the contextual factors causing this disruption and create targeted interventions. Such ongoing research may also help health systems improve resilience for future epidemics or disasters. Likely, the devastating effect of COVID-19 on livelihoods and economies will impact health outcomes for years to come, with disproportionate effects on LMICs and marginalized groups. Public health professionals must continue to identify these problems, implement adaptations when possible, and advocate for durable, equitable solutions on behalf of those most impacted by the pandemic.

Supplementary data

Supplementary data are available at *EURPUB* online.

Conflicts of interest: None declared.

Key points

- This review provides an overview of the literature on the indirect health effects of the COVID-19 pandemic and demonstrates a global decrease in healthcare service utilization, regardless of the severity of the pandemic in a given area.
- The literature published thus far focuses on changes in healthcare delivery and utilization; the impact on health outcomes may take years to demonstrate.
- Most research to date includes single health facility or regional data, drawing attention to the need for additional research on national-level effects using health information systems.
- Data disparities exist, with a relative paucity of research published from low- and middle-income countries despite these countries experiencing significant numbers of COVID-19 cases.
- The indirect health effects of COVID-19 are an important area of ongoing study, and future research should aim to translate findings into actionable recommendations to improve healthcare access and delivery.

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