

The impact of pandemics on medical research publication trend: Tested on PubMed as an example through the COVID-19 era

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ABSTRACT

Introduction: COVID-19 pandemic negatively influenced the entire life globally including various aspects of patients' care. Its effect on medical research production is not known. The aim of this study is to assess the impact of COVID-19 pandemic on medical research reporting trend.

Methods: Advanced search on PubMed was performed over 2011- August, 2021. Monthly comparison was done for the years 2019, 2020, and 2021. Kruskal Wallis test was used to compare continuous distributions.

Results: The total publication count showed constant increment over the study period. Faster rise was noticed on 2020 (15.7%). A steady growth in publications over the years and through the pandemic was also seen in seven studied countries with variable, both in total and also after exclusion of COVID-19 related papers. Italy and India have the highest proportions of COVID-19 related publications in comparison to the total papers in 2020, but USA has the highest quantity. Statistically significant differences exist between the first eight months of the last three years with and without counting COVID-19 related publications (p-values=0.0003907 and 0.001084, respectively).

Conclusion: Our results reflect that investigators world-wide succeeded to reconfigure their work style and utilize the spared time induced by the lockdown to enrich the medical research platform.

Keywords: COVID-19, pandemic, medical, research, publication

INTRODUCTION

On March 11th 2020, the World Health Organization (WHO) declared that coronavirus disease 2019 (COVID-19) caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as a pandemic after its fast global dissemination [1]. Many countries adopted precautionary measures in order to slow down the virus spread with a variable extent of lockdown. Hospitals and other health care facilities changed their workflow dramatically to cope with this emergency, and to secure safety of their employees, as the continuous supply of personal protective equipment (PPE) was initially a major challenge. With prioritizing the containment of COVID-19 cases, many hospitals were overloaded and under-staffed. Health care workers (HCW) were overwhelmed, and some have to shift their point of care and join the frontline to contain this crisis.

Patients' care was negatively impacted in several aspects. For instance, the quantity of patients served in outpatient clinics was reduced, many invasive procedures were postponed, and inpatient units implemented an earlier discharge policy. Many hospitals were devoted to be COVID-19 centers in various countries. In a global cross-sectional study, over 10% of oncology patients in 46.3% of health care centers contributed in the survey reported a minimal of one missed cycle of chemotherapy treatment during the pandemic, with an overall incidence of 36.5% of care interruption [2].

While the pandemic resulted in definite disturbance of all activities, including school education and ambulatory health care, the continuity of medical research was prone to a potential risk, the magnitude of which is still undetermined.

Faced challenges to maintain an unfragmented continuous medical research activity during the pandemic are numerous. Direct patients' care is definitely more important. With prioritizing clinical service, shortage of manpower and staff being burnout, medical research is expected to be compromised. Besides, restriction of nonessential services and laboratory closures can adversely affect both the access to resources as well as the face-to-face idea exchange and ongoing discussion between investigators. Most HCW were not trained to handle virtual professional platforms at the early phase of the pandemic [3]. The psychologic impact of the situation [4-6], the fact that some investigators and HCW have comorbidities; making them more prone to develop complications if they caught the infection [7,8], and the undeniable negative role of the rumors and social media [9], especially in places where the transparency of the real situation is questionable [10], all are potential contributing factors to slow down the process of research. Moreover, the urgent effort toward improving COVID-19 detection and treatment caused deviation of resources and grants restraint.

On December 2020, cancer research UK (CRUK) announced cut of 45 million pounds to the research budget [11]. The Canadian Cancer Society estimated that the pandemic will

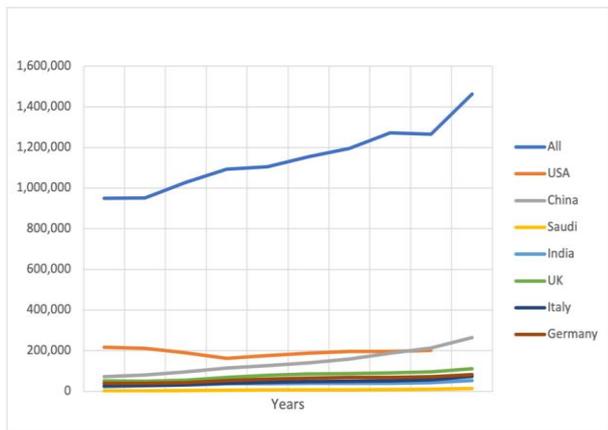


Figure 1. The trend of publication over the studied period

cause more than half of its budget loss from donation [12]. The American Cancer Society also cut its new research fund to half [13]. Institutions such as Stanford University stopped hiring new faculty due to the pandemic and announced hiring-freeze for a minimal duration of two years [14,15]. Some big centers like Mayo Clinic, Minnesota (MN) have cut salaries [15].

Most clinical trials require patients' enrollment and direct contact. Medidata's analysis of 4,667 studies and 186,807 study sites indicates that 74% drop of patients' count among recruited participants in clinical trials world-wide in the mid-2020 in comparison with the same time of the preceding year [16]. Furthermore, leading scientific journals have postponed and prolonged deadlines of manuscript revisions, which might also contribute to the decline in medical publication.

On the other side, publications related to the novel virus and its related disease grew very fast. More than a thousand of clinical trials were registered in COVID-19 clinical registry [www.COVID-19-trials.com] globally between January and May, 2020 [17]. Such a huge number can grow on the expense of medical research in other fields that continue to exist as chronic pandemics like oncology and other infectious diseases.

Medical research is a fundamental aspect of patients' care. Considerable serious short-and-long term consequences are expected to follow compromising its steadiness. For example, patients care will be negatively impacted by putting clinical trials on hold [15]. Besides, progress in post-graduate studies relies mostly on research work.

To address this concern, the current study aimed to quantify the impact of COVID-19 pandemic on medical research reporting trend on PubMed.

METHODS

This study complies with the World Medical Association Declaration of Helsinki regarding ethical conduct of medical research. As it exclusively depends on the web-data and it does not require any information related to human subjects, the approval of the local institutional review committee is not required/ exempted.

Study Design

This is an observational, cross-sectional study. The PubMed was selected as the database to investigate the effect of the pandemic on its publication trend. PubMed is a well-known

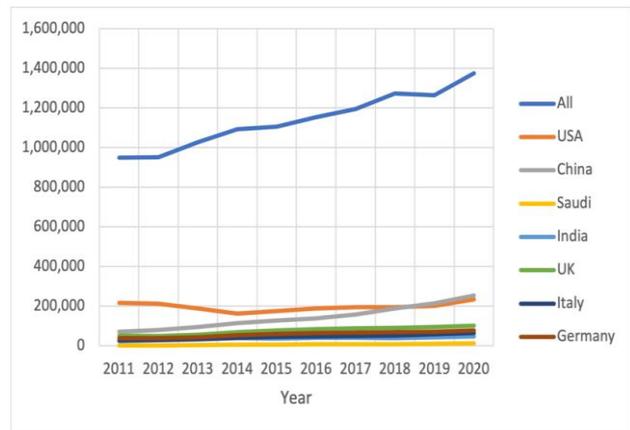


Figure 2. The trend of publication over the studied period excluding COVID-19 related papers

substantial free search engine specialized in life sciences and biomedical researches with humongous database [18]. Many scientists, health care workers, students, and fellows refer to it as the preferred data resource worldwide.

Advanced search on PubMed using various specific dates, certain words like COVID-19, SARS-CoV-2, and countries of authors' affiliation, was performed from 2011 till August 31st, 2021.

The total number of annual publications were recorded over the study period, and specifically for seven selected countries that showed a spectrum of geographical and socio-economic background, and were impacted in variable degree during the pandemic. The studied countries are USA, China, United Kingdom (UK), Saudi Arabia (SA), India, Italy, and Germany. In addition, monthly comparison was done for the years 2019, 2020, and 2021 with and without counting COVID-19 papers.

Results were tabulated in Microsoft Excel for Mac. Kruskal Wallis test was used to compare continuous distributions. P-value <0.05 was considered statistically significant.

RESULTS

The total publication counts over the study period showed constant increment from 949,607 in 2011 to 1,463,930 in 2020 (54.2%). Ironically, a faster rise was noticed on 2020 (15.7%) (**Figure 1**).

Even after exclusion of COVID-19 related literature, there was still 8.6% increment in publications count in 2020 (**Figure 2**).

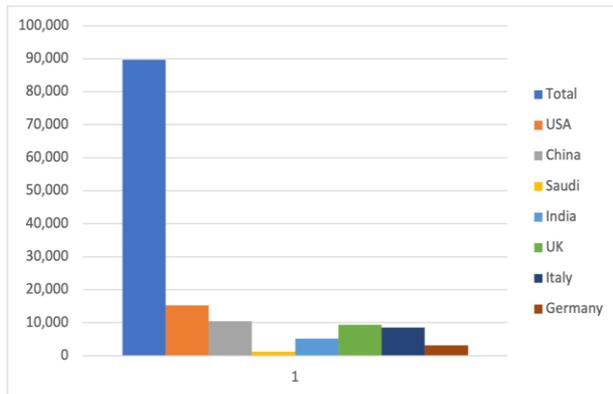
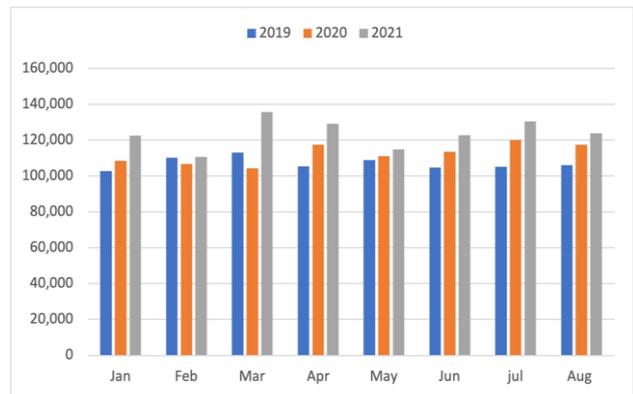
All the studied countries showed also a steady growth in publications over the study period and through the pandemic, both in total and also after exclusion of COVID-19 related papers (**Table 1**, **Figure 1**, and **Figure 2**).

Among all the seven studied countries, Italy and India have the highest proportions of COVID-19 related publications in comparison to the total papers in 2020, but USA has the highest quantity, followed by China and UK (**Table 1** and **Figure 3**).

Table 1. The publication counts over the study period

Year	All	USA	China	Saudi Arabia	India	UK	Italy	Germany
2011	949,607	216,360	72,034	1,775	22,483	50,345	28,071	38,839
2012	951,015	212,070	79,521	2,285	27,785	49,746	29,286	38,476
2013	1,028,338	189,461	95,692	3,390	31,385	55,054	33,141	42,796
2014	1,093,532	161,750	113,858	4,736	37,522	67,769	40,064	53,438
2015	1,105,289	174,950	126,742	6,038	37,150	77,876	44,135	60,149
2016	1,154,437	187,888	139,164	7,173	39,473	84,574	47,722	64,666
2017	1,194,878	195,397	158,114	7,371	40,008	87,436	49,907	67,477
2018	1,272,742	195,770	187,436	7,992	38,910	90,587	52,002	68,770
2019	1,265,285	201,339	213,992	9,622	42,617	94,911	56,927	71,376
2020	1,463,930	248,932	264,047	13,498	52,789	111,053	74,025	81,490
2020*	1,374,237	233,686	253,519	12,310	47,566	101,636	65,512	78,336

Note. *Excluding COVID-19 papers

**Figure 3.** COVID-19 related publications in 2020**Figure 5.** Monthly comparison of publications in the first eight months of 2019-2021 after excluding COVID-19 related papers**Figure 4.** Monthly comparison of publications in 2019-2021

Monthly comparison between 2019, 2020, and the first two thirds of 2021 showed constant growth of publications every year except for a brief shortfall in February and March 2020 (**Figure 4** and **Figure 5**). Statistically significant differences exist between the first eight months of the three years with and without counting COVID-19 related publications (p -values=0.0003907 and 0.001084, respectively).

DISCUSSION

On the end of January 2020, WHO declared COVID-19 as a public health emergency of international concern (PHEIC) with a reported death toll of 171. By the end of 2020, this figure mounted to 1,813,188, with a preliminary estimate suggests

that the real number of global deaths attributable to the pandemic in 2020 is at least three million, representing 1.2 million more deaths than officially reported. United States has the highest figure [19]. On the other hand, there are an estimated figure of almost 10.0 million cancer deaths occurred worldwide in the same year [20]; more than three folds of the rate attributed to the pandemic. The data illustrates that focus was shifted toward improving detection, prevention, and treatment of the new disease. Yet, this should not jeopardize all the ongoing effort toward improving care of other significant medical conditions.

The results of the current study ironically disclosed that medical research has been somehow pushed forward during the pandemic phase. It seems probably that scientists were inspired to devote more time to work on research during the curfew stage. The utilization of smart-working modalities might also help to uphold the already going up trend in a positive direction.

During the epidemic, different specialties were indeed impacted unevenly. For instance, intensivists, infectious diseases specialists, and radiologists were more overwhelmed than others. In an Italian survey assessing the impact of the COVID-19 pandemic on radiology research showed that there was a significant increment of the dedicated time per week spent for research purposes during the national lockdown (mean 4.5 ± 8.9 hours versus 3.3 ± 6.8 hours before the lockdown), followed by a significant drop after terminating the lockdown (3.2 ± 6.5 hours). Besides, 14.1% of participants completed old papers, 8.9% started new review articles, and 15.6% worked on both new review articles as well as completed old papers [21].

Therefore, positive utilization of the COVID-19 associated circumstances was evident in the most concerned departments in one of the most hit countries particularly for creating review articles and finishing pending work.

On the other hand, another Italian survey assessing cancer research activity revealed an initial 69.1% drop down of research activities in phase 1 (9 March-4 May). In phase 2, research activities were resumed in most centers (80.4%) with some new guidelines-based restrictions [22]. In this context, our results showed an overall 15% increase of the non-COVID-19 published papers from Italy in 2020. Overall, despite the evident brief interruption of research publication ensued in the beginning of the pandemic timed with the universities and laboratories closure in several parts of the world (**Figure 4**), committed investigators vigorously adopted remote working activities that sustained the growth of annual publication rate. All studied countries with variable recourses and prosperity maintained their publication activity despite all the challenges, including USA and UK; both countries have announced research budget cut [11,13].

In this study, there was no short-term negative impact of the ongoing COVID-19 pandemic on medical research production trend while evaluated on PubMed. As published papers in 2020 are at least partially reflecting an earlier research activity dated before the beginning of the crisis, the long-term effect is still ambiguous especially if the current setting lasts for a prolonged time with repeated waves hitting the health and economy of many countries.

Some limitations of this study should be highlighted. First, the scope of this work was to assess the overall impact of the pandemic on medical research in whole. Therefore, the specialties of the researchers were not taken into account. Departments like emergency medicine and intensive care units were more overwhelmed than other disciplines and might be more drastically impacted. Second, we did not compare the different publication subtypes like original articles, case reports, review articles versus clinical trials as longitudinal time is needed to show the impact on clinical trials studies if they are any, since trials are usually planned to be run over years. A major highlight of the study is including countries like China; the first place to discover the disease, and United States and United Kingdom; both have adequate surveillance systems and financial records, with documented hundred-thousands of confirmed COVID-19 related mortality and announced budget cuts.

CONCLUSION

Despite all aforementioned obstacles associated with the challenging scenario of the global crisis and budget restrictions, our results reflect that investigators world-wide succeeded to reconfigure their work style and employ smart and remote working modalities, and utilized the spared time induced by the lockdown to complete an enduring work, and to review the literature and create comprehensive review articles to enrich the medical research platform.

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