ETHIOPIAN MEDICAL JOURNAL

60 YEARS ANNIVERSARY

2022 SPECIAL ISSUE

OCTOBER 2022 VOLUME 60 SUPPLEMENT -1

COVID-19 TWO YEARS ON: CONSEQUENCES AND LESSONS

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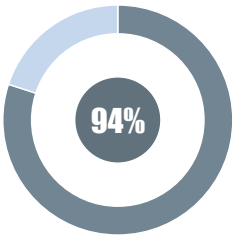

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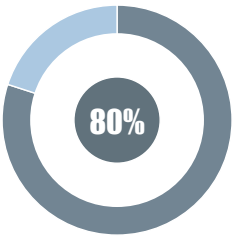

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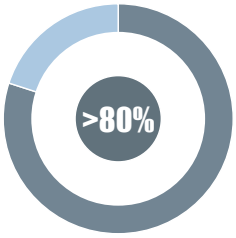

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Editorial

"Building back better": Lessons from the COVID-19 Pandemic and control measures

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"*All I maintain is that on this earth there are pestilences and there are victims, and it's up to us, so far as possible, not to join forces with the pestilences. That may sound simple to the point of childishness; I can't judge if it's simple, but I know it's true … I'd come to realize that all our troubles spring from our failure to use plain, clean-cut language. So I resolved always to speak, and to act, quite clearly, as this was the only way of setting myself on the right track.*" Albert Camus, 1948.

The Plague, a novel written by Albert Camus, a French Algerian 'literary icon' of the first half of the 20th century (1), describes in a matter-of-factly fashion how a 'worldly' port town with mundane routines was suddenly turned upside down by a plague. His descriptions perfectly predict the current COVID-19 pandemic, with few exceptions. The exceptions: i) The plague he described was more localised and more deadly; ii) In his novel, misinformation spread fast but only through word of mouth, and the print media. Misinformation is now a global phenomenon 'supercharged' by instantly accessible networking platforms. Misinformation is a uniquely 21st century problem and has been a truly monumental challenge during COVID-19 implying that pandemic response should integrate proactive approaches to tackle misinformation (2). Although we did not find corroborative report, our general observation was that the simple approach of the Ministry of Health– Ethiopia in the early stages of the pandemic of providing regular updates by the Minister, as a trusted source of information, was highly valued. More broadly, the effort of African countries to tackle the COVID-19 pandemic by implementing simple public health control measures was remarkable. The Taskforce for Coronavirus was established to assist African countries with pandemic preparedness and as a platform to share best practices and ensure availability of essential medicinal products (3). In addition to the COVAX mechanism, the African Vaccine Acquisition Trust was established as a 'pool procurement' method to facilitate access to vaccines (4). This fraternity among African countries was a very important lesson, which should be maintained through more routine or established mechanisms. Nevertheless, the complexity of controlling a respiratory pandemic is enormous (5). The commitment to continental and national mechanisms did not spare Africa from the spread or impact of the pandemic. For example, the spread and surges of the pandemic in the east African region mimicked that of the rest of the world (6).

One of the major challenges for controlling the pandemic in Africa has been the shortage of diagnostic tests, which prohibited timely evaluation of the national spread of the disease. The authors in this special issue piloted a relatively simple mHealth surveillance mechanism to track national spread and impact of COVID-19. This method appears to have a reasonable performance compared with standard reverse transcription polymerase chain reaction (7). While the simplicity and scalability of the mHealth surveillance suggests potential utility, the low response rate and the selection bias related to access to mobile phones are important limitations.

Overall, despite the relatively high adherence to control measures (8), the health and economic impact of COVID-19 in Ethiopia, as demonstrated in this study, was high, disproportionately affecting women and the unemployed or those in private business (9, 10). Vaccine acceptance appears relatively good with most people constrained by lack of access (11) implying that the most important barrier to vaccination was unavailability of vaccines (12). This is not to minimise the relevance of vaccine hesitancy, as also highlighted by Timothewos and colleagues in this issue (11).

There is a broad consensus that COVID-19 is on the decline. Yet, significant challenges remain for Africa.
First, the pandemic is not yet over. While there is a clear trend of decline in incidence and mortality, current reporting is likely to be an underestimate (13). There is a need to remain vigilant. mHealth surveillance may play a role in the ongoing monitoring and control responses in Africa.

Second, because of the 'collective trauma' experienced by the pandemic and the attendant control measures, mobilising similar public commitment to control measures in any future pandemics will be challenging. Strategies have to be developed to address such eventualities.

Third, the Achilles' Hill for Africa is its import dependence. Overall, 94% of essential medicines (14), over 99% of vaccines (15) and a similar proportion of diagnostics are imported at substantial cost to the health, economy and security of Africa. This is complicated further by recent plans to increase the price of COVID-19 vaccines. For example, Pfizer has planned to quadruple the US price of its vaccine next year (16). Other manufacturers are likely to follow suit, which would make the vaccines unaffordable for many countries in Africa and beyond. Additional concern is maintaining the commitment of vaccine or drug producers for conditions that primarily affect Africa or other developing countries. Cholera may be a good example. Despite the unprecedented cholera outbreak at present, one of the two companies that produces cholera vaccine (Shanchol) is discontinuing the vaccine (17). Thus, the authors rightly point out to the urgency of building Africa's capabilities to make all its essential medical commodities within the its territories (18).

In conclusion, we suggest the following as important inputs for building back better and pandemic resilience: i) developing simple alternatives for tracking the spread and impact of pandemics, as was tested in this series papers, may have utility. ii) While vaccines are critical for the control of pandemics, it is availability than hesitancy that is the bottleneck of vaccination in Africa. International partners and governments cannot use the "talk" of vaccine hesitancy to "get off the hook" (12). iii) Continental initiatives may enhance and energize the commitment to make essential medicines within Africa. But it is critical that countries, particularly those with large populations, lead the way by creating the required infrastructure, systems, and human capabilities. iv) Building back better requires assimilating the lessons from the pandemic, creating diverse and more resilient economy that also engages biotechnology for local manufacturing, and construing a more equitable and caring social system.

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Ethiopian Medical Journal 2022, 60 (Supplement 1)
ISSN 0014-1755 eISSN 2415-2420

Brief Communication

COVID-19 two years on: Four fundamental lessons to curb future pandemics in Africa

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Abstract
Background: COVID-19 is one of the major pandemics of the past 100 years. We reflect on the key lessons from the COVID-19 pandemic for deflecting similar threats in Africa.
Results: We describe four fundamental lessons. (1) The need for capable and empowered national/regional knowledge translation centers to synthesize and translate rapidly evolving evidence during pandemics to inform policy and practice. (2) Importance of harnessing the power of global partnerships: Pandemics, as shown during COVID-19, attract global partnerships. Thus, mechanisms should be devised to use partnerships to control or mitigate consequences of pandemics. (3) Urgency of improving the innovation ecosystem drastically: The unprecedented drive for innovations during pandemics requires flexible and robust systems to absorb them. (4) Need for producing critical medical supplies within country: The extreme dependence of Africa on imports constitutes an existential threat for Africa and must be addressed as a priority.
Conclusion: Building world class knowledge translation units, medical discovery capabilities and harnessing innovations and partnerships should be part of the critical foundation of a secure and prosperous Africa that can confidently tackle future pandemics.

Citation : *Fekadu A, Makonnen E, Abayneh A, et al , COVID-19 two years on: four fundamental lessons to curb future pandemics in Africa. Special issue of Ethiop Med J 60 (Supplement 1) 4-10*
Submission date : *15 September 2022 Accepted: 29 October 2022 Published: 30 October 2022*

Background

Four major pandemics of the past 100 years have taken the lives of close to 100 million people globally. The Spanish flu, with nearly 50 million deaths, remains the leading cause of pandemic related mortality (1). To date, over 6.5 million people have died from the Corona Virus Disease 2019 (COVID-19) pandemic (2). The economic impact of the pandemic has been immediate, deep, persistent, and more pronounced in emerging economies (3). Unlike previous pandemics that took up to 10 years to become global, COVID-19 had made its way around the world within three months of the first report of the disease. Aware of what was coming, many African countries took drastic actions. In fact, African countries can be proud of their collective response. Their implementation of public health control measures was unprecedented. Recognising the health system challenges, they focused on enhancing service provision. They engaged in continental and international frameworks to keep the pandemic at bay. In Ethiopia, COVID-19 was just one of the many problems the country was facing. But COVID-19 received the full attention of the nation with coordination at the highest level of political leadership. The Ministry of Health led from the front putting into use the extensive diaspora network and effective communication strategy. The Ethiopian Public Health Institute was strengthened to lead the control effort. Diagnostic capacity was scaled up rapidly. When vaccines were produced, Ethiopia negotiated access to these vaccines. These are all monumental achievements and will serve as important inputs for preventing or controlling future pandemics. However, the public response in many developed countries was lukewarm, and global leadership was 'absent' (4). The Independent Panel for Pandemic Preparedness and Response lamented the flagging political commitment to end the pandemic and prevent another. It particularly noted that the extremely slow pace will not bring about the required transformative changes (4).

Albert Camus, the French Algerian novelist in his novel, the Plague, aptly captures the public sentiment displayed during COVID-19 (5):

> *"A pestilence isn't a thing made to man's measure; therefore we tell ourselves that pestilence is a mere bogy of the mind, a bad dream that will pass away. But it doesn't always pass away and, from one bad dream to another, it is men who pass away, and the humanists first of all, because they haven't taken their precautions."*

Camus also captures the slow and timid leadership response (especially in high income countries): *"The only hope was that the outbreak would die a natural death; it certainly wouldn't be arrested by the measures the authorities had so far devised"* This inconsistent public and leadership response in the current pandemic, along with the severe global inequity, formed the basis for an unrelenting pandemic.

Monkey pox, an endemic disease in some parts of Africa, has been recently declared a "Public Health Emergency of International Concern" by the World Health Organization as it spread relatively quickly across 75 countries and territories infecting over 16,000 people (6).

Despite its endemicity in Africa for half a century, virtually all reports of recent cases have come from outside of Africa (7), undoubtedly a function of the familiar poor diagnostic capability in Africa. Financially and technologically advanced countries are now in a hurry to hoard the little available vaccine (8, 9). Africa remains woefully unprepared. We have not learnt from the lessons of previous pandemics or the still unabated COVID-19 pandemic. Therefore, it seems right to stop and ask: What should Africa learn from this pandemic for deflecting or surviving another pandemic? While the typical recommendations focus on early detection through surveillance, modelling of transmission and spread, communication and development of therapies (10-12), there are unique lessons from the current pandemic to help Africa protect its people from another pandemic largely on its own terms and resources (13).

Thus, we put forward four key suggestions based on the lessons we learned through active participation in the prevention, and control of the disease for over two years. First, it is critical to be serious in generating and managing new knowledge. Second, institutional and national systems have to be in place to harness the opportunities of partnerships. Third, the essential culture and ecosystems must be in place to absorb and benefit from inevitable innovations created during times of crisis. Finally, Africa should have the key human, infrastructure and system capabilities to produce all its essential drugs, vaccines and diagnostics domestically. We provide more details below based on our experience in participating in the national and regional response, knowledge translation, global partnerships, and medical discovery initiatives.

Harnessing knowledge to track pandemics and inform policy and practice

When the COVID-19 pandemic started nearly three years ago, there was little knowledge about the disease. The global quest to understand the origins and nature of the disease, its cause, treatment and prevention opportunities was instant. This pursuit resulted in an overwhelming amount of knowledge of unconfirmed veracity. During the first two years of the pandemic, over half a million papers were published in peer reviewed journals, with about half generated in the first year [Figure 1]. Standards for peer review were virtually suspended. Approvals for medicines were accelerated and occurred under intense political pressure. It was suggested that the extreme clinical concerns warranted dropping the normal standards and that patients should be allowed to use drugs not approved by the appropriate regulatory authorities. This was believed to reflect the recommendations of the then president to try unproven treatments for COVID-19 (14, 15)The interest to repurpose old drugs (e.g., using well established drugs like chloroquine for COVID-19), and the recommendation to use traditional medicines

(e.g., herbal tonic endorsed by the president of Madagascar (16)) increased significantly despite the lack of clear evidence. The extreme panic and lockdown led to substantial economic losses and pressure on the health system. While major contribution has been made by regional and national institutions, such as the Africa CDC and the Ethiopian Public Health Institute in describing the spread of the disease, making sense of the overwhelming data in the public domain and to use it to inform policy and practice remained a major challenge. Aware of this clear gap, the Addis Ababa University's Centre for Innovative Drug Development and Therapeutic Trials for Africa (CDT-Africa) established a knowledge synthesis team to verify and harness the knowledge that was being generated (17). The team collated all critical new knowledge relevant to the nature of the disease, diagnosis, treatment and control from reputable sources and forwarded it to the Ministry of Health, initially daily, in a structure that the team felt was easy to comprehend. However, the team was only assembled to address the obvious gap without sufficient mandate or authority to influence policy direction even in issues as basic as 'universal' face coverings.

Therefore, it seems critical to establish sufficient number of highly specialized knowledge translation units with sufficient expertise and mandate that work along health ministries. These units should provide continuous and actionable health security intelligence to a national office tasked with pandemic preparedness and response. There should also be clear path of accountability. Perhaps no pandemic will command similar interest as COVID-19 had partly because of the exhausting enthusiasm it caused. However, knowledge translation units that generate and track new knowledge are likely to be even more important for conditions that may emerge 'under the radar' and lead to very serious public health consequences.

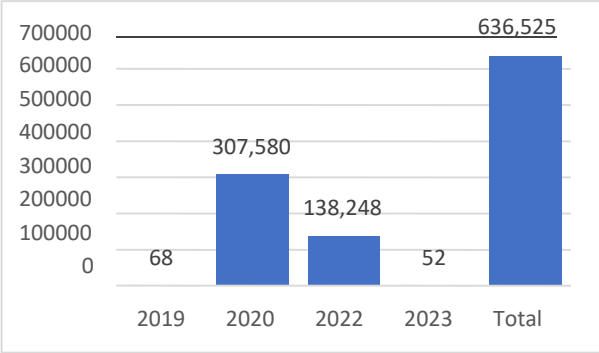

Figure 1. Publications by Year since start of the COVID-19 pandemic

[Source: WHO. COVID-19. Global literature on coronavirus disease (16)].

Harnessing the power of partnership

The relevance of global partnerships to assist low-income countries to achieve the sustainable development goals [1, 2] was heightened during the COVID-19 pandemic. For example, the Solidarity trial, described as "unprecedented international collaboration", had engaged 2000 researchers from 52 countries (19). Within few months of the pandemic, a global research coalition was formed by individuals from 98 countries and 900 organizations, including the Addis Ababa University, to bring together expertise and capabilities to accelerate the implementation of COVID-19 clinical trials in resource limited countries (20). An international collaboration, which also included Addis Ababa University and various hospitals in Ethiopia, worked on a UV-C Cabinet to support reuse of N95 respirators (21). The initial collaboration environment was also conducive in many organizations (22). However, these partnerships did not provide the transformative platform required to address the pandemic or produce sustainable impact.

First, these partnerships were very transient engendered by the immediate need of knowledge generation or short-term business and philanthropic interests, without lasting relationship or impact envisaged. Second, most African countries had limited capacity for developing or marketing high impact innovations, while potential partners from high-income countries were interested identifying marketing destination (23).

Third, countries where most of the innovation happened were not willing to share critical knowledge and resources required to make these innovations in low-income countries. This was shown clearly in the discussions about waiver of intellectual property protection for covid-19 vaccines (24).

"Building back better" through partnership requires a new model of partnership. An example is the "Partnership Maturity Model", a values-driven partnership growth model (25). At the core of this model is equity and mutual benefit with dedication of partners to long-term and sustainable relationship. While partnerships have great potential for rebuilding a better and safer Africa, these partnerships must be built to last on values such as equity, choice, freedom, and agency. Preventing and surviving another pandemic requires countries and institutions to invest and carefully engage in such partnerships. Better engagement mechanisms with the African diaspora and private business has to be devised.

Harnessing the potential of innovation

The pandemic has accelerated innovation meaningfully as major crises tend to do (26). The primary beneficiary of the innovation drive was the healthcare system, both as a solution and business proposition. New diagnostics, vaccines and repurposed drugs were developed and marketed in ultra-short time. Countries with ready expertise, infrastructure, and mature innovation system benefited most from the opportunity.

African countries were engaged in some documented innovation activities, including "virus-testing robots, contact-tracing apps, non-invasive testing kits, foot-operated hand-washing stations, oxygen machines, drone medicine delivery service, genome sequencing, [Artificial Intelligence] AI-powered healthcare chat-bots" (27). There was also major interest in innovative solutions in Ethiopia. The former Ministry of Science and Higher Education of Ethiopia organized numerous exhibitions of products, with all national universities actively engaged. Nevertheless, with all the 'dust' of excitement and chaos settled, there is no clear evidence that these innovations and the enthusiasm have led to significant and sustainable impact. While challenges abound, two critical barriers to innovation and impact deserve mention. First, low expectation of universities: While universities are critical for innovation and, even the achievement of the Sustainable Development Goals (28), the low expectation of African Universities (29) is antithetical to their mission of generating transformative knowledge and innovation that can address emerging threats or bring about sustainable impact. Without the right expectation and leadership, universities cannot be valued and receive the right investment, governance and accountability systems that underpin their purpose. Policies and engagements with universities need to change drastically. Whether acknowledged or not, Ethiopia's transformation requires drastic re-invigoration and accountability of all its higher education institutions. The private colleges and universities have played an important role in terms of increasing access to higher education although concerns of quality are raised (30). These private institutions must also be part of the solution. Ethiopian universities have led many of the national political changes of the past half century. They now should be the drivers of national transformation through innovation. Solomon Nwaka, one of the major advocates of African innovation, emphasizes the point that investment should be on innovation rather than on education arguing that innovation itself will force the education system to change (31). The indicator of impact would then be the number of innovations rather than the number of graduates. We illustrate this in Figure 2, extending the link of innovation to overall societal wellbeing.

One of the most critical barriers to impactful partnership was perhaps the lack of a mature and facilitative innovation ecosystem. Despite a considerable number of innovations during COVID-19, there is no evidence that any national system has kept a useful inventory of the innovations or the innovators. Bright innovators have not been given ongoing support for bigger purposes. There is no clear evidence that Ethiopia, or Africa more broadly, has benefited directly from the potential of innovation that came about because of the pandemic. Africa has to improve its innovation ecosystem not only for the next pandemic, but to address its perennial development challenges as well.

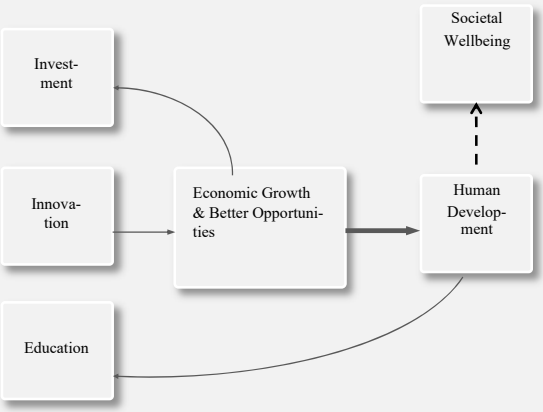

Figure 2 The investment-for-innovation paradigm for economic growth and better pandemic control opportunities

Medical discovery and development capabilities

Africa's main threat in any new pandemic is its absolute dependence on import for the supply of its essential medicines. The United Nations Economic Commission for Africa (UNECA) estimates that Africa imports about 94% of its pharmaceutical and medicinal supplies from outside the continent at an annual cost of $16 billion (32). All in all, there are only 600 pharmaceutical manufacturing plants in Africa, just 5% of India's (33), and only capable of handling downstream processes. Only 1% of the vaccines Africa needs are produced within Africa, while consuming 25% of the global vaccine supply (34). Diagnostic production capability is similarly low. In Ethiopia, the plan to "… increase the contributions of local manufacturers in supplying EPSA [Ethiopian Pharmaceutical Supply Agency] to 60% are far behind 2020 targets" (35).

Approaches to develop non-African solutions to perpetual African health problems, such as the Product Development Partnerships (PDPs) have failed. For example, in a period spanning 30 years, while over 1500 new molecular entities have been developed, only 21 of these were for diseases of poverty, including TB (36). The recent establishment of the Africa Medicines Agency is a step in the right direction. Similarly, the Partnerships for African Vaccine Manufacturing (PAVM), the African Medicines Regulatory Harmonization (AMRH) and African Vaccine Regulatory Forum (AVREF) are important initiatives for improving access to medicines. However, for Africa to produce its essential medicines within its boundaries requires a lot more. Multiple inter-related capabilities must be built — medical discovery and development expertise, transformation of the academic environment, medical discovery infrastructure, investment in basic sciences, clinical development

and regulatory capabilities, quality assurance, fully functional industries with Good Manufacturing Practice standards, full engagement of the private sector, and government leadership. The current technology transfer and funding mechanisms have to be drastically restructured (36). A land-locked country with a large population, such as Ethiopia, must commit to produce its essential medicines, including those required to respond to any public health emergencies within its territories. This makes not only public health sense but is also needed for effective economic growth and national security (Figure 3)

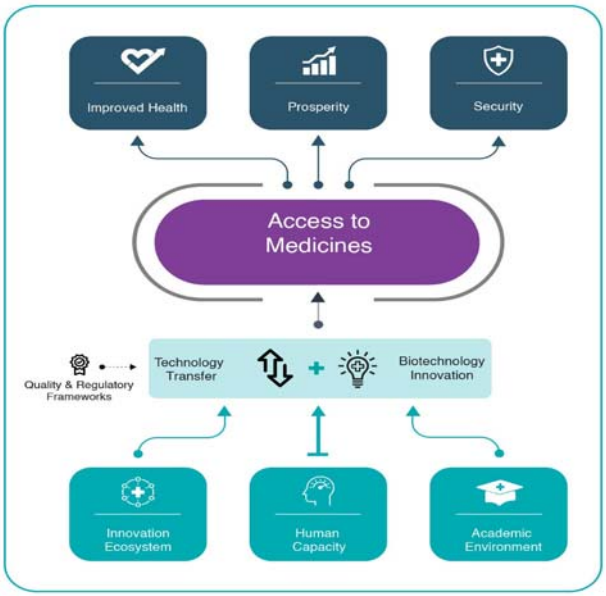

Figure 3 :Required inputs for improving access to medicines and potential impact

Conclusion

Albert Camus astutely predicts the future of pandemics: *"Everybody knows that pestilences have a way of recurring in the world; yet somehow we find it hard to believe in [the] ones that crash down on our heads from a blue sky. There have been as many plagues as wars in history; yet always plagues and wars take people equally by surprise."* There is a high likelihood that Camus will be right again. The commitment of the international community to act on its expressed desire of ensuring equal access to essential drugs, diagnostics and vaccines during pandemics has been very low. Africa must have the essential capabilities that would allow it to engage with any health threats on its own terms and resources. At the core of this, freedom is the capacity of researchers within Africa to conduct fundamental therapeutic discovery and development research.

Funders and African governments should create new mechanisms to support local technology innovations, including medical discovery capabilities. These local capabilities will have major transformative impact that goes far beyond the prevention or control of pandemics.

Such local capabilities will open the opportunity to use the untapped knowledge and biodiversity of Africa to address not only the perpetual health challenges of the continent but also assist in finding solutions for global health challenges such as cancer.

While the potential of partnerships is obvious, new models of partnerships in the current highly competitive global environment are needed to encourage congressive relationships.

Abbrevations /Acronomys

COVID 19: Coronavirus Disease 2019
AI: Artificial Intelligence
AMRH: the African Medicines Regulatory Harmonization
AVREF: African Vaccine Regulatory Forum
CDT-Africa: Centre for Innovative Drug Development and **Therapeutic Trials for Africa**
PAVM: Partnerships for African Vaccine Manufacturing
PDPs: Product Development Partnerships
UNECA: United Nations Economic Commission for Africa

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication:

Not applicable

Availability of data and material:

Not applicable

Competing interests:

The authors declare that they have no competing interests.

Funding:

This work is part of the thematic research work that received funding from Addis Ababa University through the Thematic Research Grant scheme [Grant ID: LT/PY-045/2021]. The work is coordinated by the Unit for Health Evidence and Policy (UHEP) at CDT-Africa, which is supported financially by the Wellcome Trust [Grant ID: 221576/Z/20/Z]. CDT- Africa is a world bank supported academic center of excellence of the Addis Ababa University [Grant Id: P151847-IDA57940].

The views expressed in this publication are those of the author(s) and not necessarily those of Addis Ababa University, the Wellcome Trust or the World Bank supporting CDT-Africa.

Acknowledgement

We thank the CDT-Africa administrative staff for successfully organizing study activities.

Supplementary Material:

None

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Ethiopian Medical Journal 2022, 60(Supplement 1)
ISSN 0014-1755 eISSN 2415-2420

Original Article

Epidemiologic pattern of COVID-19 pandemic in East Africa

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Abstract

Introduction: *Coronavirus disease 2019 (COVID-19) is a global pandemic upending the health, political and economic landscape of the world. Knowledge about COVID-19 has evolved very fast and the epidemiologic pattern is far from comprehensive. Therefore, the primary aim of this study was to map the epidemiology of COVID-19 in Ethiopia in the past two years and to draw lessons for effective control measures.*

Methods: *A prospective synthesis on reports of new infections and mortality due to COVID-19 infection in Ethiopia from the first index case report in March 13, 2020 until June 20, 2022. Number of new cases, deaths and recoveries were extracted on daily bases from publicly available sources. Descriptive analysis was conducted, and trends were graphically depicted.*

Results: *Ethiopia is currently in the fifth wave of COVID-19 pandemic, sharing the global trend. So far, more than 5 million tests were carried out with 484,536 people (9.58%) with confirmed disease. The severity rate has declined with every wave with the most severe illness having occurred in the first wave and the least severe in the latest wave. Thus, the Case Fatality Rate (CFR) has declined from 4.7 in the first wave to 1.5 in the 4th wave. So far, 21% of the population has been fully vaccinated.*

Conclusion: *While the decline in mortality is encouraging, knowledge about the pandemic and vaccination trends remain poor. Continued efforts to understand the pandemic in Ethiopia and addressing barriers to vaccination are urgent priorities.*

Keywords*: COVID-19, epidemiologic pattern, global pandemic, public health control*

Citation : *Wondimagegnehu A, Yirgu R, Fekadu B, et al , Epidemiologic pattern of COVID-19 pandemic in East Africa. Special issue of Ethiop Med J 60 (Supplement 1) 12-20*

Submission date : *10 April 2022 Accepted: 11 August 2022 Published: 30 October 2022*

Introduction

The novel coronavirus disease first emerged in Wuhan city, China, with a cluster of unknown pneumonia cases diagnosed in December 2019 [1]. In less than three months, the outbreak has reached multiple continents and was declared a pandemic on March 11, 2020 [2]. By June 20, 2022 the disease has affected 228 countries and territories of the world with more than 546 million infections and 6.3 million deaths [3]. The pandemic revealed how interconnected the world is and exposed how the health care system globally, not just systems in low-income settings, was unprepared to deal with major public health threats [4]. In this globalized and interconnected world, an outbreak of a highly contagious infectious disease in one country can spread quickly across the world. Improved early detection and preparedness play a crucial role in preventing an outbreak from having an extensive impact [5].

In addition to its catastrophic effect on the health care system, the coronavirus pandemic has created several disruptions of systems worldwide including education and economy [6]. Before the pandemic, the world was already facing an education crisis

and COVID-19 exacerbated pre-existing disparities between developed and developing countries. Closures of schools and other learn-ing spaces have impacted 94 percent of the world's student population, up to 99 percent in low and lower-middle income countries [8]. It has taken 1.6 billion learners out of school in more than 190 countries and all continents [7, 8].

According to the world economic forum report, students now risk losing $17 trillion in lifetime earnings in present value, or about 14% of today's global GDP, because of COVID-19 related school closures and economic shocks [9]. The pandemic has also caused short and long-term damage to economies and living standards for many people. It has put unprecedented pressure on governments to maintain essential services and keep their economies running. The virus threatens people's daily life on every level and the situation is worse in low- and middle-income countries particularly in Sub-Saharan Africa [10,11].

Knowledge about COVID-19 and its pathogenesis has evolved quickly. Relatively consistent findings were reported on the clinical manifestations [12-15], mode of transmission [3, 16], and its risk factors [13, 17, 18]. The overall burden of the disease, particularly the number of confirmed cases and deaths across the world, is changing constantly to the extent that predicting the future epidemiologic pattern has proven difficult. The varying case fatality rate in different countries also warrants explanation [3, 19].

Even though the discoveries of several vaccines and supportive treatments brought a significant reduction in the transmissibility and severity of the disease, countries have to monitor the epidemiologic pattern continuously and closely to put in place appropriate public health control measures, which can be adapted to changing disease patterns. This is particularly important in the current pandemic where the emergence of new variants continues to be a major public health concern.

This study aimed to determine the epidemiology of COVID-19 in Ethiopia and look into a change in the disease pattern driven by major events in the past two years. We also aimed to draw lessons from past and ongoing public health control measures and their effect on the disease pattern.

Methods

Study design and selected countries

A prospective synthesis approach was used to evaluate COVID-19 incidence in Ethiopia and mortality secondary to the infection in the past 26 months (March 13, 2020 to June 20, 2022). In addition, the number of new and total number of COVID-19 cases in Ethiopia were compared with neighboring East African countries namely: Eritrea, Sudan, Kenya, Somalia, and Djibouti. Subsequently, the proportions of incident cases from these five countries were compared.

Data abstraction and analysis procedures

Quantitative data on the number of new cases, deaths and recoveries were obtained from the data bases available at the Worldometer [3], our world in data [19], Johns Hopkins University [20], World Health Organization (WHO) [1], and Africa Center for Disease Preventions and Control (Africa CDC) [21, 22]. These databases were selected as they are the main sources of COVID-19 related global data and they provide reliable, original, and comprehensive data about the pandemic. Ethiopian Health Data [23], Ethiopian Public Health Institute (EPHI) [24], and the Ethiopian Ministry of Health websites [25] were reviewed as the main sources of data at the national level.

Publications in the British Medical. Journal, JAMA, the Lancet, Nature, and the New England Journal of Medicine were reviewed to identify typical interventions and explore the explanations for the outcomes. Articles published in local journals such as Ethiopian Medical Journal and Ethiopian Health Development were reviewed as important repositories of local knowledge. Scientific justifications were also sought by attending different webinars [26], international and national debriefings, and meetings as well as news media and expert opinions.

We tracked number of daily tests, new cases, and number of severely ill and dead on a daily basis between May 1, 2021 and June 20, 2022, the period when such details became available. Data from the reports were extracted into Microsoft Excel 2013 for analysis. Descriptive analysis was conducted to calculate frequencies, proportions, and positivity and severity rates. The case fatality rate was computed by dividing the total number of deaths due to COVID-19 by the total number of COVID-19 cases. The positivity rate was calculated by dividing the number of positive tests by the number of total COVID tests. Line graph, area graph, and bar graph were used to depict trends. The distribution of the cases was presented using a map of Ethiopia.

Throughout the process, the multidisciplinary research team of the knowledge synthesis unit (now Unit for Health Evidence and Policy) at the Center for Innovative Drug Development and Therapeutic Trials for Africa (CDT-Africa), Addis Ababa University, had virtual meetings at least three times per week in the first year of the pandemic and as frequently as needed in the year 2021. Findings of relevance, timeliness, methodological, and scientific plausibility of the extracted information were discussed in these meetings.

Result

By June 20, 2022, there were a total of 484,536 cases, 7524 deaths and 458,374 recoveries from COVID-19 in Ethiopia (Fig 1). This is the highest number of cases reported in East Africa followed by Kenya (329,605cases) and Sudan (62,521cases). Two third (66.89%) of the total COVID-19 cases were reported from Addis Ababa, 15.02% from Oromia and 5.37% from SNNPR regions (Fig 1).

Eritrea has a relatively low number of cases (9777 cases) in the region and only 103 deaths were reported as of June 2022. However, by considering the total population in these countries, Djibouti is the leading country with a total of 15,656 cases per one million population while Ethiopia was the third country with 4,110 cases per million people (Fig 2).

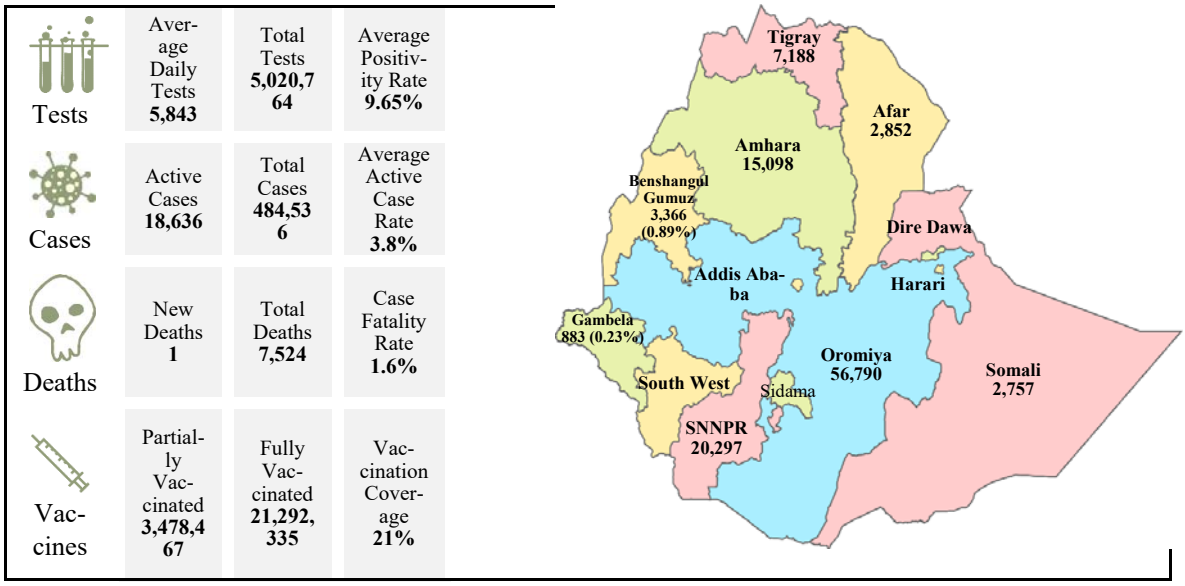

Figure 1: Profile of COVID-19 tests, cases, vaccine coverage and deaths in Ethiopia since the first report of COVID-19 to June 20, 2022, and case distribution by region (up to Jan 31, 2022).

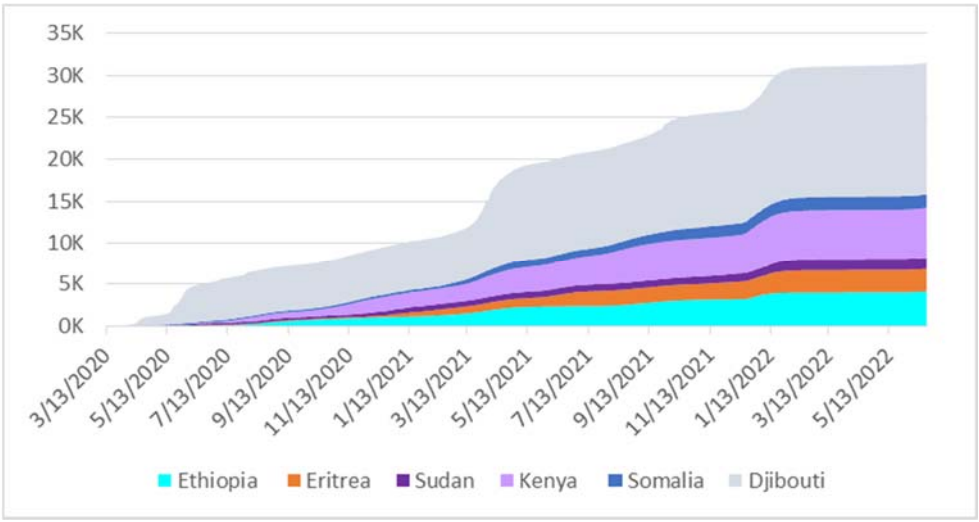

Figure 2: Total COVID-19 cases per million in Ethiopia comparing with neighboring countries from March 13, 2020 to June 2022

Ethiopia is currently on the fifth wave of COVID-19. In the first three months of the pandemic, the number of new cases was increasing slowly as almost all cases were identified among the people isolated in quarantine centers. Subsequently, the community transmission began to exceed the reports from quarantine centers with most of the cases identified through active surveillance and contact tracing. As a result, this number rose swiftly, especially starting from July 2020 until October 2020.

The second wave occurred between February 2021 and May 2021 while the third continued from August 2021 until Mid-November 2021.

The third and the biggest wave so far started in mid-December 2021 and the highest number of new cases (5,185 cases) was reported on December 28th, 2021. The fifth wave started in Mid-May 2022, and the number of new cases has continued to rise. Similarly, neighboring countries have experienced similar pattern of COVID-19 waves over the past 26 months except for Kenya, which is passing through a sixth wave (Fig 3).

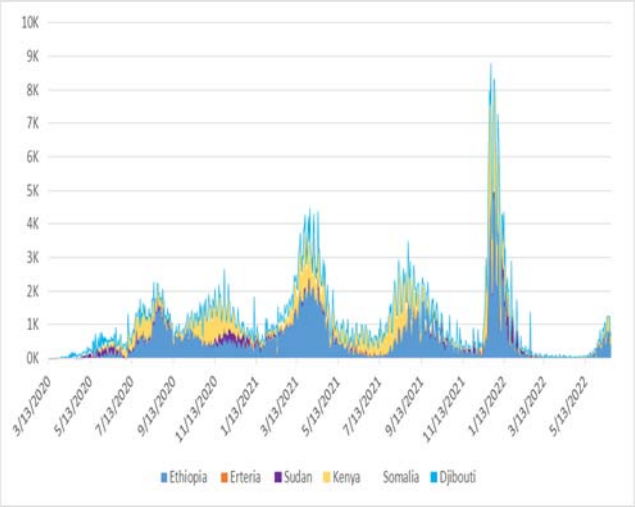

Figure 3: Number of new COVID- 19 cases and disease waves in Ethiopia compared with neighboring countries, June 2020 to June 2022

Next to Eritrea, a comparably lower number of deaths (63 deaths per million people) was reported in Ethiopia. Even though Djibouti is one of the countries in the region with a low absolute number of cases (15,690 cases), the relative number of deaths reported until the date of reporting was higher (188 deaths per million people) compared to other neighboring countries (Fig 4).

At the beginning of the pandemic, the Case Fatality Rate (CFR) in three of the countries was high ranging between 8.3 in Somalia to 4.7 in Ethiopia. The rate has gradually declined to below 2 (Supplementary file 1).

Ethiopia started in country Polymerase Chain Reaction (PCR) tests for SARS-CoV-2 in February 2020 in just one center until 2nd April when the testing centers increased to three. By the end of July 2020, the number of laboratories has increased to 46 and the overall testing capacity reached 11,000 tests per day. Initially, the testing was only for suspected cases and those with special indications.

The testing case definition then expanded to include all people under mandatory quarantine, those in the Intensive Care Unit (ICU), all those with respiratory symptoms, and essentially all deaths in hospitals. Currently, there are laboratories all over the country that perform both PCR and rapid tests. As of June 20, 2022, a total of 5,020,764 laboratory tests were carried out with a positivity rate of 9.58% (Fig 1). The severity rate was high relative to positivity rates in the second and third waves of the epidemic. However, the severity rate was declining over time despite the rising positivity rate during the fourth and fifth waves (Fig 5).

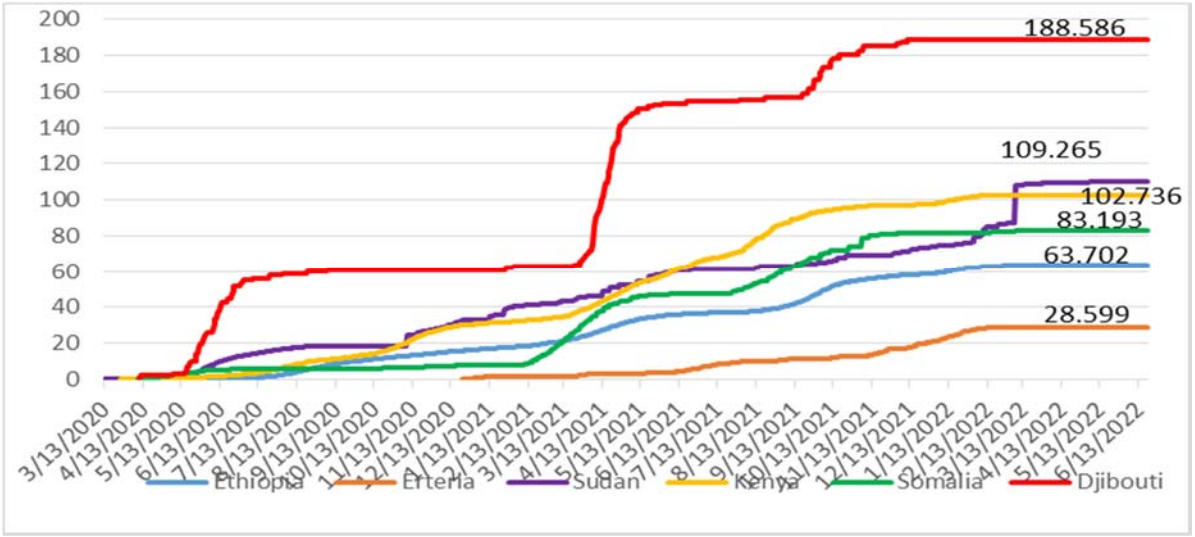

Figure 4: Total COVID-19 deaths per million from March 13, 2020 to June 2022

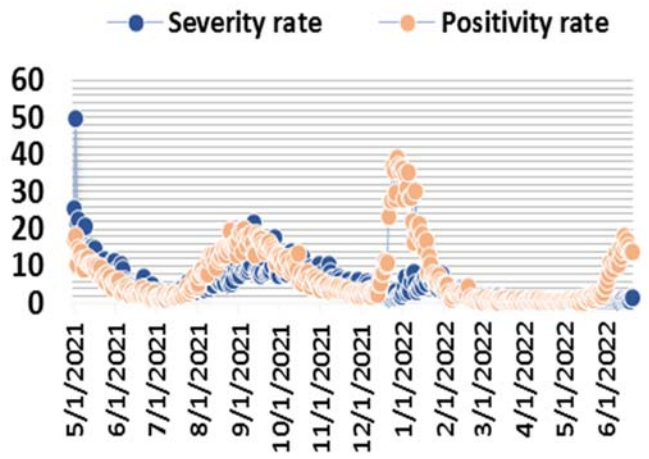

Figure 5: Ethiopia- COVID-19 Test Positivity and Severity Rates, May 2021 to June 2022

Ethiopia has administered at least 50,868,663 doses of COVID vaccines which accounted for 21 % of the country's population. Out of this, 21,292,335 (18 %) were fully vaccinated. A similar proportion of people (19%) were vaccinated in Djibouti with the vast majority fully vaccinated (15%). Kenya has the highest vaccination coverage (23%) in the region and more than two third were fully vaccinated (Fig 6).

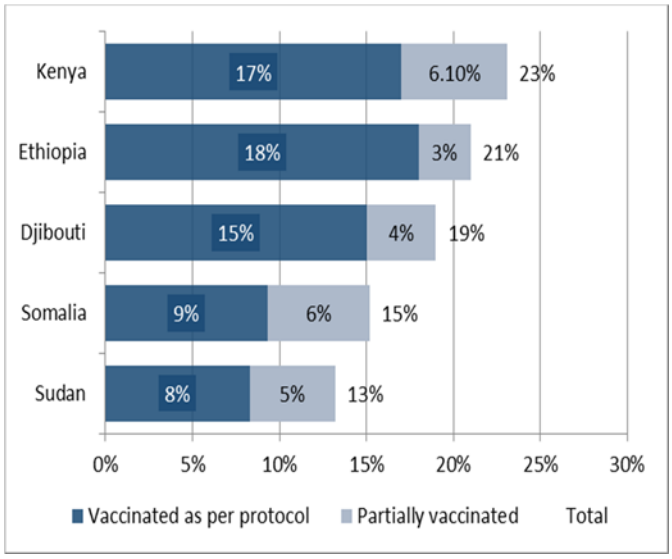

Figure 6: COVID-19 vaccination coverage in East African countries, June 2022

Discussion

In this study, we described the overall pattern of COVID -19 infection in Ethiopia over the past two years. Nearly half a million COVID-19 cases and more than 7500 deaths have been reported. Majority of the cases were reported from Addis Ababa possibly because, by the virtue of it being the capital city, is the primary epicenter of the disease. In addition, having more diagnostic centers than the remaining regional states in the country and mandatory COVID-19 tests for international travelers might have contributed to the high number of cases. Several reports have revealed that cities are more vulnerable to COVID-19 and the pandemic has brought some of the world's wealthiest global cities to their knees. New York, London, Nairobi, Lagos, and other Africa's largest cities were some of the witnesses of this [27, 28].

Although epidemiologic projections of the pandemic forecasted rapid transmission and subsequent catastrophic losses in Africa, the number of cases remained relatively low compared to other continents and the number of deaths was also minimal. This might be due to the delay in the onset of the pandemic that has given a rare opportunity for African countries to get prepared for and apply the recommended public health measures early on. The disparity in the number of cases and deaths in East African countries may be explained by the difference in total population, way of aggressively implementing public health control measures, mass testing, and vaccine coverage.

Several studies reported that non-pharmaceutical control measures were more effective in reducing the transmission of SARS-CoV-2 particularly during the first wave of the disease. Early implementation of such public health control measures helped to flatten the curve in different countries such as China, South Korea, Singapore, Germany [29-32] and averted an estimated 3 million deaths in 11 European countries [33]. Likewise, preparation to mitigate the spread of COVID-19 in Ethiopia was initiated as of the end of January 2020. Public health emergency operating centers were activated; screening at Bole international airport commenced, isolation and treatment centers were designated, and testing was initiated in early February with aggressive contact tracing and isolation. Schools and offices were also closed. Mandatory quarantine was announced for all incoming travelers, a five-month national state of emergency was declared, granted a pardon for 20,402 prisoners and parliamentary elections were officially postponed. International flights were also halted, testing capacity was expanded, and additional treatment centers were designated in different parts of the country [18, 26, 34, 35].

Despite these public health measures, the number of new cases was increasing, especially after the end of May 2020. The progressive decline in adherence to the control measures with the early reopening, increased movement of people for holidays, a national protest following the assassination

of the Ethiopian singer, and reopening of schools might have contributed to the first wave of the disease. Some countries such as the USA, Singapore, and South Africa have also witnessed the consequences of early reopening and loosening control measures [36 - 38]. Although subsequent waves follow surges in other parts of the world, major national events such as the election held in June 2021and the ongoing conflict in the north that began on November 3, 2021, may also have contributed to the second and third waves of COVID-19 in Ethiopia.

The low number of deaths in Ethiopia, and the continent more generally, is justified by the young population dominated demographics of the continent. Though the evidence is far from conclusive, the hot and humid tropical climate is also hypothesized to be unconducive for the virus and might reducing the risk of infection [39]. The possible explanation for the low severity rate, particularly after the second and third waves of the pandemic, can be due to immunity acquired through primary infection and the discovery of COVID-19 vaccine. Several studies proved that the vaccine has remarkably reduced severe or critical COVID-19-related hospitalizations and deaths [40 -42]. However, the significant decrement in the severity rate while the positivity rate was increasing during the fourth wave might be explained by the nature of the omicron variant. This variant is less severe than previous strains [43]. It is less able to penetrate deep lung tissue and 91% less fatal than other variants, with 51% less risk of hospitalization [44, 45].

Although a booster (third) dose of the COVID-19 vaccine is being administered widely all over the world [46, 47], the vaccine coverage in Ethiopia (21%) is still very low compared to the global average (66.4%) and that of developed countries: 86.0% in Canada, 82.3% Japan, 78.5% United Kingdom, 78.1% United States and 76.9% in Germany [19]. Irregular and limited vaccine supply and hesitancy might be the main reasons for the low coverage in the country (48,49). Therefore, more must be done to increase vaccine supply and uptake to speed up the control of the pandemic.

Some of the limitations of this study are in our review we prospectively extracted the data from some reliable databases. However, all the other sources were not explored. Our conclusions were mainly based on the data we gathered from these sources, and this may not consider the existing variations in those countries, particularly in relation to testing capacity and several other factors. Some countries have not reported some basic data, for example, vaccine coverage. It was not clear whether this was because vaccines were not offered or because these were simply not reported.

CONCLUSION

The pandemic is still evolving with recurrent waves and variants reported worldwide. The poor access to effective antiviral treatments, and low vaccine coverage in conjunction with the fragile health system in Africa calls for ongoing cautious monitoring. Despite the availability of vaccines, the current pattern of the disease also suggests that effective control measures should consistently be implemented to prevent subsequent waves of the pandemic. Urgent action and additional mitigation measures should be taken to improve vaccine uptake in Ethiopia.

Abbreviations

Africa CDC: Africa Center for Disease Preventions and Control; **CDT- Africa:** Centre for Innovative Drug Development and Therapeutic Trials for Africa; **CFR:** Case Fatality Rate; **COVID-19:** Coronavirus Disease of 2019; **EPHI:** Ethiopian Public Health Institute; **ICU:** Intensive Care Unit; **PCR**: Polymerase Chain Reaction; **SARS-CoV-2:** Severe Acute Respiratory Syndrome Coronavirus 2; **SNNPR:** Southern Nations, Nationalities, and Peoples' Region.

Declarations

Ethics approval and consent to participate

Not applicable for this study as the data were extracted from publicly available global and national data sources.

Consent for publication: Not applicable

Availability of data and material: The source datasets used and/or analysed during the current study are publicly available. The extracted data sets are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding:

This research received funding from Addis Ababa University through the Thematic Research Grant scheme [Grant ID: LT/PY-045/2021]. Additional support was obtained from the National Institute for Health Research (NIHR) Global Health Research Unit on Health System Strengthening in Sub-Saharan Africa, King's College London [Grant ID: GHRU 16/136/54] using UK aid from the UK Government to support global health research. The work is coordinated by the Unit for Health Evidence and Policy (UHEP) at CDT-Africa which is supported financially by the Wellcome Trust [Grant ID: 221576/Z/20/Z]. CDT-Africa is a world bank supported center of excellence [Grant Id: P151847-IDA57940]. The views expressed in this publication are those of the author(s) and not necessarily those of Addis Ababa University, the NIHR or the Department of Health and Social Care or the Wellcome Trust or the World Bank supporting CDT-Africa.

Authors' contributions
AF, AW, MK and RY conceived and designed the study. AW, BF, HN and ST extracted the data from the data sources. AW, RY, MS, RB and GM performed the data analysis and interpretation of the findings. AW and RY drafted the manuscript. AF and RY were actively involved in data interpretation and critically reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgements
We thank the CDT-Africa administrative staff for successfully organizing study activities. Authors also express their appreciation to Prof Martin Prince from King's College London for supporting this work.

Supplementary Material
Supplementary file 1: Case fatality rate of COVID - 19 in Ethiopia compared with neighboring countries.

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Supplementary Material—https://bit.ly/3Wwtozh

Ethiopian Medical Journal 2022, 60 (Supplement 1)
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Creative Commons Attribution Licence [CC by 4.0]
ISSN 0014-1755 eISSN 2415-2420

Original Article

Disparities in socioeconomic effects of COVID-19: Exploration of 11 rounds of panel data from high frequency phone survey of households in Ethiopia

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Abstract

Introduction: *Public health control measures were crucial to curb the health crisis of Corona Virus Disease 2019 (COVID-19). However, these control responses, along with health system fragility and import dependence, are also likely to lead to significant socioeconomic crisis. This study aimed to present empirical evidence on the socio-economic effects of COVID-19 in Ethiopia exploring how differences in effects varied by gender and wealth.*

Methods: *Eleven rounds of panel data from the COVID-19 high frequency phone survey (HFPS) conducted among households in Ethiopia were used. Data were collected between April 2020 and May 2021 among 3249 households in Round 1, which eventually waned and reached 1982 households in Round 11. Employment, income loss, and food insecurity experiences were used to measure economic impacts. Adjusted sample weights were applied to address potential selection bias associated with phone surveys. In addition, we employed reduced panel data economic regressions to estimate the change in outcomes over time and examine differences by gender and socioeconomic status.*

Results: *There was a significant adverse socioeconomic effect in terms of job loss, income loss and food insecurity. The effect was particularly pronounced during the early months of the pandemic with subsequent lingering effect observed in all the rounds. Disparities in outcomes, particularly employment and food insecurity, were observed by gender and wealth status.*

Conclusion: *The early public health measures may have contributed to the socioeconomic shockwaves, with clear indications of disparity. Policy measures should consider the needs of those groups in society predisposed to inequity, and factors that may worsen economic impact, such as import dependence for essential therapeutics.*

Keywords*: COVID-19, Ethiopia, employment, income loss, food insecurity, equity, pandemic policy response*
Citation : *Assefa E, Medhin G, Hailemariam D, et al , Disparities in socioeconomic effects of COVID-19: Exploration of 11 rounds of panel data from high frequency phone survey of households in Ethiopia..Special issue of Ethiop Med J 60 (Supplement 1) 22-31*
Submission date : *10 April 2022 Accepted: 26 August 2022 Published: 30 October 2022*

Introduction

The COVID-19 pandemic has created a major health and economic crisis worldwide. In addition to the tragic loss of human life, what became apparent as the pandemic was raging and governments started taking public health measures in response, was the serious socioeconomic consequences.

The macroeconomic impact was felt shortly afterwards, where the global economy (measured by real Gross Domestic Product growth) contracted by -3.4% in 2020 with some recovery at 5.5% in 2021 but a projected slowing down with 4.1% growth in 2022 (1). The pandemic has led 97 million more people into poverty (2) reversing some of the gains in poverty reduction prior to the outbreak.

Households have been affected by COVID-19 associated shocks in various ways. Notably, the pandemic has adverse socioeconomic impact such as reduced labour force participation, unemployment, loss of earnings, food insecurity, and access to basic services (3–6). Severe health system fragility along with import dependence for essential health commodities may intensify the economic impact (7). The health system capability is an important consideration because it may affect workforce participation in economic activities and increases the cost of health service utilization markedly.

Furthermore, COVID-19 has brought to the fore inequities in its impact that are associated with already existing gender, racial or socioeconomic inequalities (4,5). There are attempts to examine the socioeconomic impact of COVID-19 in Ethiopia. The existing few studies relied on data early into the pandemic or on specific geographical locations (6,8–14). The aim of this study was to examine the effects of COVID-19 in Ethiopia with a focus on employment, income loss and food insecurity. The study provides empirical evidence and national level estimates about the impact of COVID-19 using 11 rounds of panel data from representative households and adjusting sample weights to ameliorate potential selection bias. In addition, it explores how differences in socioeconomic outcomes vary by gender and household wealth status to understand the equity implications of the impact of COVID-19. We used data from extended survey rounds covering repeated observations over one year period, which is far beyond some of the earlier studies that used the same dataset relied on, providing evidence on the effect of COVID-19 better than the snapshots the earlier studies provided.

Materials and Methods

Data source

The study used longitudinal data from the World Bank (WB)'s COVID-19 high frequency phone survey (HFPS) (15). The HFPS sample is a subsample of households who took part in the latest round (2018-19, wave 4) of the Ethiopia Socioeconomic Survey (ESS) (16). The HFPS sampling procedures are detailed in the survey's website (17). But to briefly describe, the ESS is conducted among a nationally and regionally representative sample of households and a total number of 5,374 households who provided at least one valid phone number in wave 4 formed the sampling frame for the HFPS. The target sample household size to achieve representativeness at national level as well as urban and rural strata was 3,300 (17). Twelve rounds of HFPS data are collected to date. The final sample size ranged from 3,249 households in Round 1 to 888 in Round 12. The anonymised HFPS data and documentations are publicly available for use through the WB Microdata Library (18). This study draws data from the first 11 rounds since Round 12 focuses on outcomes among the youth population such as aspirations and employment.

Round 1 survey was conducted during the period of 22 April and 13 May 2020 and Round 11 surveys between 12 April and 11 May 2021 (18), providing repeated observations among households over approximately one year period. However, different rounds administered different modules. As a result, data for some outcome variables are not available in all rounds. (See Supplementary Material 1 for summary information on the survey rounds including total sample size and sample size stratified by urban and rural areas.).

Outcomes and measurement

Employment

The question about employment uses two timeframes - employment in the immediate seven days (current employment) and employment during the previous month (previous employment). The question about 'current employment' asks whether the respondent did any work to generate income last week. This is a binary variable taking the value 1 if they are currently working and 0 otherwise. The question about 'previous employment' asks respondents whether they were working during the early months in the pandemic (Round 1) or before the last survey call (subsequent rounds). Similarly, the previous employment variable takes binary responses indicating whether respondents were previously working (1) or not working (0). For respondents who were not working in the previous month (previous employment), further questions elicited reasons for stopping work. We rely on this information to explore various reasons for work stoppage.

Income change

Participants provided information on the various sources of household income. They were also asked to qualitatively evaluate if there was change in income from different sources compared to the pre-pandemic level (Round 1) or previous survey rounds (subsequent rounds). Following Josephson et al. (3), we construct income change indicators to signify changes in income conditional on different income sources they reported. The indicators capture changes in income from farming, non-farm business, wage, remittances, other sources (such as income from properties, investments or savings, pension and assistance) and any change in income if there is a change in income from any of these sources. These indicators were measured as a binary response variable where 1 indicates households reporting a decline in income (partial or total loss) and 0 otherwise (remained the same or increased).

Food insecurity

Food insecurity, assessed in the previous 30 days, was measured using the Food Insecurity Experience Scale (FIES) (19). The FIES assesses households' experiences of food insecurity with eight items that ask about their conditions of access to food of adequate quantity and quality (19,20).

Specifically, the FIES questions solicit responses to whether the respondent or other adult household members, because of a lack of money or other resources, (a) were worried they would not have enough to eat, (b) were unable to eat healthy and nutritious food, (c) ate only a few kinds of foods, (d) had to skip a meal, (e) ate less than they thought they should, (f) ran out of food, (g) were hungry but did not eat, or (h) went without eating for a whole day. It was administered in seven rounds (Rounds 1 to 6 and 11) but only the first three items were administered in Round 1. In this study, we did not create a summary measure of food insecurity to categorise across different levels of food insecurity. Instead, analysis for all the FIES items was separately performed and presented.

Disparity by gender and wealth

We examined for differences in economic outcomes by gender and wealth. To that end, gender of the household head and pre-pandemic household consumption quintile were used. The latter variable was used as a proxy for pre-pandemic wealth or economic status. It ranks households from the lowest (poorest) to the highest (richest) quintile and is calculated based on household per capita consumption expenditure, which came from the ESS conducted before the COVID-19 outbreak.

Data analysis

Various statistical approaches were employed to examine the effects of COVID-19. First, the mean values of the outcome variables were estimated. HFPS is prone to selection bias, owing to factors such as differences in phone ownership or lower response rate of phone surveys compared to face-to-face, and poses a challenge in the representativeness of the sample and making population level inferences (21,22). Following suggestions and similar works (3,21,22), adjusted sampling weights that correct for potential selection bias were applied in estimating the mean values. These values provide an estimate of an average household-level incidence of a given outcome variable. For example, the weighted mean for business income loss variable provides an estimate of the average household-level incidence of business income loss. Second, the adjusted sampling weights can allow us making inferences and estimating the total number of people affected (3). Therefore, we estimated the affected total number of households associated with the outcome variables. For instance, the total number estimates for business income loss variable provides estimates of the total number of households experiencing business income loss. Finally, we performed regression analyses to examine the differences in the pattern of the outcome variables across time, gender and socioeconomic status. Taking advantage of the nature of the data, we estimated panel data models instead of using pooled ordinary least square (OLS) methods. We performed several logistic regression analyses. First, we estimated models regressing the outcome variables on time (rounds), which was followed by regressions on gender of household head and consumption quintiles, controlling for time.

Some variables, such as consumption quintiles which are available from pre-pandemic survey, are time invariant and random effects model was estimated. Where appropriate, we applied a Hausman test to compare between fixed and random effects estimates. Data management, cleaning and analysis was conducted using Stata 16 (23). Codes used for data cleaning, panel data preparation from rounds and some of the analyses draw from a similar study (24).

Results

Employment

Overall, about two-thirds of participants (63.4%) reported that they were not currently working (last seven days) during the early stages of the pandemic - Round 1, April/May 2020 (Figure 1, panel (a)). Afterwards, this figure rose initially and subsequently stabilised with the proportion of people who reported not currently working falling. Responses to previous employment (worked last four weeks) also demonstrated a relatively stable proportion of people were not only currently working but also had engaged in some employment activity in the recent past (Figure 1, panel (b)). Although changed later, the previous employment question was posed only for respondents who reported not working currently (previous 7 days). The proportion of people who reported job losses due to COVID-19 were highest (62.5%) in Round 1 and fell over time (Figure 2). However, there was an exception observed in this trend, where reported current unemployment rate in the last rounds, rounds 10 and 11, rose back almost to the level of the early stages of the pandemic.

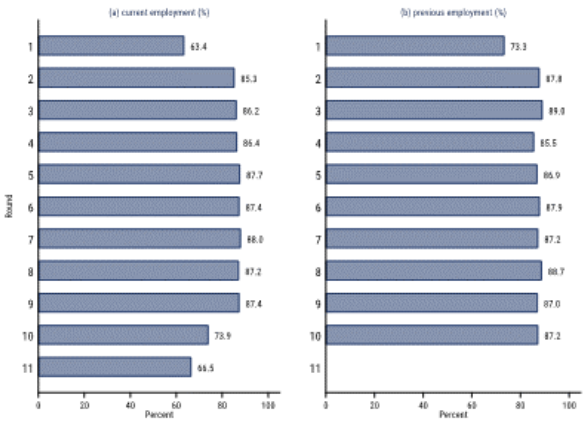

Figure 1. Employment during the COVID-19 pandemic

(a) current employment: percentage of respondents that reported undertaking any work for pay, any kind of business, farming or other activity to generate income, by survey rounds;

(b) previous employment: percentage of respondents that reported working during early months of the COVID-19 outbreak in Round 1 or before the last survey call (approximately four weeks ago) in subsequent rounds, by survey rounds.

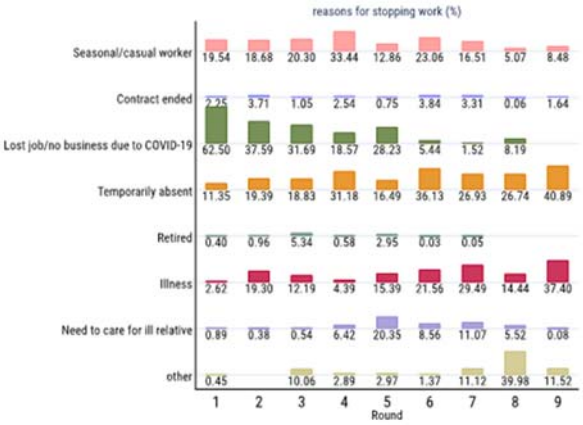

Figure 2. Reasons for stopping work

Reasons identified for stopping work among respondents who reported working during the early months of the COVID-19 outbreak or before the last survey call (four weeks ago) but not currently working, by survey rounds.

The regression results show these observed changes and patterns in employment outcomes were significant (Table 1). State of employment during the pandemic differed significantly by gender and socioeconomic status. Overall, compared to male headed households, female headed ones reported lower levels of current or previous employment, controlling for socioeconomic status and time (Table 1). Similarly, employment outcomes varied significantly by socioeconomic status where, compared to households in the lowest wealth quintile, those in higher quintiles reported lower levels of current or previous employment.

Income loss

At the start of the pandemic, majority (55.7%) of households reported experiencing income loss from one or more of their income sources (Figure 3). Reported income losses started to fall and stabilise overtime. Further breakdown by income sources shows that, across various income sources, high income loss was reported at the start of the pandemic. Those highly hit during the early shock of the pandemic appear to be households operating family businesses and non-farm enterprise. Among households who reported to earn business income, 85.1% experienced income loss at baseline (Figure 3). Although this started to fall, business income loss remained high at 41.9% in Round 6.

Table 1. Regression results of the effect of gender and wealth on employment during the pandemic

	CURRENT EMPLOYMENT	**PREVIOUS EMPLOYMENT**
	GENDER	
MALE	Ref.	Ref.
FEMALE	0.184***	0.167***
	(0.144, 0.233)	(0.127, 0.220)
	CONSUMPTION QUINTILE	
RICHEST	Ref.	Ref.
POOREST	1.753**	2.260***
	(1.120, 2.742)	(1.344, 3.800)
POORER	1.593**	1.715**
	(1.084, 2.340)	(1.103, 2.667)
MIDDLE	0.810	0.914
	(0.577, 1.136)	(0.620, 1.347)
RICHER	0.734**	0.759
	(0.547, 0.983)	(0.543, 1.062)
	TIME	
ROUND 1	Ref.	Ref.
ROUND 2	4.626***	1.935***
	(3.936, 5.437)	(1.606, 2.332)
ROUND 3	5.965***	2.567***
	(5.046, 7.051)	(2.117, 3.112)
ROUND 4	7.214***	1.373***
	(6.059, 8.590)	(1.140, 1.654)
ROUND 5	7.228***	1.750***
	(6.056, 8.626)	(1.444, 2.120)
ROUND 6	7.058***	1.817***
	(5.908, 8.432)	(1.496, 2.205)
ROUND 7	7.783***	1.826***
	(6.470, 9.363)	(1.497, 2.228)
ROUND 8	6.669***	2.058***
	(5.507, 8.076)	(1.666, 2.541)
ROUND 9	7.478***	1.737***
	(6.128, 9.125)	(1.403, 2.150)
ROUND 10	2.610***	1.709***
	(2.196, 3.103)	(1.388, 2.104)
ROUND 11	1.879***	1.935***
	(1.579, 2.235)	(1.606, 2.332)
OBSERVATIONS	28,736	28,073
NO. OF HHS	3,247	3,247
RHO	0.728	0.797

Note:

*** p<0.01, ** p<0.05, * p<0.1

- Odds ratios are reported, 95% confidence interval in parentheses
- The Rho values show the level of variation in an outcome variable that is related to inter-household differences in the variable

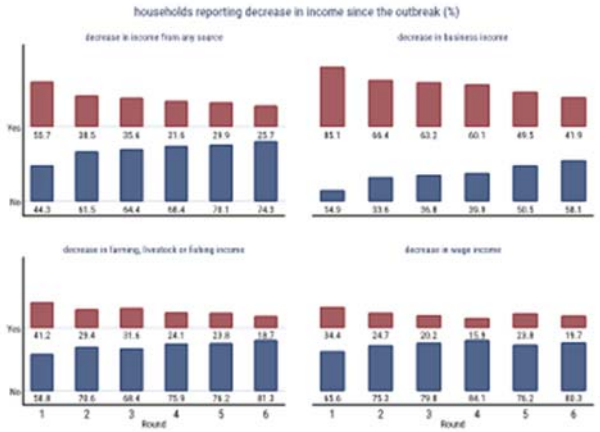

Figure 3. Income loss during the COVID-19 pandemic

Percentage of respondents reporting income loss by survey rounds and selected income sources

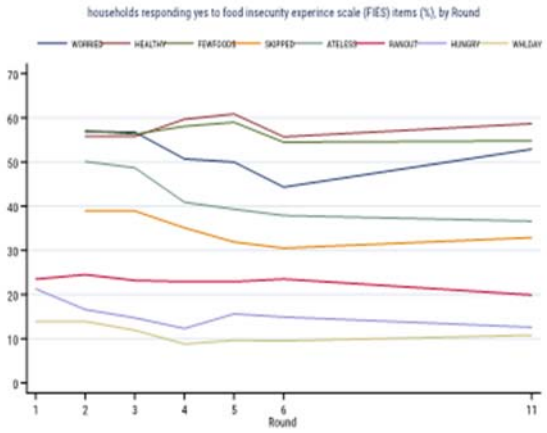

Figure 4. Experiences of food insecurity during the COVID-19 pandemic

Percentage of respondents who reported experiencing food insecurity, by FIES items and survey round

The differences in the households' experiences of income loss and the changes over time were statistically significant (see Table 2 for the regression results). Examining differences in income loss by gender, the effect of gender was significant among households earning income from farming or other sources (such as properties, investments or savings, pension and assistance). Compared to male headed households, and controlling for socioeconomic status and time, farm income loss was significantly higher among female headed households. The results did not show a clear pattern of significant differences in income loss by socioeconomic status. One notable exception here is income loss from other sources. Compared to households in the lowest strata, those in higher levels of socioeconomic status reported experiencing higher loss of income from other sources.

Food insecurity

Households reported experiencing different levels of food insecurity measured by the FIES food insecurity indicators (Figure 4). Higher proportion of households (ranging between 44 and 61%) consistently reported experiencing food insecurity during the last 30 days across three indicators: worry about not having enough food to eat, inability to eat healthy and nutritious/ preferred foods and ate only a few kinds of foods because of a lack of money or other resources. (Additional details about the incidence of food insecurity and estimated total number of affected households is provided in supplementary material 4.).

The results show experiences of food insecurity varied by gender where female headed households consistently reporting higher levels of food insecurity across all indicators than male headed ones (Table 3). Similarly, poor households reported experiencing higher food insecurity than those with more means.

WORRIED: were worried about not having enough food to eat because of lack of money or other resources during the last 30 days; **HEALTHY**: unable to eat healthy and nutritious/preferred foods because of a lack of money or other resources during the last 30 days; **FEWFOODS**: ate only a few kinds of foods because of a lack of money or other resources during the last 30 days; **SKIPPED**: had to skip a meal because there was not enough money or other resources to get food during the last 30 days; **ATELESS**: ate less than you thought you should because of a lack of money or other resources during the last 30 days; **RANOUT**: ran out of food because of a lack of money or other resources during the last 30 days; **HUNGRY**: were hungry but did not eat because there was not enough money or other resources for food during the last 30 days; **WHLDAY**: went without eating for a whole day because of a lack of money or other resources during the last 30 days.

DISCUSSION

This study presented evidence on the effect of COVID-19 in Ethiopia focusing on employment, income loss, and food insecurity. It further examined potential inequity in impact distribution by evaluating how the effects are felt by different groups with a particular focus on gender and wealth. Several key issues are worth highlighting. The adverse effect of the pandemic was visible across all the outcomes considered. There was an immediate shock felt by households in loss of employment, income loss or experiences of food insecurity in the early months of the pandemic. There was a rebound from the early shock, although there are also observed rises in some outcomes, namely unemployment and food insecurity, almost after a

Table 2. Regression results of the effect gender and wealth on income loss during the pandemic

	Any income	**Farm income**	**Business income**	**Wage income**	**Remittance income**	**Other income**
Gender						
Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Female	0.971	1.442*	1.155	0.971	0.775	0.639***
	(0.815, 1.156)	(0.982, 2.119)	(0.906, 1.472)	(0.695, 1.356)	(0.512, 1.171)	(0.474, 0.863)
Consumption quintile						
Richest	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Poorest	1.497**	1.005	0.742	2.555**	0.928	0.547**
	(1.089, 2.057)	(0.595, 1.696)	(0.430, 1.280)	(1.179, 5.540)	(0.257, 3.352)	(0.304, 0.987)
Poorer	2.000***	1.272	1.014	3.347***	1.450	0.690
	(1.524, 2.625)	(0.766, 2.111)	(0.693, 1.484)	(1.859, 6.027)	(0.663, 3.172)	(0.415, 1.146)
Middle	1.740***	0.912	1.305	2.462***	1.296	1.020
	(1.368, 2.213)	(0.554, 1.503)	(0.933, 1.823)	(1.528, 3.968)	(0.722, 2.329)	(0.673, 1.545)
Richer	1.245**	0.798	0.922	1.608**	1.377	0.927
	(1.012, 1.531)	(0.485, 1.313)	(0.699, 1.216)	(1.109, 2.332)	(0.841, 2.254)	(0.647, 1.328)
Time						
Round 1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Round 2	0.312***	0.544***	0.183***	0.345***	0.161***	0.440***
	(0.271, 0.360)	(0.418, 0.709)	(0.132, 0.254)	(0.266, 0.448)	(0.0955, 0.272)	(0.320, 0.605)
Round 3	0.262***	0.519***	0.165***	0.247***	0.0640***	0.357***
	(0.226, 0.303)	(0.395, 0.682)	(0.118, 0.230)	(0.188, 0.324)	(0.0325, 0.126)	(0.257, 0.494)
Round 4	0.178***	0.288***	0.0943***	0.152***	0.0649***	0.278***
	(0.153, 0.207)	(0.215, 0.386)	(0.0681, 0.131)	(0.114, 0.203)	(0.0342, 0.123)	(0.199, 0.390)
Round 5	0.142***	0.208***	0.0716***	0.185***	0.0547***	0.162***
	(0.121, 0.166)	(0.151, 0.285)	(0.0512, 0.100)	(0.140, 0.245)	(0.0273, 0.110)	(0.111, 0.237)
Round 6	0.0946***	0.154***	0.0343***	0.116***	0.0626***	0.153***
	(0.0802, 0.112)	(0.110, 0.214)	(0.0242, 0.0487)	(0.0854, 0.157)	(0.0329, 0.119)	(0.103, 0.229)
Observations	15,162	4,392	3,732	7,726	1,531	3,394
No. of HHs	3,213	1,268	1,237	1,893	797	1,214
Rho	0.521	0.596	0.316	0.669	0.444	0.415

Note:

*** p<0.01, ** p<0.05, * p<0.1

- Odds ratios are reported, 95% confidence interval in parentheses
- The Rho values show the level of variation in an outcome variable that is related to inter-household differences in the variable

Table 3. Regression results of the effect of gender and wealth on food insecurity during the pandemic

	WOR-RIED	HEALTHY	FEW-FOODS	SKIPPED	ATE-LESS	RA-NOUT	HUNGRY	WHLDAY
GENDER								
MALE	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
FEMALE	1.827*** (1.460, 2.286)	1.801*** (1.461, 2.219)	1.628*** (1.332, 1.991)	1.878*** (1.474, 2.392)	1.664*** (1.339, 2.067)	2.109*** (1.715, 2.594)	1.420*** (1.136, 1.775)	1.525*** (1.205, 1.930)
CONSUMPTION QUINTILE								
RICHEST	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
POOREST	15.37*** (10.17, 23.22)	10.53*** (7.170, 15.46)	7.444*** (5.166, 10.73)	21.72*** (14.11, 33.44)	15.65*** (10.60, 23.11)	5.615*** (3.898, 8.087)	9.266*** (6.357, 13.51)	12.77*** (8.621, 18.90)
POORER	7.427*** (5.231, 10.55)	5.784*** (4.168, 8.027)	4.812*** (3.514, 6.589)	9.506*** (6.535, 13.83)	6.681*** (4.767, 9.362)	3.647*** (2.642, 5.035)	5.016*** (3.563, 7.063)	6.955*** (4.852, 9.968)
MIDDLE	4.946*** (3.629, 6.740)	4.482*** (3.360, 5.980)	3.783*** (2.866, 4.993)	6.600*** (4.714, 9.241)	4.772*** (3.532, 6.447)	3.662*** (2.744, 4.889)	4.554*** (3.337, 6.215)	4.261*** (3.044, 5.966)
RICHER	2.224*** (1.702, 2.907)	2.019*** (1.574, 2.589)	2.009*** (1.580, 2.554)	2.551*** (1.891, 3.442)	2.639*** (2.027, 3.435)	2.226*** (1.723, 2.876)	2.233*** (1.679, 2.971)	2.328*** (1.705, 3.177)
TIME								
ROUND 1†						Ref.	Ref.	Ref.
ROUND 2†	Ref.	Ref.	Ref.	Ref.	Ref.	0.885 (0.756, 1.036)	0.397*** (0.330, 0.478)	0.665*** (0.543, 0.815)
ROUND 3	0.950 (0.823, 1.097)	0.971 (0.844, 1.117)	1.068 (0.931, 1.225)	0.950 (0.810, 1.115)	0.946 (0.818, 1.095)	0.804*** (0.685, 0.943)	0.259*** (0.212, 0.316)	0.437*** (0.351, 0.543)
ROUND 4	0.585*** (0.504, 0.678)	1.357*** (1.177, 1.565)	1.162** (1.010, 1.337)	0.675*** (0.572, 0.798)	0.541*** (0.464, 0.631)	0.885 (0.753, 1.041)	0.276*** (0.225, 0.338)	0.380*** (0.301, 0.479)
ROUND 5	0.517*** (0.445, 0.601)	1.313*** (1.137, 1.516)	1.119 (0.971, 1.290)	0.526*** (0.443, 0.625)	0.522*** (0.447, 0.610)	0.783*** (0.663, 0.924)	0.344*** (0.282, 0.420)	0.394*** (0.311, 0.499)
ROUND 6	0.361*** (0.309, 0.421)	0.961 (0.831, 1.112)	0.836** (0.724, 0.966)	0.415*** (0.347, 0.496)	0.407*** (0.347, 0.478)	0.785*** (0.664, 0.928)	0.304*** (0.248, 0.374)	0.332*** (0.260, 0.425)
ROUND 11	0.740*** (0.627, 0.873)	1.345*** (1.146, 1.579)	0.975 (0.832, 1.142)	0.494*** (0.406, 0.601)	0.481*** (0.404, 0.573)	0.735*** (0.609, 0.887)	0.251*** (0.197, 0.320)	0.428*** (0.327, 0.561)
OBSERVATIONS	16,482	16,482	16,483	16,485	16,483	19,723	19,725	19,726
NO. OF HHS	3,206	3,206	3,206	3,206	3,206	3,247	3,247	3,247
RHO	0.668	0.634	0.615	0.680	0.638	0.607	0.566	0.546

Note:

*** p<0.01, ** p<0.05, * p<0.1

- Odds ratios are reported, 95% confidence interval in parentheses
- The Rho values show the level of variation in an outcome variable that is related to inter-household differences in the variable
- † For the last three items the reference (base) time was Round 1 because data on these items were collected starting from Round 1 and Round 2 was the reference time for first five items since data were collected starting from Round 2.

year into the pandemic indicating a potentially persistent effect of COVID-19.

In addition, the results have shown disparities in outcomes, notably in employment and food insecurity, by gender and wealth. Although relatively lower levels of employment are reported in the last survey rounds, the figure was consistent with results from a national labour survey conducted around the same time that reported a total labour force participation rate of 65% (25). There are no straightforward explanations for the observed fall in employment but this could in part be associated with a marked surge in new COVID 19 cases that coincided with this period (see supplementary Material 5). In addition, the number of participants in the survey has been declining with subsequent survey rounds. The decline was pronounced among participants in rural areas but less so in urban areas (see supplementary Material 1) and recent evidence has shown unemployment is predominant in urban than rural areas (25).

Early into the pandemic, Ethiopia instituted a strict policy response, including closures and stay-at-home requirements. For instance, the average COVID-19 stringency index over a period of six months (mid-March to mid-August 2020) was 76 (100 being strictest) (26). These early measures may have been crucial and in part triggered by an understanding of weak and inadequate health system to handle the health crisis caused by COVID-19. However, this may also have contributed to the early socioeconomic shock and the lingering effects felt by households.

Strong mitigation strategies on potential economic impacts would have been required. In addition, health systems strengthening, and pandemic preparedness may help address not only the health crisis but also mitigate potential socioeconomic impacts of future health emergencies or pandemics (27,28). Furthermore, reducing existing inequities and building resilience of households, businesses, the health system and the economy can help with the recovery from the consequences of COVID-19 and better prepare to address challenges and mitigate the potential socioeconomic impacts of similar health crises (27,29–31).

One of the strengths of this study is that it draws data from publicly available large-scale household survey to highlight the adverse socioeconomic effects of COVID-19. We also applied adjusted sampling weights in our estimations to address biases which phone surveys are prone to. Furthermore, to take better advantage of the panel data, we estimated reduced form panel data models instead of pooled OLS estimations. With all its strengths, the study has certain limitations that future works can address. While it highlights the socioeconomic effect of the pandemic, the focus has been on selected outcomes and further research can help address the issue with broader set of social and economic outcome domains. Similarly, while examining disparities the effect of COVID-19, we employed reduced models only accounting for gender and wealth. Expanded analysis controlling for individual, household, community, or country level factors may help expand the analysis and examining the robustness of the results obtained with the reduced form models.

CONCLUSION

The findings of this study highlighted the adverse consequences of COVID-19 on households in Ethiopia. The results also indicated the role of existing inequities in differently experiencing the burden. Attention should be given in mitigating the burden of the pandemic and control measures on households. System wide pandemic preparedness and systemic resilience should be a priority to deal with potential future health emergencies and associated socioeconomic shocks.

Declaration

Ethics approval and consent to participate:
Not applicable

Consent for publication:
Not applicable

Availability of data and material:
The data used in this study are freely available and can be downloaded from the World Bank Microdata Library: https://microdata.worldbank.org/index.php/catalog/3716.

Competing interests:
The authors declare that they have no competing interests.

Authors' contributions
EA and AF conceived and designed the study. EA performed data extraction, analysis and interpretation. EA and AF drafted the manuscript. All authors read, reviewed and approved the manuscript.

Funding:
This research received funding from Addis Ababa University through the Thematic Research Grant scheme [Grant ID: LT/PY-045/2021]. The work is coordinated by the Unit for Health Evidence and Policy (UHEP) at CDT-Africa which is supported financially by the Wellcome Trust [Grant ID: 221576/Z/20/Z]. CDT-Africa is a World Bank supported centre of excellence [Grant Id: P151847-IDA57940].The views expressed in this publication are those of the author(s) and not necessarily those of the Addis Ababa University, the Wellcome Trust or the World Bank supporting CDT-Africa

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Supplementary 1-5 https://bit.ly/3gZ6CzU

Ethiopian Medical Journal 2022, 60 (Supplement 1)
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Creative Commons Attribution Licence [CC by 4.0]
ISSN 0014-1755 eISSN 2415-2420
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Original Article

Impact of COVID -19 on population health and economic wellbeing in Ethiopia: A national pilot survey

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Abstract

Introduction: *The COVD-19 pandemic has resulted in unprecedented global health and economic crisis, particularly in countries struggling with poverty. We conducted a national survey to understand the economic and health impacts of COVID-19 in Ethiopia.*
Methods: *A pilot, population-based, cross-sectional survey was conducted among adults randomly selected from the Ethio Telecom list of mobile phone numbers. Participants underwent a comprehensive phone interview about the impact of COVID-19 on their economic well-being and the health-related risks associated with COVID-19.*
Results: *Of 4,180 calls attempted, 1194 were answered, of which a successful interview was made with 614 participants. COVID-19 affected the family income of 343 [55.9%] participants, 56 [9.1%] lost their job, 105 [17.1%] perceived high stress in their household, and 7 [1.14%] reported death in their family in the past month. The odds of having a decreased income due to COVID-19 were 2.4 times higher among self-employed [adjusted odds ratio (AOR) 2.4, 95% CI (1.58-3.77)] and 2.8 times higher among unemployed [AOR 2.8, 95% CI (1.35-5.85)] participants. Two-hundred twenty-one [36%] participants had comorbidity in their household with hypertension, 72 [11.7%], diabetes,50 [8.1%], asthma, 48 [7.8%], and other chronic diseases, 51 [8.4%]. Forty-six [7.5%] participants had COVID-like symptoms in the previous month, where cough, headache, and fatigue were the most common.*

Conclusion: *COVID-19 posed serious economic pressure on households. Self-employed and unemployed were the most affected. Continuous surveillance is needed to actively monitor the impact of COVID-19 in the community and safeguard the economic and health well-being of individuals and households.*

Keywords*: Comorbidity, COVID-19, economy, Ethiopia.*
Citation: *Belay W, Manyazewal T, Woldeamanuel Y et al, mpact of COVID-19 on population health and eco nomic wellbeing in Ethiopia: A National pilot survey .Special issue of Ethiop Med J 60 (Supplement 1) 32-39*
Submission date : *10 April 2022 Accepted: 9 August 2022 Published: 30 October 2022*

Introduction

The COVD-19 pandemic has resulted in unprecedented global health and economic crisis, particularly in countries struggling with poverty. It sparked the worst economic sinking and the strikingly high health crisis the world witnessed. The World Health Organization (WHO) declared its supreme alarm in early January 2020 while few countries understood the sense of urgency and took prompt actions (1). It was difficult for many countries to predict what the ultimate impact of the COVID-19 pandemic would be and what investments are needed to mitigate the disease earlier. In current times, while great efforts are underway to advance COVID-19 therapeutics, the continued importance of preventive measures is less credited (2).

COVID-19 was initially divided into four types: mild, moderate, severe, and critical cases (3). However, with the global outbreak of coronavirus, there was increasing evidence that many infections of COVID-19 were asymptomatic although transmissible but they can transmit the virus to others and in Africa, the first COVID-19 case was reported from Egypt on February 14 (4), 2020, and in Ethiopia, the first person with COVID-19 was reported in Addis Ababa on March 13, 2020 (5).

The COVD-19 pandemic has put many groups of people at substantially increased economic vulnerability. The impact of the pandemic has been particularly high among those with existing inequalities, as predicted (6, 7). The world economy is experiencing a historic and unprecedented shock due to the COVID-19 pandemic as the pandemic triggers several shocks simultaneously, including health, supply, demand and financial shocks (8). Efforts by governments to control the COVID-19 pandemic through partial and full business closures unavoidably leads to general decline in economic activities domestically and globally where this contraction in economic activities leads to economic recession (9). Few studies have been conducted to assess the income-related impact of COVID-19 in Ethiopia, to our knowledge, this study was one of the few to assess the impact of COVID-19 nationwide.

Therefore, this national survey aimed to understand the economic and health impacts of COVID-19 in Ethiopia.

Method

Study design and period

This study was a population-based cross-sectional study using telephonic survey. A telephonic survey was chosen as a data collection method considering the pandemic situation to cover a wider geographic area of the country, financial feasibility, and efficiency. This is a pilot study of a much larger cohort to be conducted over 12 months. The study was conducted from September to November 2021.

Participants and variables

Eligible participants were adults (age 18 and above) living in the country, speaking one or more of the three Ethiopian working languages (Amharic, Afan Oromo, and Tigrigna), and with no hearing or cognitive impairment or serious mental illness that impedes interview. The participants were randomly selected from the list of mobile phone numbers available in the country using computer-generated random numbers. Initially, 11 million numbers were computed, from which 30,000 phone numbers were randomly generated. The study reported here uses the first 4180 phone numbers from the 30,000 randomly generated numbers.

Covid-like symptoms were measured using a syndromal assessment as acute respiratory illness (fever and at least one sign/symptom of respiratory disease e.g. headache, cough, fatigue, sore throat, runny nose, shortness of breath, loss of smell and loss of taste). Household comorbidity was also measured as the presence of any diseases including hypertension, heart disease, asthma, tuberculosis, and diabetes mellitus. Mortality was measured as the occurrence of death in the past 4 weeks. The economic impact of COVID-19 was assessed by directly asking participants about the impact of COVID-19 on their economy as well as their households.

Data collection procedure and quality assurance

Data was collected through telephone (mobile phone) interviews. The questionnaire was implemented on an electronic data capture platform. Whenever the phone number is not working or not answered in the first attempt, repeated trials were made up to three times before excluding.

The data collectors took over the data collection work once all the contractual and training was finalized. Data collectors were trained on the instruments and about good ethical practices. The survey procedures and tools were pre-tested with 50 interviews for utility, feasibility, and acceptability, and amendments were made based on the results of the pretest.

Statistical Analysis

Data was analysed using STATA 15.1. Descriptive statistics were conducted using frequency and proportions. Bivaraible and multivariable binary logistic regression analyses were computed to identify independent predictors of study participants' outcomes. Those variables which were screened using the results of the bivariable analysis were entered into multivariable model to control the effect of confounders. Finally, the adjusted odds ratio (AOR) and 95% confidence interval (CI) were estimated, and the level of significance was considered at a *p-value < 0.05*.

Results

Among the 4,180 calls attempted, 1194 calls were answered. While 2986 calls were unavailable, unanswered, switched off, disconnected or hung up, we were only able to conduct a successful interview for 614 participants, yielding a response rate of 51.4%. (Figure 1).

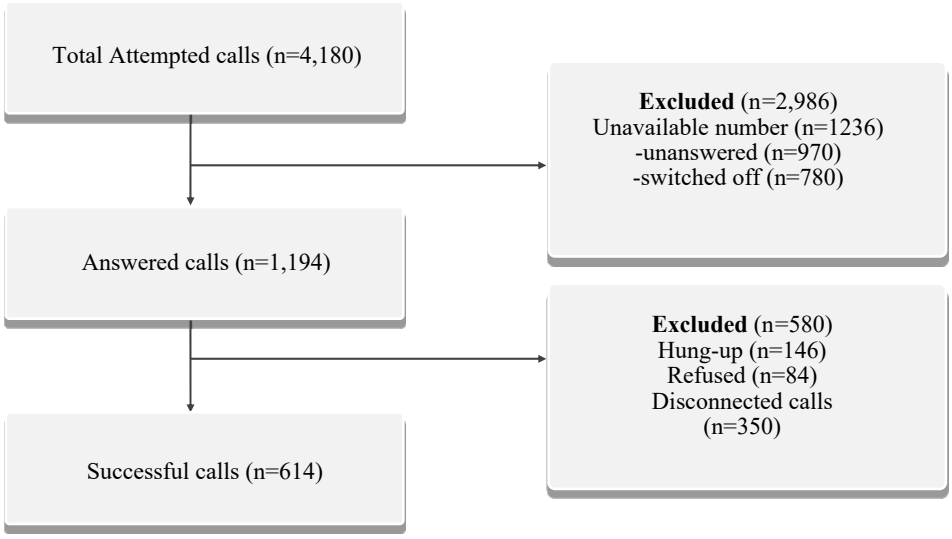

Figure 1: Flow diagram of enrolment of the study participants

Baseline characteristics of the participants

Most of the participants (71.7%) were males. 39.1% of the participants aged 30-39 years, and 77.9% reside in the urban setting. More than one-third of the participants (36.8%) were government employees, and 68.2% were married. 62.4% of participants stated that their current income didn't meet their needs whereas the majority (54.4%) of them reported that they reside in the average relative wealth subgroup (**Table 1**).

Table 1:- Socio-economic, demographic, and other baseline characteristics of the study participants (Total N=614)

Characteristics	Number	Percent
Sex		
Male	440	71.7
Female	174	28.3
Age in years		
18-29	207	33.7
30-39	213	34.7
40-49	118	19.2
50 and above	76	12.4
Marital Status		
Single	172	28.0
Married	419	68.2
Divorced/widowed	18	3.8
Level of Education		
Primary and below	55	9.0
Secondary	124	20.2
Certificate	148	24.1
College/University	287	46.7
Occupation		
Farmer	56	9.2
Self-employed	260	42.4
Government employee	178	28.9
Housewife/ Homemaker	30	4.9
Unemployed	45	7.3
Other	45	7.3
Residence		
Urban	478	77.9
Rural	136	22.1
Region		
Addis Ababa	222	36.1
Oromia	144	23.4
Amhara	139	22.6
SNNPR	66	10.7
Other	43	7.20
Relative Wealth		
Very low	53	8.60
Low	225	36.7
Average and above	336	54.7

COVID-19-like symptoms

Cough and headache were the most common symptoms which, accounts for 10.6% each among the study participants, while fatigue accounts for 9.9%, and 7.5% of the participants were found to have COVID-19-like symptoms (**Figure 2**), while most of the participants (92.5%) didn't have such symptoms.

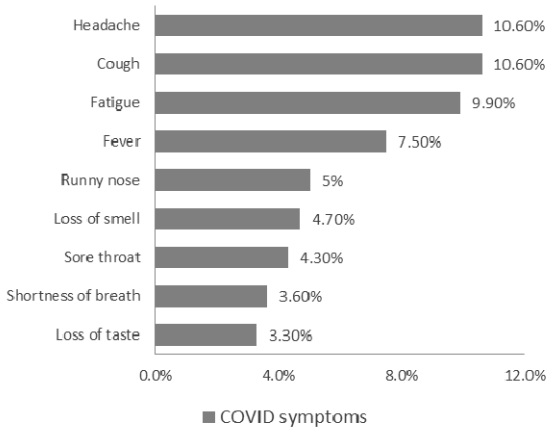

Figure 2: COVID-like symptoms of study participants

Flu-like symptom and COVID-19 test

The majority (55.2%) of the participants were found to have flu-like symptoms in the past year. Of the total participants, 41.9% participants were tested for COVID-19 of whom 7.4% were positive. 15.8% of the participants thought that they had COVID-19, and from those, only 37.5% received treatment. Further, 48.4% of the participants' perceived that they were at risk for COVID-19 (**Table 2**).

Table 2: Flulike symptom, COVID-19 test, and treatment-related characteristics of the participants

Symptoms	Number	Percent
Flu-like symptom in the past year		
Yes	339	55.2
No	275	44.8
Tested for COVID-19, (n=614)		
Yes	257	41.9
No	357	58.1
Test Result (n=257)		
Positive	19	7.4
Negative	238	92.6
Think have COVID		
Yes	32	15.8
No	170	84.2
Receive Treatment (n=32)		
Yes	12	37.5
No	20	62.5

Economic impact of COVID-19
The majority (55.9%) of the participants testified that their family income was affected by COVID-19 where 9.1% stated that their family members lost their job due to COVID-19. Among the total of 614 participants, only 7 (1.2%) of them reported death in the past month. Among the deceased, 4 of them were males (**Table 3**).

Table 3: - Impact of COVID-19 on the study participants

Symptoms	Number	Percent
Family income affected		
Yes	343	55.9
No	271	44.1
Family member lost a job		
Yes	56	9.10
No	558	90.9
Stress in the household		
Yes	105	17.1
No	509	82.9
Death in family (past month)		
Yes	7	1.10
No	607	98.9

Household Comorbidity
24.1% of the participants have one or more comorbidities. The leading comorbidity was hypertension (11.7%) followed by diabetes (8.1%) and Asthma (7.8%) (**Figure 3**)

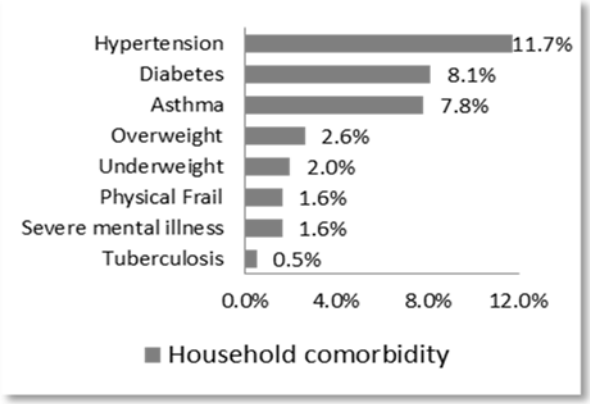

Figure 3: *Household comorbidity of study participant*

Predictors of income loss due to COVID-19
Bivariable analysis identified age, region, residence, occupational status, gender, and educational status as candidate variables for the multivariable model. The result of multiple logistic regression models showed that occupation and region were significant predictors for COVID-19 related income loss. Compared to the government employed, the odds of having a decreased income due to COVID- 19 was 2.4 times higher among self-employed (AOR=2.4; 95% CI: 1.58, 3.77), 2.8 times higher among unemployed (AOR=2.8; 95% CI: 1.35, 5.85), and 2.08 times higher among other occupation (AOR=2.08; 95% CI: 1.04, 4.18). Compared to participants living in Oromia, the odds of having a decreased income due to COVID-19 was 1.59 higher among people living in Addis Ababa (AOR=1.59; 95% CI: 1.02, 2.50) (**Table 4**).

Discussion
COVID-19 affected the family income of 343 [55.9%] study participants, 56 [9.1%] lost their job, 105 [17.1%] perceived high stress in their household, and 7 [1.14%] reported death in their family in the past month. Two-hundred twenty-one [36%] participants had comorbidity in their household with hypertension, 72 [11.7%], diabetes, 50 [8.1%], asthma, 48 [7.8%], and other chronic diseases, 51 [8.4%]. Forty-six [7.5%] participants had COVID-like symptoms in the previous month, where cough, headache, and fatigue were the most common symptoms. Loss of smell and taste were reported by about half of those with COVID-19 like symptoms. Three-hundred thirty-nine [55.2%] had flu-like symptoms in the past year, and 257 [41.9%] had undergone the COVID-19 test, of whom 19 [7.4%] were positive. The findings indicate high levels of impact on family income related to COVID-19 with over half of study participants reporting loss of family income and about one in ten reporting loss of job. Additionally, over one in six had perceived high stress in their household, and 1% reported death in their family in the past month. The odds of having a decreased income due to COVID-19 was more than twice higher among self-employed and nearly three times higher among the unemployed individuals. Similar finding is reported from the UK where the self-employed were exceptionally impacted by the crisis (10). Similarly a study done in China and Germany supports our result where they reported Self-employed to be struck hard by income loss due to the pandemic (7, 11). Another study done in Germany found that employees that were continuously in short-term contracts, transitional furlough, and unemployed experienced a significant reduction in their household income (12).

In this study, the prevalence of income loss due to COVID-19 was 56%. This is in line with a world bank report from Ethiopia where they reported 55% of the participants income has reduced income due to COVID-19 (13).This finding was also comparable with a study conducted in China, where they found almost half (48%) of the respondents reported partial income loss (7). The concordance might partly be explained by similar proportion of government employees in both studies where job security is more assured. Confirming this assumption, a study from Japan has found that non-flexible workers

Table 4: Factors associated with Income loss due to COVID-19 among adult population of Ethiopia.

Characteristics	Income affected by COVID-19		COR (95% CI)	AOR (95% CI)
	Yes	No		
Age				
18-29	120(58)	87(42)	1	1
30-39	121(56.8)	92(43.2)	1.32(0.90, 1.95)	1. 38(0.90, 2.1)
40-49	62(52.5)	56(47.5)	1.15(0.73, 1.82)	1.02(0.67,1.81)
50 and above	36(47.4)	40(52.6)	0.88(0.52, 1.49)	0.87 (0.48, 1.54)
Region				
Oromia	80(55.6)	64(44.4)	1	1
Addis Ababa	115(52)	107(48.2)	1.61(1.05, 2.46)	1.59 (1.02, 2.50)*
Amhara	86(62)	53(38)	0.95(0.60, 1.52)	1.16 (0.71, 1.89)
SNNPR	33(50)	33(50)	1.44(0.81, 2.56)	0.97(0.84 ,2.88)
Others	25(58)	18(42)	1.68(0.83, 3.39)	1. 28(0.98, 4.26)
Occupation				
Government Employee	77((43.3)	101(56.7)	1	1
Farming and pastoralist	23(41.1)	33(58.9)	0.91(0.49, 1.68)	1.01(0.48, 2.14)
Self Employed	170(65.4)	90(34.6)	2.48(1.68, 3.67))	2.4(1.58, 3.77)**
Housewife	17(56.7)	13(43.3)	1.72(0.78, 3.74)	2.23(0.93, 5.3)
Unemployed	30(66.7)	15(33.3)	2.62(1.32, 5.21)	2.8(1.35, 5.85)*
Other	26(57.8)	19(42.2)	1.79(0.92, 3.48)	2.08(1.04, 4.18)*
Gender				
Male	253(57.5)	187(42.5)	1	1
Female	90(51.7)	84(48.3)	0.79(0.55, 1.12)	0.69(0.46,1.05)
Educational level				
Primary school and below	27(49.1)	28(50.9)	1	1
Secondary school	76(61.3)	48(38.7)	1.58(0.65, 3.80)	1.31(0.66, 2.57)
Certificate	86(58.1)	62(41.9)	1.38(0.58, 3.29)	0.95(0.37,2.44)
College/University	154(53.7)	133(46.3)	1.15(.50, 2.66)	0.94(0.37,2.42)
Residence				
Urban	278(58.2)	200(41.8)	1	1
Rural	65(47.8)	71(52.2)	0.65(0.44, 0.96)	0.76 (0.48,1.23)

* Statistically significant at p value of <0.05, ** statistically significant at p value of <0.01, other occupation includes students, pators, carpenters and some NGO workers.

non-flexible workers (manufacturing, transport, and construction) were hit harder by COVID-19 crisis than flexible workers as were contingent (non-regular) workers (14). People in lower economic classes in Ethiopia, those who were awaiting for aid, and under contractual working arrangements were also affected the most (9, 15, 16).

Although slightly higher, the number is also somewhat comparable with that of a study in the United States conducted over a slightly shorter duration (3 weeks), where they reported income loss due to COVID-19 of 43.4 % (17).
While we find higher rates of impact on the unemployed and the self-employed participants, a study in Pakistan has reported much higher rate among those working in the tourist industry, with 64% reporting income decrease. This economic impact at the individual level is also reflected at the national level with studies revealing a decline in economic growth in Africa of − 2.4 to − 5.1% and other health wellbeings during the outbreak of the COVID-19 pandemic (19, 20-24).

Over half of the participants had experienced flu-like symptoms in the previous year with nearly one in ten reporting COVID-19. This, combined with the relatively high burden of co-moribdities in households, which has the potential of complicating the course of COVID-19, means that the demand on the health system would be substantial. However, of participants who thought they had acquired COVID-19, only one-third were tested and had received treatment.

This low service utilization may partly explain why the health system was not overwhelmed as anticipated.

The impact was higher in Addis Ababa. This is to be anticipated as cities have been the epicenter of the pandemic (7). Our study was telephonic survey, which is subjected to non-response bias and there is a probability of decrease in accuracy of answers. Despite the telephonic survey nature of our study, we were able to collect data nationwide and that increased the representativeness of our study.

Conclusion

The COVID-19 pandemic is an unprecedented health and economic disaster with far-reaching and long-term consequences for individuals, families. Our study has confirmed this fact, with serious economic pressure on individual households, with self-employed and unemployed people most affected. Specific plans need to be designed to address the needs of those in unstable working situations. In future pandemics, such plans should be put in place in the early stages of the pandemic to prevent similar economic hardships. Moreover, the low capacity to conduct large scale diagnostic assessments impeds control of a pandemic. Our phone survey has demonstrated that it is possible to provide real time data on probable COVID-19. Therefore, larger scale rapid phone surveys may serve to augument the limited laboratory based survey. We suggest that continuous surveillance is needed to actively monitor the impact of COVID-19 in the community and safeguard the economic and health well-being of individuals and households.

Abbrevations

COVID-19: Coronavirus disease 2019
WHO: World Health Organization

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of the College of Health Sciences, Addis Ababa University with protocol number 086/20/CDT. Data collectors were trained in Good Clinical Practice and phone interviews were conducted after informed verbal consent was obtained. The data were kept confidentially and used for the purpose of the study only.

Consent for publication:

Not applicable

Availability of data and material

The datasets supporting the conclusions of this article are included within the article and its additional files. Any additional material can be obtained upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding:

This research received funding from Addis Ababa University through the Thematic Research Grant scheme [Grant ID: LT/PY-045/2021]. Additional support was obtained from the National Institute for Health Research (NIHR) Global Health Research Unit on Health System Strengthening in Sub-Saharan Africa, King's College London [Grant ID: GHRU 16/136/54] using UK aid from the UK Government to support global health research. The work is coordinated by the Unit for Health Evidence and Policy (UHEP) at CDT-Africa which is supported financially by the Wellcome Trust [Grant ID: 221576/Z/20/Z]. CDT-Africa is a world bank supported center of excellence [Grant Id: P151847-IDA57940]. The views expressed in this publication are those of the author(s) and not necessarily those of Addis Ababa University, the NIHR or the Department of Health and Social Care or the Wellcome Trust or the World Bank supporting CDT-Africa.

Authors' contributions

AF, GM and TM conceived and designed the study. WB, TM, GM and AF performed the data analysis and interpretation of the findings. WB drafted the manuscript. All authors critically reviewed the manuscript and approved the final manuscript.

Acknowledgements

We thank the CDT-Africa administrative staff for successfully organizing study activities. Authors also express their appreciation to Prof Martin Prince from King's College London for supporting this work.

Supplementary Material

None

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Ethiopian Medical Journal 2022, 60 (Supplement 1)
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ISSN 0014-1755 eISSN 2415-2420
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Original Article

COVID -19 vaccine hesitancy and determinants in Ethiopia: A national pilot survey

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Abstract

Introduction: *Despite major advances in Corona Virus Disease 2019 (COVID-19) vaccine development, vaccine hesitancy threatens the progress made to curb the disease. We aimed to assess the level of COVID-19 vaccine hesitancy and the underlying determinants in Ethiopia.*

Methods: *A pilot mobile phone survey of adults in Ethiopia with mobile phones selected randomly.*

Results: *The pilot survey included 614 participants who were predominantly male (71.7%), and married (68.2%) with a median age of 34 years (interquartile range [IQR] = 14.0). Overall, 150 (24.4%) participants reported to have been vaccinated; either the first [57 (38%)], second [19 (12.7%)], or both [74 (49.3%)] doses. About one in six participants (16.3%; n=100) reported vaccine hesitancy, with a significant difference by employment status, with self-employed more likely to show hesitancy [adjusted odds ratio (AOR) 1.85, 95% CI (1.05-3.27)], and region. Major drivers of hesitancy were lack of interest [n=30 (30%)], fear of side-effects [n=24 (24%)], and lack of trust in the vaccine [n=13 (13%)]. Having chronic disease conditions in the family had no association with hesitancy (p > 0.05).*

Conclusion: *While representativeness of the sample is an issue, the findings show a relatively low rate of COVID-19 vaccine hesitancy among the Ethiopian population. The major drivers of hesitancy, lack of interest, fear of side-effects, and lack of trust in the vaccine, may be reversed by disseminating accurate and timely information using credible sources across communities.*

Keywords*: Vaccine, hesitancy, COVID-19, mobile phone, Ethiopia.*
Citation : *Timothewos S, Negussie H, Fekadu B, et al , Covid-19 vaccine hesitancy and determinants in Ethiopia: a national pilot survey .Special issue of Ethiop Med J 60 (Supplement 1) 40-47*
Submission date : *10 April 2022 Accepted: 9 August 2022 Published: 30 October 2022*

Introduction

First reported in late 2019, COVID-19 is a pandemic that has impacted and continues to impact millions across the globe. According to the latest World Health Organization (WHO) report, there are over 340 million confirmed cases globally, with Africa accounting for 2.3% of the cases (1). In Ethiopia, there were a total of 467,975 confirmed cases as of 18th February 2022 and COVID-19 has taken the lives of 7430 individuals (2). The best way to tackle the pandemic is implementing public health control measures, including mass vaccination.

Thus far, nine vaccines have been evaluated for safety and efficacy and endorsed by the World Health Organization (WHO) (3), and there were 140 clinical and 194 pre-clinical studies underway (4).

Despite such major advances, vaccine hesitancy – the reluctance or refusal to vaccinate despite the availability of vaccines – threatens to reverse progress made in tackling COVID-19 (5).
According to a systematic review of worldwide COVID-19 vaccine hesitancy, the highest vaccine acceptance rates among the general public were found in Ecuador (97.0%), Malaysia (94.3%), Indonesia (93.3%) and China (91.3%), while the lowest vaccine acceptance rates were from Kuwait (23.6%), Jordan (28.4%), Italy (53.7), Russia (54.9%), Poland (56.3%), US (56.9%), and France (58.9%) (6). A study conducted on Health Care Workers (HCW) in Ethiopia indicated that nearly two-thirds of HCWs were hesitant to the COVID-19 vaccine (7). These figures are particularly alarming considering HCWs were cited as the most trusted source of information about the COVID-19 (8). On the other hand, one out of five residents of Addis Ababa, the capital city of Ethiopia, were not willing to get vaccinated (7, 9). While studies such as these give us an idea about the potential extent of vaccine hesitancy in a limited geographic region and population, national data is required to estimate the scope of the problem and plan interventions accordingly.

Vaccine hesitancy and the underlying reasons are complex and context-specific that vary with geography, period, and vaccine type. The reason for hesitancy can also arise from a range of factors such as complacency around the disease, convenience of access, and trust in the vaccine. The recognition of these factors could help develop targeted interventions across different sets of populations to increase vaccination uptake once the vaccines are available (10, 11).

Little is known about COVID-19 vaccine hesitancy and the underlying determinants in sub-Saharan Africa where access to the vaccine is suboptimal and most of the available evidence is from developed nations. Hence, we aimed in this study to assess the level of COVID-19 vaccine hesitancy and the underlying determinants in Ethiopia.

Methods

Study Design

This was a pilot cross-sectional mobile phone survey in all the regions of Ethiopia. and was conducted from September to November 2021. Mobile Phone surveys were used because these were safer research tools at the time of COVID-19 where face-to-face data collection could put the health of the study participants and the data collectors in jeopardy.

Study setting and population

We recruited participants nationwide, from all the ten regions and two city administrations in Ethiopia. Adults who spoke one or more of the working languages and with no hearing or cognitive impairment or serious mental illness that impedes interview were eligible to participate.

Sample size and sampling procedure

We approached 4180 participants from the pool of randomly generated phone numbers that were obtained from phone registries retained in Addis Ababa and the regions. Of these, we were able to include 614 participants who answered the phone call meeting also the eligibility criteria and consented. This was considered a sufficient sample size to obtain preliminary evidence on the extent of vaccine hesitancy and about the feasibility of a larger scale study.

Measurements

Socio-demographic and household factors hypothesized to have an impact on vaccine hesitancy (age, gender, education, marital status, occupation, residence, region, economic status (self-reported status ranging from very low to high), participant's perceived risk of getting COVID 19 and living with people aged 65 years and above) were assessed using a structured questionnaire developed for this purpose. Information about known risk factors for a complicated course of illnesses, mainly chronic medical conditions (hypertension, diabetes, asthma, TB, physical frailty, over or underweight) and older age was also assessed at the participant and household level. Vaccine hesitancy was evaluated by asking multiple questions including if the participants have been vaccinated for COVID-19, whether they got the opportunity to be vaccinated, and whether they will be vaccinated if they got the opportunity. Participants who were considered vaccine hesitant were those who were unvaccinated and would not be willing to take the COVID 19 vaccine if presented with the opportunity. These participants these were asked further questions on their reason for hesitancy.

Data collection procedures

Data was collected through telephone (mobile phone) interviews. Potential participants were randomly selected from the population of individuals with mobile phones registered centrally with the Federal or the regional authorities. For Ethical reasons no identifier information other than phone numbers that are accessible to the general public were obtained.

The questionnaire was implemented using an electronic data capture platform. Data collectors were recruited and trained on all the instruments and Good Clinical Practice (GCP) before starting data collection. The survey procedures and tools were pre-tested with 50 interviews for utility, feasibility, and acceptability.

Data processing and analysis

Data was entered using Open Data Kit (ODK) software and exported into STATA 14.0 for data cleaning, coding, and further analysis. Descriptive statistics was conducted using frequency and proportions. We also applied measures of central tendency. In describing participant characteristics, all the variables were disaggregated based on vaccine hesitancy.

The association between vaccine hesitancy and determinants was assessed using crude and adjusted odds ratios (OR), with 95% confidence intervals (95% CI). From the bivariate analysis, all variables with a likelihood ratio p-value < 0.25 were included in the multivariable analysis. For the multivariable analysis, p-values $\leq$ 0.05 were considered significant. We also used Pearson's chi-square test (fisher's exact test for those with observations less than 10) to explore the distribution of household or participant level risk factors against vaccine hesitancy.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board of the College of Health Sciences, Addis Ababa University, Ethiopia (Protocol no. 086/20/CDT). Verbal consent was obtained from participants once the information sheet was read to the study participants. Clarification was given based on the queries from study participants, where thereafter verbal informed consent was obtained.

Results

Socio-demographic and household characteristics of participants are summarized in **Table 1**. A total of 4180 calls were made, out of which, 1194 calls were answered (12). The remaining 2986 calls were either unavailable, unanswered or switched off. Among the answered calls, 580 were excluded because they got disconnected, refused, or hung up. Overall, we were able to call and successfully administer the questionnaires to 614 participants.

Participants were predominantly male (71.7%), married (68.2%) with a median age of 34 (IQR = 14.0) years. Most resided in an urban area (77.9%) where more than half reportedly had an average economic status (54.7%) and received at least secondary level education (91%). One-fifth of the participants were living with one or more people aged 65years and above. A little less than half (48.4%) of them stated they believe they are at risk of getting COVID 19.

Overall, 150 (24.4%) participants reported that they have received the COVID-19 vaccine. Of those who were not vaccinated, 100 (21.5%) were are not willing to take the vaccine or were vaccine hesitant. The most frequent reasons for hesitancy were lack of interest (30%) or fear of potential side-effects of the vaccine (24%) including potential infertility or death (**Table 2**).

Table 3 summarizes participants or any member of their household's having a comorbid condition that can increase the chance of getting severe COVID-19 and whether it bears any relationship with vaccine hesitancy. The results indicate that having someone in the household with chronic conditions (hypertension, diabetes or asthma), being physically frail, and being over or overweight bears no relationship with participants' willingness to get vaccinated.

Self-employed participants were more likely to be hesitant to take the COVID-19 vaccine [Adjusted odds ratio (AOR) 1.85, 95% CI (1.05-3.27)] compared to those who were government-employed. On the other hand, compared to those living in Addis Ababa, those living in the Oromia region [AOR 0.54, 95% CI (0.29-0.99)] and other regions (i.e., regions outside Amhara, SNNPR) were found to be less likely to be hesitant to take the vaccine (**Table 4**). Living with a person with any chronic medical condition that could complicate the course of COVID-19 was not associated with acceptance (p >0.25 in crude analysis; not shown in Table 4)

Table 1 Socio-demographic and household characteristics disaggregated by vaccine hesitancy (n = 614)

Characteristics	**Vaccine Hesitancy**				**Total**	
	Non-hesitant		Hesitant		n	%
Sex	N	%	N	%		
Male	374	85.0	66	15.0	440	71.7
Female	140	80.5	34	19.5	174	28.3
Age						
Less than 30years	176	85.0	31	15.0	207	33.7
30-39 years	177	83.1	36	16.9	213	34.7
40-49 years	95	80.5	23	19.5	118	19.2
50 years and above	66	86.8	10	13.2	76	12.4
Residence						
Urban	392	82.0	86	18	478	77.9
Rural	122	89.7	14	10.3	136	22.2
Region						
Addis Ababa	168	75.7	54	24.3	222	36.2
Oromia	124	86.2	20	13.9	144	23.5
Amhara	122	87.8	17	12.2	139	22.6
SNNPR	60	90.9	6	9.1	66	10.8
Others	40	93.0	3	7.0	43	7.0
Level of education						
Primary school or less	50	90.9	5	9.1	55	9.0
Secondary school	108	87.1	16	12.9	124	20.2
Certificate	125	84.5	23	15.5	148	24.1
College/University	231	80.5	56	19.5	287	46.7
Occupation						
Farming/ Pastoralist	53	94.6	3	5.4	56	9.1
Self-employed/daily laborer	204	78.5	56	21.5	260	42.4
Government employee/ pensioner	153	86	25	14.0	178	29.0
Housewife/Homemaker	24	80	6	20	30	4.9
Unemployed	40	88.9	5	11.2	45	7.3
Other	40	88.9	5	11.1	45	7.33
Marital status						
Single	142	82.6	30	17.4	172	28.0
Married	352	84.0	67	16.0	419	68.2
Divorced or widowed	20	87.0	3	13.0	23	3.8
Economic status						
Very low	44	83.0	9	17.0	53	8.6
Low	191	84.9	34	15.1	225	36.6
Average	279	82.9	57	17.0	334	54.4
High	2	100	0	0	2	0.3
Living with people aged ≥65						
No	404	82.3	87	17.7	491	80.0
Yes	110	89.4	13	10.6	123	20.0
Perceived risk						
No	268	84.5	49	15.5	317	51.6
Yes	246	82.8	51	17.2	297	48.4

Table 2: COVID-19 vaccine hesitancy of participants (n = 614)

Variable name	Status	n, %	Proportion (95% CI)
Vaccination (n=614)	No	464	75.6 (72.0-78.8)
	Yes	150	24.4 (21.2- 28.0)
Dose received (n=150)	First	57	38 (30.5-46.1)
	Second	19	12.7(8.2- 19.1)
	Both	74	49.3(41.3-57.4)
Vaccine Hesitancy (n=614)	No	514	83.7(80.6-86.4)
	Yes	100	16.3(13.6-19.4)
Reason for hesitancy (n=100)	Lack of trust in the vaccine	13	13 (7.6-21.3)
	No interest	30	30 (21.7-39.8)
	Fear of side-effects	24	24(16.5-33.5)
	Religious or other beliefs	4	4(1.5-10.3)
	Not willing to dis-close	17	17 (10.8-25.8)
	No reason or unde-cided	12	12(6.9-20.1)

Table 3: Household-level risk factor for COVID-19 disaggregated based on vaccine hesitancy (n = 614)

Characteristics		**Participants**		**Vaccination**				**Chi-square**	**P value**
		N	**%**	Non-hesitant/ vaccinated		Hesitant			
				N	%	N	%		
Hypertension	No	542	88.3	451	83.2	91	16.8	0.86	0.35
	Yes	72	11.7	63	87.5	9	12.5		
Diabetes	No	564	91.9	470	83.3	94	16.7	0.73	0.39
	Yes	50	8.1	44	98.0	6	12.0		
Asthma	No	566	92.2	475	83.9	91	16.1	0.23	0.63
	Yes	48	7.8	39	81.3	9	18.8		
Physically frail	No	604	98.4	505	83.6	99	16.4		1.00*
	Yes	10	1.6	9	90	1	10.0		
Underweight	No	602	98.1	502	83.4	100	16.6		0.23*
	Yes	12	2.0	12	100	0	0		
Overweight/ obese	No	598	97.4	97	83.8	501	16.2		0.73*
-	Yes	16	2.6	3	81.3	13	18.8		
Household risk of COVID-19	No	466	75.9	79	83.0	387	17.0	0.63	0.43
	Yes	148	24.1	21	85.8	127	14.2		

* *P* values *based on* Fisher's exact test)

Table 4: Factors associated with COVID vaccine hesitancy

Characteristics	Crudes Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)	P-Value
Level of Education			
Primary school or less	1	1	
Secondary school	1.48(0.51-4.27)	1.51(0.50-4.57)	0.47
Certificate	1.84(0.66-5.11)	1.50(0.51-4.46)	0.46
College/University	2.42(0.92-6.36)	2.34(0.81-6.74)	0.11
Gender			
Male	1	1	
Female	1.37(0.87-2.17)	1.32(0.79-2.22)	0.29
Residence			
Urban	1	1	
Rural	0.52(0.29-0.95)	0.99(0.48-2.01)	0.97
Occupation			
Farming/ Pastoralist	0.35(0.10-1.19)	0.69(0.17-2.81)	0.60
Self-employed/daily laborer	1.68(1.00-2.81)	1.85(1.05-3.27)	0.03
Government employee and pensioner	1	1	
Housewife/Homemaker	1.53(0.57-4.11)	1.47(0.49-4.46)	0.49
Unemployed	0.77(0.28-2.12)	0.87(0.29-2.54)	0.80
Other	0.77(0.28-2.12)	0.34(0.28-2.80)	0.97
Region			
Addis Ababa	1	1	
Oromia	0.50(0.29-0.88)	0.54(0.29-0.99)	0.05
Amhara	0.43(0.24-0.78)	0.53(0.27-1.02)	0.06
SNNPR	0.32 (0.13-0.76)	0.40 (0.15-1.04)	0.06
Others*	0.24(0.07-0.78)	0.25(0.07-0.88)	0.03
Living with a person 65years of age and older			
No	1.82(0.98-3.39)	1.59(0.83-3.04)	0.16
Yes	1	1	
Control Measures			
No	3.1(1.27-7.61)	4.0(1.5-10.50)	0.005
Yes	1	1	

*other regions include; Diredawa = 8(1.3%), Tigray = 1(0.2%), Somali= 4(0.7%), Afar= 7(1.1%), Benishangul= 6(1.0%), Gambella= 2(0.3%), Harari=4(0.7%), Sidama= 11 (1.8%)

Discussion

In this study that aimed to assess the level of COVID-19 vaccine hesitancy and the underlying determinants in Ethiopia, COVID-19 vaccine hesitancy was relatively low at 16.3%. Thus, the proportion who expressed vaccine hesitancy are much smaller than those who may be considered vaccine accepting. This is an encouraging result considering the fact that 60–75% of the population needs to be vaccinated to halt the forward transmission and community spread of the virus (6). This also demonstrates the need to direct vaccination campaigns towards converting positive intentions into uptake. Dissemination of reliable information about the effectiveness and safety of the vaccine is equally important to address the knowledge gap in the community (13). This must be coupled with improving access opportunities to vaccination.

Our finding of low vaccine hesitancy was consistent with studies from some low- and middle-income countries (LMICs) that reported an average hesitancy rate of (19.7%) (13). A systematic review that compared COVID-19 vaccine acceptance rate in over 33 countries reported the lowest vaccine hesitancy at < 10% and the highest at > 40% (6). The reason for low vaccine hesitancy in LMICs may be because of the lived experience of people in these countries where many vaccine-preventable infectious diseases are still causing millions of deaths annually, which is likely to result in a higher perceived need for or value of vaccines (14). On the other hand, the nature of the study is such that people who are more likely to have positive attitude towards the vaccine may have participated. This would underestimate the level of vaccine hesitancy.

Reasons for hesitancy were mostly related to fear of vaccine side effects and lack of interest to take the vaccine. Some mentioned lack of trust and religious or traditional beliefs. Fear of side effects seems a common reason for vaccine hesitancy. For example, an online survey conducted in the US reported fear of side effects and lack of trust as the main reasons for vaccine hesitancy (15). Other studies conducted in Ethiopia also mentioned fear of safety and side effects as one of the main reasons for hesitancy (9, 16). These reasons may be amenable to awareness campaigns and modelling. Further exploration of those that stated "no interest" as a reason for not accepting vaccines is also required to support development of more robust evidence for intervention.

One of the factors influencing vaccine hesitancy was region of residence, with nearly 25% of those living in Addis Ababa expressing vaccine hesitancy with 13% or less from other regions expressing similar sentiment. This is in line with a previous study, which reported that one in five people residing in Addis Ababa were not willing to be vaccinated (9). This should be of major concern Since Addis Ababa is the epicentre of the COVID-19 pandemic and an international hub that could serve as a 'reservoir' for infection and transmission. Moreover, the relatively higher exposure of persons living in bigger cities to diverse social media information (some of which could be misleading and anti-vaccine) could have sensitized residents in these high-risk areas against the vaccine (8, 9, 17). Another predictor of vaccine hesitancy was occupation, where self-employed participants were found to be more likely to be vaccine hesitant. This is counter-intuitive since one would expect those who are self-employed would want to get vaccinated to avoid loss of productivity due to sick days. However, self-employed people may have less structured day, and limited time to access vaccine, to obtain information or to 'be sick' if they become sick from side effects.

We would like to acknowledge some of the limitations of our study. The study was based on a mobile phone survey, which might have impacted the reliability and representativeness of the data. Only people with mobile phones and those having mobile networks were able to participate in the study. The low proportion of rural respondents in the dataset is an important indicator of the generalisability gap. Secondly, self-reports may be influenced by a recall and social desirability bias. However, the findings are consistent with our findings from Ethiopia and elsewhere, supporting the value and robustness of the information collected. Qualitative approach may have allowed exploration of vaccine hesitancy, particularly the reasons, in a more nuanced way.

Conclusion

The findings show a relatively low rate of COVID-19 vaccine hesitancy among the Ethiopian population. Major drivers of hesitancy were lack of interest, fear of side-effects, and lack of trust in the vaccine that should be reversed by disseminating accurate and timely information using credible sources and across communities. Replication of the findings and larger scale studies are required. If the findings are taken at face value, ensuring access to vaccines is the primary challenge at present.

Abbreviation

Corona Virus Disease 2019 (COVID-19), World Health Organization (WHO), Health Care Workers (HCW), Good Clinical Practice (GCP), Open Data Kit (ODK), low- and middle-income countries (LMICs)

Declaration

Ethics approval and consent to participate:
The study was approved by the Institutional Review Board of the College of Health Sciences, Addis Ababa University (Protocol no. 086/20/CDT). Data collectors were trained in Good Clinical Practice and phone interviews were conducted after informed verbal consent was obtained. The data were kept confidentially and used for the purpose of the study only.

Consent for publication
Not applicable

Availability of data and material
The datasets supporting the conclusions of this article are included within the article and its additional files. Any additional material can be obtained upon reasonable request.

Competing interests
The authors declare that they have no competing interests.

Funding
This research received funding from Addis Ababa University through the Thematic Research Grant scheme [Grant ID: LT/PY-045/2021]. Additional support was obtained from the National Institute for Health Research (NIHR) Global Health Research Unit on Health System Strengthening in Sub-Saharan Africa, King's College London [Grant ID: GHRU 16/136/54] using UK aid from the UK Government to support global health research. The work is coordinated by the Unit for Health Evidence and Policy (UHEP) at CDT-Africa which is supported financially by the Wellcome Trust [Grant ID: 221576/Z/20/Z]. CDT-Africa is a World Bank supported center of excellence [Grant Id: P151847-IDA57940]. The views expressed in this publication are those of the author(s) and not necessarily those of Addis Ababa University, the NIHR or the Department of Health and Social Care or the Wellcome Trust or the World Bank supporting CDT-Africa.

Authors' contributions

AF, YW and TM conceived and designed the study. ST and AF performed the data analysis and interpretation of the findings. ST drafted the manuscript. HN, BF, MS, EG, WB, AW and TE contributed contents to include into the draft. AF, TM, CH and YW critically reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgements

We thank the CDT-Africa administrative staff for successfully organizing study activities. Authors also express their appreciation to Prof Martin Prince from King's College London for supporting this work.

Supplementary Material

None

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Ethiopian Medical Journal 2022, Supplement 1)
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ISSN 0014-1755 eISSN 2415-2420
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Original Article

Adherence to COVID -19 protective practices in Ethiopia: Use and predictors of face mask-wearing

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Abstract

Introduction: *The Ethiopian Ministry of Health strongly recommends that anyone, regardless of vaccination status, wears a standard face mask consistently when in public. This study aimed to assess the self-reported use and predictors of wearing face masks in the general population in Ethiopia.*
Methods: *This was a population-based cross-sectional study using a telephone survey. Adults living in Ethiopia were randomly selected from the Ethio Telecom list of mobile phone numbers and interviewed about their mask-wearing practice and individual and household-level factors that could impact on the use of face masking. Multivariable logistic regression was used to measure associations.*
Results: *A total of 614 participants were interviewed from September to November 2021. The prevalence of self-reported face mask use when in public was 81.1%. Living outside Addis Ababa, including Oromia [adjusted odds ratio [(AOR) 0.30, 95% confidence interval (CI) (0.14, 0.63)], Amhara [AOR 0.11, 95% CI (0.05, 0.23)], and Southern Nations, Nationalities and People's Region [AOR 0.31, 95% CI (0.12-0.79)] and being divorced or widowed [AOR* 0.18, 95% CI (0.06, 0.62)] *were found to be inversely associated with face mask use. Female gender [AOR 1.91, 95% CI (1.02, 3.58)] and older age [age ≥ 50, AOR 2.96, 95% CI (1.09-7.97)] were positively associated with the use of face masks. Attending social events [AOR 0.51, 95% CI (0.31-0.82)], was negatively associated with the use of face masks.*
Conclusion: *Self-reported use of face masks was relatively high nationally, but inconsistent among different regions and demographics. The findings imply that policies and messaging campaigns may need to focus on specific populations and behaviors in this ongoing pandemic.*

Keywords*: COVID-19,, personal protective equipment, face mask, Ethiopia*
Citation : *Negussie H, Timothewos S, Fekadu B et al , Adherence to covid-19 protective practices in Ethio pia: use and predictors of face mask-wearing..Special issue of Ethiop Med J 60 (Supplement 1) 48—56*
Submission date : *10 April 2022 Accepted: 26 Augest 2022 Published: 30 October 2022*

Introduction

The novel coronavirus disease 2019 (COVID-19) was declared a pandemic on March 11th 2020 by the World Health Organization (WHO)(1). In an effort to reduce the spread of COVID-19, health authorities have recommended the use of various public health control measures. These include use of face masks, physical distancing, hand washing, use of hand sanitizers and avoiding body contact (2). Even with the development of effective vaccines for COVID-19, it is still important to adhere

to these control measures as the vaccines do not confer full protection(3). Their effectiveness is also decreasing with new variants(4). In addition, vaccine inequity, particularly in low-resource countries meaning that population coverage remains low (5). Vaccine hesitancy has also hampered access to vaccines substantially(6, 7).

Although the different types of control measures play a role in curbing the spread of COVID-19, the lifestyle and economic constraints that force people to continue in work, make compliance to physical distancing and related control measures difficult. In such context, use of face masks in public settings is critical to curb the spread of COVID-19. Growing evidence has shown the effectiveness of using face masks in reducing the transmission of COVID-19 (8-14). The use of face masks has also been associated with better mental wellbeing (15, 16). However, there are still differences in face mask usage across different countries, regions and socio-demographic characteristics. A cross-sectional online survey on global trends and predictors of face mask usage during the COVID-19 pandemic has shown that socio-demographic factors such as older age, female gender, education and living in urban areas were significantly associated with higher mask usage in public settings (17). But not all studies have confirmed these associations between mask wearing and gender or residences(18).

In Ethiopia, there is still a lack of knowledge regarding mask-wearing behaviors at a national level. This study aimed to explore the use of face masks and its predictors in Ethiopia. Although there have been a few studies conducted in Ethiopia to investigate COVID-19 control measure compliance in different regions of the country and different target groups (19-23); this study explores the use of face masks as a preventive measure against COVID-19 on a national scale. Such studies will help to understand and target behaviors that are considered risky in the context of this pandemic, across individuals and regions to clarify and refine public health messaging around the use of face masks during the pandemic.

Methods

Study Design and period

This study was a population-based cross-sectional study using mobile call surveys. This survey was a pilot for a population-based prospective cohort study that has gone on to recruit 10,000 participants. The pilot survey was conducted from September to November 2021.

Study setting and population

This national study was conducted across Ethiopia, including ten regions and two city administrations (Addis Ababa and Dire Dawa). Potential participants were selected randomly from the population of individuals with mobile phones, registered centrally with the federal or the regional authorities. Eligible participants were adults (age 18 and above) with mobile phones, speaking one or more of the Ethiopian working languages (Amharic, Afan Oromo or Tigrigna), and with no hearing or cognitive impairment or serious mental illness that impeded interview.

Sample size and sampling procedure

This study is a pilot national survey and no formal sample size calculation was considered. For this pilot report, the data were collected within a specified period to inform policy and practice earlier.

Nevertheless, the result from power analysis shows that the considered sample size (n=614) will give a power of at least 80% at 5% level of significance and enables detection of a minimum difference of 5% in testing a prevalence of face masking ranging from 20% to 80% in the population.

All participants that were selected randomly from mobile phones and those who were answering their phones during the data collection period were included in the study.

Data collection procedures

A mobile phone interview was used to collect the data. The data were collected on an electronic data capture platform using Open Data Kit. The recruitment included a rigorous evaluation of the data collectors.

The data collectors were trained before they started data collection. In addition to the data collection instruments, they were also trained about good clinical practice and research ethics. The survey procedures and tools were pre-tested with 50 interviews for utility, feasibility and acceptability.

Measurements

Participants' behavior of use of face masks when outside or in public was assessed for the previous month (the month prior to the interview). Participants who reported to wear face mask when they were out in public were considered to use face mask when outside. Several individual and household level factors that could be associated with the use of face masks were included based on a priori hypotheses and existing literature.

Individual-level predictors assessed were: age, gender, level of education, residence (defined as living in an urban or rural area), region, marital status, occupation, and perceived risk for COVID-19. Household level risk factors assessed included self-reported economic status of the household of the participants, having people aged 65 and older in the household, having a person living with a medical condition (hypertension, diabetes or asthma, physically frail, underweight or overweight/obese).

Data processing and analysis

Data were analyzed using Stata version 14.0(24). Demographic and other factors were stratified by face mask use and tested for any significant differences using Pearson's chi-square test. Further association of potential risk factors, and wearing of face masks was assessed using multivariable logistic regression. Magnitude of association was determined using the odds ratio or Adjusted odds ratio (AOR) and 95% confidence interval (95% CI).

Ethical considerations

Ethical approval was obtained from the Institutional Review Board of the College of Health Sciences, Addis Ababa University, Ethiopia. The items in the information sheet were read and clarification was given to the participants. All participants were informed that their identity would be kept confidential, and all the collected information would be anonymized during the phone call. In addition, the respondents were also informed that participation in the study was voluntary and that they could stop the interview at any time. Verbal informed consent was then obtained from the participants.

Results

In this phone call survey, 4180 calls, selected randomly from a pool of 30,000 phone numbers, were attempted. Of 4180 attempted calls, 1194 calls were answered. The rest, 2986 calls, were unavailable , unanswered, switched off, disconnected, or hung up. Out of the 1194 calls answered, we completed successful interviews with 614 participants, yielding a response rate of 51.4%.

General characteristics of participants

Among the 614 participants, most were male (71.1%; n=440) with 12.4% (n=76) aged 50 years or older. Most participants were from urban areas (77.9%) where more than half reportedly had an average economic status (54.7%) and received at least secondary level education (91%). Almost half (48.4%) of the participants believed they were at risk of getting COVID-19.

Use of face mask and factors associated with the use of face mask

The prevalence of self-reported face mask use when in public was 81.1% with 95% CI (77.8 – 84.0). Significantly more women (87.9%) than men (78.4%) reported wearing face masks (p=0.01) (Table 1; P values not shown in the table).

There was also a significant trend in wearing face masks with increasing age (z=2.45, p=0.014). The highest proportion of those wearing face masks were from Addis Ababa (93.7%) and the lowest among those from the Amhara region (62.6%), with significant difference between the two groups (p<0.001). Married persons (83.3%) also had higher levels of face mask compared to those who were divorced or widowed (p=0.001). Although not statistically significant, those who live in a household with average and above economic status were more likely to use face masks compared to those living in a household with low economic status.

Table 1: Socio-demographic and household characteristics and use of a face mask when outside the house in Ethiopia, September to November, 2021 (N=614)

Characteristics	Category	No.	%
Age	< 30	207	33.7
	30-39	213	34.7
	40-49	118	19.2
	≥ 50	76	12.4
Gender	Male	440	71.7
	Female	174	28.
Residence	Urban	478	77.8
	Rural	136	22.2
Region	Addis Ababa	222	36.2
	Oromia	144	23.5
	Amhara	139	22.6
	SNNPR*	66	10.8
	Others**	43	7.0
Level of education	Primary school or less	55	9.0
	Secondary school	124	20.2
	Certificate	148	24.1
	College/ University	287	46.7
Marital status	Single	172	28.0
	Married	419	68.2
	Divorced/Widowed	23	3.8
Occupation	Farming/Pastoralist	56	9.1
	Self-employed/ daily laborer	260	42.4
	Government employee/ Pensioner	178	29.0
	Housewife/ Homemaker	30	4.9
	Unemployed	45	7.3
	Other	45	7.3
Household economic status	Very low	53	8.6
	Low	225	36.6
	Average and above	336	54.7

Although there were more people living with older people or someone with a chronic condition (hypertension, asthma and diabetes) who wore face masks, this was not statistically significant. Similarly, increased personal risk perception did not appear to enhance wearing of face masks (Table 2; P values not shown in the table). On the other hand, more people who had attended social events in the previous month were less likely to wear face masks (p=0.01)

Table 2: Household risk factors for COVID-19 and use of face mask when outside the house in Ethiopia, September to November, 2021 (N=614)

Risk factors		No.	%
People aged 65 and above in HH	No	491	80.0
	Yes	123	20.0
Think they are at risk for COVID-19	No	317	51.6
	Yes	297	48.4
Attended any social related events in the past month	No	295	48.1
	Yes	319	51.9
Hypertension	No	542	88.3
	Yes	72	11.7
Diabetes	No	564	91.9
	Yes	50	8.1
Asthma	No	566	92.2
	Yes	48	7.8
Physically frail	No	604	98.4
	Yes	10	1.6
Underweight	No	602	98.1
	Yes	12	1.9
Overweight/obese	No	598	97.4
	Yes	16	2.6

Results from the multivariable logistic regression analysis showed female gender (AOR 1.91, 95% CI [1.02, 3.58]), and older age (age ≥ 50 AOR 2.96, 95% CI [1.09 -7.97]) were significantly associated with higher levels of face mask wearing in public. Being divorced or widowed (AOR 0.18, 95% CI [0.06-0.62]) and living outside of Addis Ababa (Oromia: AOR 0.30, 95% CI [0.14, 0.63]; Amhara: AOR 0.11, 95% CI [0.05, 0.23]; SNNPR: AOR 0.31, 95% CI [0.12-0.79]; others: AOR 0.16, 95% CI [0.06-0.41]) were found to be negatively associated with the use of face masks (**Table 3**).

Multivariable logistic regression controlling for other household risk factors also showed that attending social events in the past one month (AOR 0.51, 95% CI [0.31-0.82]), was negatively associated with the use of face masks. Other household risk factors (living with people aged 65 and older, perceived risk for COVID-19, having

a person in the household living with hypertension, diabetes or asthma, and physical frailty, or being underweight or overweight/obese) did not have a significant association with the use of face masks (**Table 4**).

DISCUSSION

This national survey indicates that an encouraging proportion of people are wearing face masks in Ethiopia although this varied with demographic and geographic characteristics. About nine in ten residents of Addis Ababa, the capital of Ethiopia and the political hub of Africa, wore face masks during the study period. . If this level of adherence is maintained along with additional public health control measures, COVID-19 control may be achieved in the not-so-distant future. Similar or slightly higher levels of use of face masks has been reported in Uganda (25, 26) and India (27).

Such relatively high proportion of the public wearing facemasks is important to control the spread of COVID-19, which is mostly transmitted through asymptomatic infections(28, 29). The high hopes that vaccines may control the spread of the disease is now tempered with the realization that the efficacy of vaccines in preventing reinfections is onlymodest(30) and short lived(31). Despite the initial promise to distribute the vaccine globally, there is extreme inequity with most African countries having extremely limited access to the vaccines(5). Moreover, vaccine acceptance is relatively low and well below what is required for ending the pandemic(32). In this context, universal face masking is a critical measure. Equally encouraging is the fact that people who wear face masks are also adherent to other public health control measures such as social distancing and hand hygienic practices. Ensuring continued adherence to these public health control measures must be at the forefront of the fight to end this pandemic.

The survey also showed that certain demographic groups, such as women and those aged 50 and above, and those living in Addis Ababa were more likely to wear face masks. The finding of association with female sex and older age is in conformity with other studies that hypothesized that adherence may be due to tendency of these groups in general to engage more with health-preventive behaviours, social role modelling and peer pressure (33).

Table 3: Factors associated with use of face masks when outside and socio-demographic and household characteristics in Ethiopia, September to November, 2021 (N=614)

Variable		Characteristics		COR (95% CI)	AOR (95% CI)	P value
Age (years)		No.	%			
	< 30	207	33.7	Reference	Reference	
	30-39	213	34.7	1.31 (0.81-2.09)	1.28 (0.71-2.29)	0.411
	40-49	118	19.2	1.48 (0.83-2.64)	1.54 (0.76-3.39)	0.217
	≥ 50	76	12.4	2.57 (1.15-5.71)	2.96 (1.09-7.97)	0.033*
Gender	Male	440	71.7	Reference	Reference	
	Female	174	28.3	2.0 (1.21-3.34)	1.91 (1.02-3.58)	0.042*
Residence	Urban	478	77.8	Reference	Reference	
	Rural	136	22.2	0.69 (0.44-1.10)	1.19 (0.67-2.11)	0.550
Region	Addis Ababa	222	36.2	Reference	Reference	
	Oromia	144	23.5	0.31 (0.15-0.61)	0.30 (0.14-0.63)	0.001*
	Amhara	139	22.6	0.11 (0.06-0.21)	0.11 (0.54-0.23)	<0.001*
	SNNPR	66	10.8	0.34 (0.15-0.78)	0.31 (0.12-0.79)	0.015*
	Others	43	7.0	0.16 (0.07-0.36)	0.16 (0.06-0.41)	<0.001*
Level of education	Primary school or less	55	9.0	0.55 (0.28-1.07)	0.53 (0.20-1.42)	0.209
	Secondary school	124	20.2	1.01 (0.58-1.77)	0.95 (0.46-1.97)	0.900
	Certificate	148	24.1	0.78 (0.47-1.28)	0.64 (0.35-1.18)	0.153
	College/University	287	46.7	Reference	Reference	
Marital status	Single	172	28.0	Reference	Reference	
	Married	419	68.2	1.37 (0.86-2.13)	1.19 (0.65-2.13)	0.581
	Divorced/ Widowed	23	3.8	0.43 (0.17-1.06)	0.18 (0.06-0.62)	0.006*
Occupation	Farming/ Pastoralist	56	9.1	0.68 (0.33-1.39)	1.27 (0.45-3.62)	0.648
	Self-employed/ daily laborer	260	42.4	1.01 (0.62-1.64)	0.86 (0.47-1.60)	0.643
	Government employee/ Pensioner	178	29.0	Reference	Reference	
	Housewife/ Homemaker	30	4.9	2.05 (0.59-7.16)	1.13 (0.25-5.10)	0.871
	Unemployed	45	7.3	1.48 (0.58-3.78)	1.44 (0.49-4.22)	0.507
	Other	45	7.3	0.63 (0.29-1.34)	0.74 (0.30-1.80)	0.509
Household economic status	Very low	53	8.6	Reference	Reference	
	Low	225	36.6	0.97 (0.46-2.02)	0.85 (0.36-1.99)	0.704
	Average and above	336	54.7	1.28 (0.62-2.64)	1.00 (0.43-2.33)	0.992

Table 4: Factors associated with use of face mask and household risk factors for COVID-19 in Ethiopia, September to November, 2021 (N=614)

Risk factors		Characteristics		COR (95% CI)	AOR (95% CI)	P-value
People aged 65 and above in HH		No.	%			
	No	491	80.0	Reference	Reference	
	Yes	123	20.0	1.17 (0.69-1.96)	1.17 (0.62-2.21)	0.629
Think they are at risk for COVID-19	No	317	51.6	Reference	Reference	
	Yes	297	48.4	0.75 (0.50-1.12)	0.83 (0.50-1.37)	0.460
Attended any social related events in the past month	No	295	48.1	Reference	Reference	
	Yes	319	51.9	0.58 (0.38-0.87)	0.51 (0.31-0.82)	0.006*
Hypertension	No	542	88.3	Reference	Reference	
	Yes	72	11.7	1.19 (0.62-2.29)	1.19 (0.52-2.70)	0.680
Diabetes	No	564	91.9	Reference	Reference	
	Yes	50	8.1	2.21 (0.86-5.68)	1.69 (0.56-5.13)	0.352
Asthma	No	566	92.2	Reference	Reference	
	Yes	48	7.8	0.77 (0.38-1.55)	1.03 (0.44-2.39)	0.945
Tuberculosis	No	611	99.5	Reference	Reference	
	Yes	3	0.5	0.12 (0.10-1.28)	0.15 (0.10-2.04)	0.153
Physically frail	No	604	98.4	Reference	Reference	
	Yes	10	1.6	0.54 (0.14-2.11)	0.34 (0.69-1.67)	0.184
Underweight	No	602	98.1	Reference	Reference	
	Yes	12	1.9	0.46 (0.14-1.54)	0.49 (0.10-2.38)	0.376
Overweight/obese	No	598	97.4	Reference	Reference	
	Yes	16	2.6	1.01 (0.28-3.60)	1.16 (0.23-5.78)	0.860

Overall, this suggests that more needs to be done among men and those living in regions other than Addis Ababa to encourage compliance to public health control measures. However, it may not be surprising that participants outside Addis Ababa (the capital) are less likely to use face masks as the COVID-19 transmission rate has been lower in other regions of the country when compared to Addis Ababa (19, 22). Although marital status was associated with wearing face masks as observed in previous studies from Ethiopia (22) the mechanism for this association has not yet been explored.

In this survey, interestingly, there was no significant association between the use of face masks and education levels or occupation. This is different from what was found among west Ugandans where the practices of wearing face masks in public places differed across education levels and occupation of participants ($P<0.05$) (26).

Furthermore, there was no difference in the use of face masks by socioeconomic status unlike a study from South Africa that found significantly lower odds of wearing masks amongst the poor than the wealthiest (18).

Among the household risk factors, attending social events, which has been considered to be one of the most risky social behaviors during the pandemic (34), was associated with lower use of face masks. This finding is in line with a study conducted on a global scale (17). This result indicates that those who voluntarily engage in risky social activities during the pandemic are also less likely to use face masks. Social gatherings form an important part of life in Ethiopia and so measures like face mask assume even greater importance to allow people to socially participate in a safer way.

Hence, there is a need to target these groups for public health intervention as they are likely to contribute to the spread of COVID-19.

The lack of association between wearing of face masks and perceived personal or family risk was not anticipated although perceived personal risk was also not found to be associated with mask wearing in other studies (18). This implies more effort is required to educate the public regarding risk factors and that the severity of the COVID-19 symptoms increases with such risk factors (35).

This study has, however, some limitations. A phone call survey was used in this study and it was difficult to ascertain some of the exclusion criteria. The decision was based on the judgment of the interviewers. Such survey is also prone to selection bias in that the phone survey participants may be different from the general adult population in a range of socio-demographic characteristics (36). This was compounded by the relatively low response rate among contacted individuals. Moreover, the study is also prone to the short comings of self-reported questionnaires, such as recall bias and verification concerns. In this study, social desirability bias may also be important given the government recommendations to wear a face mask. Moreover, we did not inquire about the type of face mask the participants used and about proper use to indicate their effectiveness. It is worth noting that the survey was conducted during the third surge of the COVID-19 pandemic in Ethiopia, which may have overestimated the practice compared to non-surge periods. In addition, we asked participants specific questions about their economic status, social related events in the past one month, weight, physical status, other COVID-19 measures and other variables without an operational definition. They were all self-reported answers based on the perception of the participant and no actual measurement was done.

Conclusion

This study examined the use of face masking during the COVID-19 pandemic in Ethiopia. About four out of five participants reported they use face masks when in public, which is an encouragingly high proportion although based on a self-reported data during a surge. However, it should be of major concern that people with risk behaviors are less likely to use face masks. These findings imply policies and messaging campaigns should better target specific populations and behaviors in this ongoing pandemic and future public health emergencies.

Abbreviations

COVID-19: Coronavirus Disease 2019
SNNPR: Southern Nations, Nationalities and People's Region
WHO: World Health Organization

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of the College of Health Sciences, Addis Ababa University (086/20/CDT). Data collectors were trained in Good Clinical Practice and phone interviews were conducted after informed verbal consent was obtained. The data were kept confidentially and used for the purpose of the study only.

Consent for publication

Not applicable

Availability of data and material

The datasets supporting the conclusions of this article are included within the article and its additional files. Any additional material can be obtained upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This research received funding from Addis Ababa University through the Thematic Grant scheme. Additional support was obtained from the National Institute for Health Research (NIHR) Global Health Research Unit on Health System Strengthening in Sub-Saharan Africa,

King's College London (GHRU 16/136/54) using UK aid from the UK Government to support global health research. The views expressed in this publication are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care." and the World Bank grant [P151847-IDA57940] supporting CDT-Africa.

Authors' contributions

HN analyzed the data and wrote the first draft; ST, BF, MS, EG, AW, TE and RB contributed contents to include into the draft. AF, TM, CH and EM supervised the study and revised the draft; and all authors approved the final version for publication.

Acknowledgements

Authors express their appreciation the UK's NIHR (NIHR Global Health Research Unit on Health Systems Strengthening in Sub-Saharan Africa at King's College London for supporting this work. We also thank the CDT-Africa administrative staff for successfully organizing the study activities.

Supplementary Material

None

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Ethiopian Medical Journal 2022, Supplement 1)
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ISSN 0014-1755 eISSN 2415-2420

Fekadu et al

Original Article

Mental wellbeing during the time of COVID-19 pandemic: A national pilot survey in Ethiopia

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Abstract

Introduction: *The Coronavirus Disease 2019 (COVID-19) pandemic substantially disrupts population health and wellbeing globally, while little is known about the effect on mental wellbeing in developing countries. This study aimed to assess the impact of COVID-19 on mental wellbeing of individuals and households in Ethiopia.*
Methods: *A cross-sectional, national pilot survey was conducted through phone interviews from September to November 2021. Mental wellbeing and disability were assessed using a questionnaire adapted from the 5-item World Health Organization Wellbeing Index (WHO-5), the Oslo Social Support Scale (OSSS-3), and the WHO Disability Assessment Scale (WHODAS 2.0).*
Results: *A total of 614 adults completed the pilot survey. The mean age was 36 years (standard deviation 11) and 71.7% were male. Mental wellbeing was poor in 218 (35.5%) participants. The most important predictors for poor mental wellbeing were rural residence (Adjusted Odds Ratio [AOR] 1.89; 95% CI 1.14, 3.14; p=0.012), perceived COVID-19 risk (AOR 1.75; 95% CI 1.18, 2.60; p=0.005), household stress (AOR 2.09; 95% CI 1.31, 3.34; p=0.002), experience of symptom of COVID-19 in the household (AOR 2.14; 95% CI 1.13, 4.04; p=0.019), and poor social support (AOR 2.43; 95% CI 1.51, 3.91; p<0.001).*
Conclusion: *The study provides evidence that COVID-19 had a significant adverse impact on the mental wellbeing of individuals and households in Ethiopia. Further studies are needed to understand in detail the implications of the pandemic and interventions needed to keep mental wellbing of citizens.*

Keywords*: COVID-19, mental wellbeing, mental health, disability, Ethiopia*
Citation : *Fekadu B, Selamu M Getachew E et al ,* ***Mental wellbeing during the time*** *of COVID-19 pandemic****: A national pilot survey in Ethiopia.****. Special issue of Ethiop Med J 60 (Supplement 1) 58 – 64*
Submission date : *10 April 2022 Accepted: 9 August 2022 Published: 30 October 2022*

Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has impacted the physical, social and mental wellbeing of people globally (1). The very limited initial knowledge and the nature of the spread of the pandemic had required drastic change and adaptation at the individual, community and societal level with consequent rise in the level of stress among individuals and communities (2).

The adaptations have included implementation of good hygiene practices, social distancing, quarantine measures and isolation, most of which are likely to expose people to continuous stress while disrupting the normal ways of living and social networks (3).

These mental wellbeing challenges are not peculiar to this pandemic; for example past public health epidemics, such as severe acute respiratory syndrome (SARS),

have been associated with unfavorable effect on mental wellbeing (4-6). During COVID-19 decreased mental wellbeing and an increase in mental health problems were reported in some studies (7, 8). A meta-analysis done on population based studies during COVID-19 pandemic reported high prevalence of depression (33.7%), anxiety (31.9%), and stress (29.6%) (9). A study from a town in southern Ethiopia has also indicated high prevalence of mental distress during the COVID-19 lockdown: depression 37.7%, anxiety 39.0%, and stress symptoms as 44.2 % (10).

The COVID-19 pandemic continues to disrupt the life of individuals, communities and healthcare providers (11). The psychological effects of this disease might even be higher in Ethiopia and other low- and middle -income countries (LMICs) as a result of resource constraints, weaker health systems, including inadequately developed mental healthcare system although little studied. There is a need to develop population-level mental health interventions that are believed to be well-suited where there is a lack of human and material resources in the sector (12). The aim of this study was to assess the mental wellbeing of Ethiopians during the COVID-19 pandemic and determine factors associated with the mental wellbeing status.

Methods

Study Design and sampling

Details of the methods are described elsewhere in this issue (13) and will be presented here briefly. The study recruited participants from all nine regional states of Ethiopia and the two chartered cities (Addis Ababa and Dire Dawa). The study period was from September to November 2021. The study was a population-based national cross-sectional survey using mobile phone interviews. Adults aged 18 and above who were able to provide information about themselves and their family were invited to take part in this study. The study was conducted in the three main languages of Ethiopia: Amharic, Afan Oromo and Tigrigna.

From a sampling frame of 11 million people with mobile phones starting with 0910 to 0920, random samples of 30,000 were selected. For the pilot, the first 614 participants from this random sample who responded and agreed to participate were included. The study included all the study participants who agreed to participate during the pilot study data collection period which was one month. As the study was an initial pilot survey for a larger cohort study, formal sample size calculation was not conducted. The study was conducted across Ethiopia and all participants contacted were from parts of the country since study participants were randomly contacted.

Assessments

Subjective mental wellbeing was the main outcome of interest.

In addition to subjective mental wellbeing: disability, relevant individual and household risk factors were assessed.

Wellbeing

Subjective mental wellbeing was assessed using the 5 -item World Health Organization Well-Being Index (WHO-5), a widely used ‘condition neutral’ tool (14) and validated in Ethiopia (15). The items are only positively phrased and include the following: (1) I have felt cheerful and in good spirit, (2) I have felt calm and relaxed, (3) ‘I have felt active and vigorous', (4) ‘I woke up feeling fresh and rested' and (5) ‘My daily life has been filled with things that interest me'.

The respondents were asked to rate how well each of the 5 statements applies to him/her in the past four weeks or the past 30 days. Each of the 5 items is scored from 5 (all of the time) to 0 (none of the time). The total raw score would therefore range from 0 (absence of well-being) to 25 (maximal well-being). Conventionally, health-related quality of life measures are converted to a percentage scale from 0 (absent) to 100 (maximum), it is recommended to multiply the raw score of the WHO-5 by 4 (14) to transform the raw scores of the WHO-5 into the more conventional score. We, therefore, multiplied the total score of each participant by four to obtain the recommended range of scores. When used as a screening tool, a score of <50 in the WHO-5 is considered indicative of compromised mental wellbeing and depression(16).

Disability

Two items from the World Health Organization Disability Assessment Schedule (WHODAS) 2·0 scale were used. The questions focused on the past month and enquired (1) for how many days the participant was totally unable to carry out his/her usual activities or work because of any health condition; (2) Excluding the days that the person was totally unable to carry out his/her activities, for how many days he/she had to cut back or reduce their usual activities or work because of any health condition.

Sociodemographic measures

Sociodemographic and economic data considered relevant for mental wellbeing at the participant and household level were assessed using simple structured questionnaire that consisted of basic characteristics such as age, marital status, residence, educational status, occupation and region as well as income status.

Household and participant level risk factors

Risk factors included medical conditions in the household that may complicate the course of COVID -19such as chronic medical conditions (hypertension, heart disease, asthma, TB, liver disease, kidney disease, diabetes) which may require some life style modifications for the family;

and household level conflict that may affect mental wellbeing and assessed by asking whether there is an increase in stress and conflict in the household for the past one month of data collection period. Social support was assessed at the participant and household level using the Oslo 3-items social support scale (OSS). In addition, participants were also asked their perceived risk for COVID-19 and if they have been experiencing COVID-19 like symptoms in the previous month.

Data collection procedures

Data were collected through mobile phone interviews using an electronic data capture platform. Data collectors were trained on the instruments and ethical data collection. Whenever the phone number didn't work or wasn't answered on the first try, retries were made up to three times before being excluded. The data collectors took over the data collection work once all contracts and training were completed. The survey procedures and instruments were pre-tested with 50 interviews for benefit, feasibility and acceptance and adjusted on the basis of the results of the pre-test.

Data analysis

Data was exported to Stata version 14 (StataCorp, 1985-2013) for statistical analysis. For the primary outcome variable (Wellbeing index 5), total score was generated by adding up the items for each scale. The result was multiplied by four with a total score extending to 100. As per the recommendation, a cut-off value of 50 was taken as a wellbeing threshold, with those scoring below 50 categorized as experiencing low or poor wellbeing.

Descriptive analysis was used to explore the socio demographic, personal and household level stress related factors that are believed to be linked with wellbeing score. Multivariate logistic regression was used to evaluate factors associated with poor mental wellbeing (i.e. sex, age, marital status, place of work, perceived social support, perceived household stress, and perceived COVID-19 risk).

Results

Socio-demographic characteristic of study participants

A total of 614 participants were included in the study. Of those, 440 (71.7%) were male, 213 (34.7%) were in the age group of 30–39 years and most (78%; n=478) lived in urban areas. The mean (±Standard Deviation; SD) age of the participants was 36 (SD 11) years. Most were self-employed (42.3%; n=260) or government employees (n=178; 29%). More than two thirds (68.2%; n=419) of participants were married (Table 1).

Mental wellbeing, disability and social support during COVID-19

The mean (±SD) score of the WHO-5 wellbeing scale in all the sample was 60.08 (±27.9). Low wellbeing was reported by 35.5% (n=218) of participants.

In terms of disability or ability to function in the past 30 days, all in all, over half of the participants had some impairment for at least a day, with a third of participants (n=202; 32.9%) reporting total inability to carry out their usual activities at least for a day because of any health condition at the time of COVID-19. Participants who were forced to reduce or cut back their usual activity at least for one day for the past one month in the time of COVID-19 were slightly lower (n=174; 28.3%).

Over a quarter (n=173; 28.18%) reported poor social support, with the rest reporting strong (n=220; 35.83%)) and intermediate social support (n=221; 36%). Significantly higher proportion of those with poor social support had compromised or poor mental wellbeing (X^2=17.97; P<0.001).

Factors associated with mental wellbeing during the COVID-19 pandemic

In the multivariable logistic regression model, poor mental wellbeing was significantly higher among those who reported an increase in household stress and conflict during the pandemic (AOR 2.09; 95% CI 1.31, 3.34), those who perceived that they were at risk of COVID-19 (AOR 1.75; 95% CI 1.18, 2.60), had someone with a chronic illness in the household (AOR 1.72; 95% CI 1.12, 2.64) or they had a symptom of COVID-19 in the past month (AOR 2.14; 95% CI 1.13, 4.04). Compared to those with good social support, the odds of poor mental wellbeing was increased in those with intermediate (AOR 1.61; 95% CI 1.03, 2.49) and poor social support (AOR 2.43; 95% CI 1.51, 3.91). Rural residence was also independently associated with poor mental wellbeing (AOR 1.89; 95% CI 1.14, 3.14). See table 2.

Table 1:Socio-demographic characteristics in relation to mental wellbeing score

Characteristics	Response Category	Total (%)	Mental Wellbeing Score ≤ 50		X^2	P Value
			Number (%)			
			Yes	No		
SEX	Male	440 (71.7)	156 (34.5)	84 (64.6)	0.00	0.967
	Female	174 (28.3)	62 (35.6)	112 (64.2)		
AGE	18-29 years	207 (33.7)	79 (38.2)	128 (61.8)	1.58	0.663
	30-39 years	213 (34.7)	76 (35.7)	137 (64.3)		
	40-49 years	118 (19.2)	37 (31.4)	81 (68.6)		
	≥50 Years	76 (12.4)	26 (34.2)	50 (65.8)		
RESIDENCE	Urban	478(77.9)	159 (33.3)	319 (66.7)	4.73	0.030
	Rural	136 (22.2)	59 (43.4)	77 (56.6)		
REGION	Addis Ababa	222 (36.2)	71 (32.0)	151 (68.0)	5.33	0.255
	Oromia	144 (23.5)	53 (36.8)	91 (63.2)		
	Amhara	139 (22.6)	59 (42.5)	80 (57.6)		
	SNNPR	66 (10.8)	23 (34.9)	43 (65.2)		
	Others	43 (7.0)	12 (27.9)	31 (72.1)		
LEVEL OF EDUCATION	Primary school	55 (9.0)	17 (30.9)	38 (69.1)	2.72	0.435
	Secondary school	124(20.2)	40 (32.3)	84 (67.7)		
	Certificate	148 (24.1)	60 (40.5)	88 (59.5)		
	College/University	287 (46.7)	101 (35.2)	186 (64.8)		
OCCUPATION	Farmer/Pastoralist	56(9.1)	19 (33.9)	37 (66.1)	5.76	0.330
	Self-employed	260(42.4)	92 (35.4)	168 (64.6)		
	Government employee	178 (29.0)	63 (35.4)	115 (64.6)		
	Housewife	30 (4.9)	6 (20.0)	24 (80.0)		
	Unemployed	45 (7.3)	17 (37.8)	28 (62.2)		
	Others	45 (7.3)	21 (46.7)	24 (53.3)		
MARITAL STATUS	Single	172(28.0)	65 (37.8)	107 (62.2)	0.54	0.761
	Married	419 (68.2)	145 (34.6)	274 (65.4)		
	Divorced/widowed	23 (3.8)	8 (34.8)	15 (65.2)		
RELATIVE WEALTH	Very low	53 (8.6)	19 (35.9)	34 (64.2)	7.47	0.024
	Low	225(36.6)	95 (42.2)	130 (57.8)		
	Average and above	336 (54.7)	104 (31.0)	232 (69.1)		
LIVING WITH PEOPLE AGED ≥65	No	491(79.9)	167(34.01)	324(65.9)	2.38	0.123
	Yes	123(20.1)	51(41.46)	72(58.54)		
HOUSEHOLD CO MORBIDITY	No	466(75.9)	151(32.4)	315(67.6)	8.12	0.004
	Yes	148(24.1)	67(45.3)	81(54.7)		
PERCEIVED RISK FOR COVID 19	No	317(51.6)	92(29.1)	225(70.9)	12.02	0.001
	Yes	297(48.3)	126(42.4)	171(57.6)		
HOUSEHOLD SYMPTOM PAST ONE MONTH	No	562(91.5)	193(34.3)	369(65.7)	3.92	0.048
	Yes	52(8.4)	25(48.1)	27(51.9)		
PERCEIVED INCREASE IN STRESS AND CONFLICT IN HOUSEHOLD	No	509(82.9)	163(32.1)	346(67.9)	15.75	<0.001
	Yes	105(17.1)	55(52.4)	50(47.6)		
SOCIAL SUPPORT	Strong support	220(35.8)	161(40.7)	59(27.1)	17.97	<0.001
	Intermediate support	221(36)	144(36.36)	77(35.3)		
	Poor support	173(28.2)	91(22.9)	82(37.6)		

Table 2: Factors associated with poor mental wellbeing during the COVID-19 pandemic in Ethiopia

Characteristics	Response Category	Crude Odds Ratio (95% Confidence Interval)	Adjusted Odds Ratio (95% Confidence Interval)	P Value
Sex	Male	Ref	Ref	
	Female	1.01 (0.69, 1.45)	1.36 (0.87, 2.12)	0.169
Age (years)	18-29	Ref	Ref	
	30-39	0.89 (0.60, 1.33)	1.03 (0.64, 1.67)	0.877
	40-49	0.74 (0.45, 1.19)	0.83 (0.46, 1.50)	0.544
	50 and above	0.84 (0.48, 1.46)	1.01 (0.50, 2.00)	0.990
Residence	Urban	Ref	Ref	
	Rural	1.53 (1.04, 2.26)	1.89 (1.14, 3.14)	0.013
Region	Addis Ababa	Ref	Ref	
	Oromia	1.23 (0.79, 1.92)	1.02 (0.61, 1.69)	0.922
	Amhara	1.56 (1.01, 2.43)	1.29 (0.76, 2.19)	0.340
	SNNPR	1.13 (0.63, 2.03)	0.77 (0.39, 1.53)	0.471
	Others	0.82 (0.39, 1.69)	0.52 (0.22, 1.20)	0.128
Occupation	Farmer/pastoralist	Ref	Ref	
	Self-employed/daily labourer	1.06 (0.58, 1.96)	0.98 (0.43, 2.22)	0.975
	Government employee	1.06 (0.56, 2.01)	1.01 (0.42, 2.41)	0.985
	Housewife	0.48 (0.17, 1.39)	0.61 (0.18, 2.11)	0.444
	Unemployed	1.18 (0.52, 2.67)	1.06 (0.38, 2.95)	0.900
	Others	1.70 (0.76, 3.81)	1.84 (0.66, 5.07)	0.238
Level of education	Primary school	Ref	Ref	
	Secondary school	1.06 (0.53, 2.11)	1.30(0.61, 2.79)	0.494
	Certificate	1.52 (0.78, 2.94)	1.78(0.82, 3.87)	0.144
	College/University	1.21 (0.65, 2.25)	1.56(0.71, 3.44)	0.266
Marital status	Single	Ref	Ref	
	Married	0.87 (0.60, 1.25)	0.96(0.61, 1.53)	0.883
	Divorced/widowed	0.87 (0.35, 2.18)	1.02(0.36, 2.91)	0.958
Relative wealth	Very low	Ref	Ref	
	Low	1.31 (0.70, 2.43)	1.39(0.70, 2.75)	0.343
	Average and above	0.80 (0.43, 1.47)	0.89(0.45, 1.75)	0.737
Living with people aged ≥65	No	Ref	Ref	
	Yes	1.37(0.91, 2.05)	1.32(0.82, 2.12	0.242
Household stress	No	Ref	Ref	
	Yes	2.33 (1.52, 3.57)	2.09 (1.31, 3.34)	0.002
Perceived covid-19 risk	No	Ref	Ref	
	Yes	1.80 (1.28, 2.51)	1.75 (1.18, 2.60)	0.005
Household co-morbidity	No	Ref	Ref	
	Yes	1.72 (1.18, 2.51)	1.72 (1.12, 2.64)	0.012
Household symptom past 1 month	No	Ref	Ref	
	Yes	1.7 (0.99, 3.13)	2.14 (1.13, 4.04)	0.019
Social support	Strong support	Ref	Ref	
	Intermediate support	1.45 (0.97, 2.19)	1.61 (1.03, 2.49)	0.034
	Poor support	2.41 (1.54, 3.79)	2.43 (1.51, 3.91)	<0.001

DISCUSSION

There is consistent evidence from the literature of high income countries and some low and middle income countries that COVID-19 affects mental health negatively (17). Although selection bias, for example, those likely to have some anxiety may be more likely to volunteer for interview, could affect the quality and reliability of data in this study, a larger study from a cohort sample has indicated an increase in mental illness during COVID-19. This British cohort study found that mental distress rose from 18.9% during the pre-pandemic time to 27.3% during the early lock down of COVID-19. Similarly, the Global Health Questionnaire score rose from 11.5 during the pre-pandemic time to 12.6 in the early lock down periods of the pandemic (18).

Hence, COVID-19 is a likely explanation of the high level of poor mental wellbeing in our study. This is supported further by the association of poor mental wellbeing with concerns of contracting COVID-19 and living with someone who might have complicated course of illness if they contracted the illness. Again the association with low levels of social support engendered by the required life style changes during the COVID-19 era may partly explain the increase in poor mental wellbeing.

Nevertheless, a larger scale prospective study is required to have a clearer picture of the ongoing impacts of the COVID-19 pandemic. As part of such a study, any maladaptive behaviors, such as increase in alcohol consumption, need to be evaluated.

Interventions to mitigate the social disruptions caused by the disease and the public health control measures are also required. Such measures need to be locally developed or adapted and scalable.

The association of rural residence with poor mental wellbeing is in line with a previous population based study conducted prior to the pandemic (19). Understanding the vulnerabilities and risk factors among the rural population and developing community level mental wellbeing promotion interventions to tackle such risk factors need proper attention (12).

Conclusion

This is the first national evaluation of the impact of COVID-19 pandemic on mental wellbeing of Ethiopians. Although selection bias is an important concern, the study has found poor mental wellbeing in over a third of participants, which is a relatively high rate. Further large scale cohort studies are needed to understand the impact of COVID-19 and to evaluate the consistency of the risk factors that need to be considered in any intervention plan. Locally developed or adapted interventions may also need to be prioritized.

Abbrevations

COVID 19: Coronavirus Disease 2019, LMICs: low and middle income countries, SARS: Severe acute respiratory syndrome, WHO-5:5 -item World Health Organization Well-Being Index.

Declarations

Ethics approval and consent to participate:

The study was approved by the Institutional Review Board of the College of Health Sciences, Addis Ababa University (Ref.086/20/CDT). The study participants were asked for their willingness to participate in the study and they were only enrolled after giving verbal consent. Data collectors were trained in Good Clinical Practice and phone interviews were conducted after informed verbal consent was obtained. The data were kept confidentially and used for the purpose of the study only.

Consent for publication:

Not applicable

Availability of data and material:

The datasets supporting the conclusions of this article are included within the article and its additional files. Any additional material can be obtained upon reasonable request.

Competing interests:

The authors declare that they have no competing interests.

Funding:

This research received funding from Addis Ababa University through the Thematic Research Grant scheme [Grant ID: LT/PY-045/2021]. Additional support was obtained from the National Institute for Health Research (NIHR) Global Health Research Unit on Health System Strengthening in Sub-Saharan Africa, King's College London {Grant ID: GHRU 16/136/54} using UK aid from the UK Government to support global health research. The work is coordinated by the Unit for Health Evidence and Policy (UHEP) at CDT-Africa which is supported financially by the Wellcome Trust [Grant ID: 221576/Z/20/Z]. CDT-Africa is a world bank supported center of excellence [Grant Id: P151847-IDA57940].

The views expressed in this publication are those of the author(s) and not necessarily those of Addis Ababa University, the NIHR or the Department of Health and Social Care or the Wellcome Trust or the World Bank supporting CDT-Africa.

Authors' contributions

AF and TM conceived and designed the study. BF, MS, EG, GM and AF performed the data analysis and interpretation of the findings. BF, MS and EG drafted the manuscript. HN, ST, WB, AW and TE contributed contents to include into the draft. AF, TM, CH, and GM critically reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgements

We thank the CDT-Africa administrative staff for successfully organizing study activities. Authors also express their appreciation to Prof Martin Prince from King's College London for supporting this work.

Supplementary Material:

None

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Ethiopian Medical Journal 2022, 60 (Supplement 1)
ISSN 0014-1755 eISSN 2415-2420
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Original Article

Consequences of COVID-19 on access and delivery of mental health care in two rural Ethiopian districts. A mixed method study

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Abstract

Introduction: *The impact of COVID-19 on people with Severe Mental Health Conditions (SMHCs) has been neglected. We aimed to describe the effect and explore the consequences of COVID-19 on people with SMHCs and mental health services in rural districts of Ethiopia.*

Methods: *We conducted a mixed-method study nested within well-characterized population cohorts in Butajira and Sodo districts. We sampled 336 people (168 people with SMHCs, 168 comparisons) in a cross-sectional survey. We conducted qualitative key informant interviews with psychiatric nurses (n=3), primary health care workers (n=3), service users (n=4), family members (n=6) and community members (n=2). We assessed wellbeing (WHO wellbeing index), social support (Oslo social support scale; OSS) and food security quantitatively and used thematic analysis to explore impacts.*

Results: *People with SMHCs reported significantly lower wellbeing (WHO wellbeing score 52 vs. 72; p<0.001), less social support (OSS score 8.68 vs. 9.29; p<0.001), worse living standards (47.0% vs. 29.0%; p<0.001) and increased food insecurity (26.0% vs. 12.5%; p<0.001). Household economic status worsened for over one-third of participants.*

Participants reported increased relapse, exacerbated stigma due to perceived susceptibility of people with SMHCs to COVID-19, and increased restraint. In mental healthcare settings, there was decreased patient flow but an increase in new cases. Innovations included flexible dispensing of medicines, longer appointment intervals and establishing new treatment centers.

Conclusions: *COVID-19 had negative consequences on people with SMHCs and mental health services, which must be anticipated and prevented in any future humanitarian crisis. Adaptive responses used during COVID may increase health system resilience.*

Keywords*: COVID-19, Severe Mental Health Conditions, consequences, Low Income Country, Rural*
Citation : *Fekadu W, Shewangizaw S, Girma T et al , Consequence of COVID-19 on access and delivery of mental health care in two rural Ethiopian districts. Mixed method study .(Supplement 1) 66—74*

Submission date : *10 April 2022 Accepted: 31 August 2022 Published: 30 October 2022*

Introduction

Coronavirus Disease 2019 (COVID-19) has caused major global economic, social, and psychological challenges in addition to the physical health effects of the disease (1, 2). These impacts are likely to be worse for vulnerable populations, including people with severe mental health conditions (SMHCs : enduring and disabling psychotic disorders, bipolar disorder, and major depression) (3-5).

People with SMHCs and their families are already at increased risk of poor living standards (6-9), premature mortality (10), exclusion from the community, homelessness (11), and human rights abuses (12). These health and social inequalities mean that people with SMHCs, and their families, might be at an elevated risk of adverse outcomes due to the COVID-19 pandemic (13).

The pandemic may also affect mental health care and worsen the treatment gap for people with SMHCs, affecting both first contact and follow-up care, and potentially increasing the risk off relapse (5, 14). Ignorance of the differential impact of the pandemic on people with SMHCs will not only hinder any aims to prevent further spread of COVID-19 but will also exacerbate existing health inequalities (15). The current study sought to describe the effect and explore the consequences of COVID-19 on people with SMHCs in well-characterized cohorts in rural districts in Ethiopia.

Methods

Study design and setting

This mixed method study (comparative cross-sectional and descriptive qualitative study) was nested within the existing Butajira and Sodo population-based cohorts of people with SMHCs. The Butajira cohort was established between 1998-2001 from a screened population of 68,368 with confirmed diagnosis using standardized, semi-structured clinician interviews. A total of 919 people with SMHCs were identified at baseline (16, 17). The cohort was under follow up for over 10 years and was the basis for a nested trial of task-shared mental health care (18), as well as a study of intergenerational impact of SMHCs (8).

The Sodo study on SMHCs was established by the PRogramme for Improving Mental health care (PRIME) project (19). In the PRIME study, people with probable SMHCs were identified by community-based health extension workers, community leaders and project outreach workers who had received half a day of training on common presentations of SMHCs for the setting. A total of 300 people with clinician-confirmed psychosis were included at baseline (20, 21) and followed up over 12 months (22).

Specialist mental health care is available in both districts (psychiatric nurse-led clinics in Butajira and Buei hospitals). Mental health care has also been integrated into primary health care centers in Sodo and Butajira districts (18, 20), with over 250 health center-based clinicians trained in the World Health Organization's mental health Gap Action Programme (mhGAP) (23), which aligns with the National Mental Health Strategy of the Ministry of Health Ethiopia (24).

Study timing

The study was conducted from October to November 2020. At that time, the nationwide state of emergency, declared due to the pandemic, was lifted.

Participants

For the quantitative study, we selected 336 participants from the two cohorts (168 people with SMHCs and 168 matched (sex and age (±5 years)) comparisons). For the qualitative study, we purposively selected people with SMHCs and their caregivers, community members, psychiatric nurses and primary health care (PHC) workers who had been involved in task-shared mental health care. The recruitment stopped when saturation was reached.

Data collection

For the quantitative study, we collected data on socio-demographic information, wellbeing, social support, living standards, and food insecurity. We used the WHO well-being index to assess wellbeing. , This Index consists of five items with six possible responses where a higher score indicated better wellbeing (25, 26).

Social support was measured using the Oslo Social Support Scale (OSSS-3). The OSSS is a three item instrument which has been used previously in this setting (27). Food insecurity (before and after COVID-19) was assessed based on an item used in the C-MaMiE cohort study (28). We also asked the participants to rate their living condition relative to their neighbors.

For the qualitative study, we developed an interview guide to explore participants' perceptions regarding the potential impact of COVID-19 on people with SMHCs, how mental health services are being, and could be, adapted, the unmet needs of people with SMHCs due to COVID-19 and how these could be addressed.

Data analysis

We conducted McNemar's test and paired t-tests to assess the association between the exposure and the outcome variables. We also applied descriptive statistics (frequency, percentages, mean, median, standard deviations, and interquartile ranges) using STATA-17

In the qualitative study, all interviews h were audiotaped. The data were analyzed thematically (29) using OpenCode 4.03 software (30) in parallel with data collection. Constant comparison with the emerging data was carried out (31, 32).

After repeated listening to the audio files and reading the transcripts, WF developed initial codes by carrying out open coding on two transcripts. This initial framework was discussed with SS, CH and EG in order to assess relevance and appropriateness of codes and to refine definitions and descriptions. Coding of the remaining transcripts was done based on the agreed codes, with new emerging codes identified and added. After examining the links between the initial codes, subthemes were developed. The themes were defined and named after the subthemes had been reviewed for patterns and relationships. Illustrative quotes (33) were selected for each theme or subtheme.

Ethical considerations

We obtained ethical approval from the Institutional Review Board of the College of Health Sciences, Addis Ababa University (072/20/CDT). We provide detailed information for the participants before receiving consent.

Results

Participant *characteristics* (Quantitative study)

The mean age of study participants was 43.0 years (±12.9). A higher percentage of participants in the comparison households (83.9%) were currently married compared to participants with SMHCs (54.2%). Nearly two-thirds (64.0%) of participants were farmers (Table 1).

Table 1: Participant's sociodemographic characteristics

Variable	Responses	People with SMHCs	Comparison	P-value
Age (years)	Median (IQR)	41.5 (35, 50.5)	42 (34,50)	---
Current marital status	Currently married	91 (54.2%)	141 (83.9%)	P<0.001
	Currently not married	77 (45.8%)	27 (16.1%)	
Level of education	Cannot read and write	82 (48.8%)	66 (39.2%)	0.19
	Informal education	20 (11.9%)	20 (11.9%)	
	Formal education	66 (39.3%)	81 (48.5%)	
Years of education	Median (IQR)	6 (4,8)	7 (4,10)	0.32
Living place	Rural	124 (73.8%)	124 (73.8%)	
	Urban	44 (26.2%)	44 (26.2%)	

Economic status and COVID-19 impact

Lower self-rated standard of living compared to others in the neighborhood was reported by a higher percentage of households of people with SMHCs (47.0%) compared to comparison households (29.0%). Similarly, 26.0% of households of people with SMHCs reported hunger because of lack of . money/food but only 12.5% of comparison households.The household economic situation was reported to have worsened after the pandemic in about one-third of households (39.0% in SMHCs vs. 33.3% in comparison households). A total of 22 people (12 in SMHCs and 10 in comparison households) had lost their job due to the pandemic

Wellbeing

The median wellbeing index score was higher in comparison households (72 (IQR; 56, 88)) compared to SMHCs households (52 (IQR; 44, 64)) ($p<0.001$). The same was true for social support, with higher mean OSSS score (reflecting better social support) in the comparison households (9.29 ($\pm$2.18)) compared to SMHCs households (8.68 ($\pm$1.93)) ($P<0.001$) (Table 2).

Table 2: Comparison of WHO wellbeing index

Question	Responses	SMHCs (%)	Comparison (%)
I have felt cheerful and in good spirits	None of the time	19 (11.3)	1 (0.6)
	Some of the time	68 (40.5)	27 (16.1)
	Less than half of the time	45 (26.8)	42 (25.0)
	More than half of the time	22 (13.1)	59 (35.1)
	Most of the time	14 (8.3)	39 (23.2)
	All of time	-	-
I have felt calm and relaxed	None of the time	16 (9.5)	3 (1.8)
	Some of the time	72 (42.9)	28 (16.7)
	Less than half of the time	40 (23.8)	41 (24.4)
	More than half of the time	27 (16.1)	56 (33.3)
	Most of the time	13 (7.7)	39 (23.2)
	All of time	-	1 (0.6)
I have felt active and vigorous	None of the time	17 (10.1)	1 (0.6)
	Some of the time	67 (39.9)	39 (23.2)
	Less than half of the time	45 (26.8)	38 (22.6)
	More than half of the time	26 (15.5)	52 (31.0)
	Most of the time	13 (7.7)	37 (22.0)
	All of time	-	1 (0.6)
I woke up feeling fresh and rested	None of the time	20 (11.9)	-
	Some of the time	62 (36.9)	38 (22.6)
	Less than half of the time	44 (26.2)	43 (25.6)
	More than half of the time	23 (13.7)	50 (29.8)
	Most of the time	19 (11.3)	37 (22.0)
	All of time	-	-
My daily life has been filled with things that interest me	None of the time	23 (13.7)	-
	Some of the time	72 (42.9)	37 (22.0)
	Less than half of the time	52 (31.0)	40 (23.8)
	More than half of the time	18 (10.7)	64 (38.1)
	Most of the time	3 (1.8)	27 (16.1)
	All of time	-	-
Composite score	Median (IQR)	52 (44, 64)	72 (56, 88)

Mental health care

In people with SMHCs, 45.0% had experienced relapse after the corona virus pandemic hit Ethiopia. Of these, 48.0% did not seek any help, 27.7% visited a health facility, 16.0% visited holy water, and 9.3% purchased medicines from the local pharmacy outlet. Of those on psychotropic medication, 15.0% reported stopping their medicines due to the pandemic.A total of nine (5.4%) people with SMHCs reported being restrained in the preceding month, reportedly due to unmanageable symptoms for most (n=8), but due to fear of contracting coronavirus infection for one individual.

In the qualitative study, we interviewed psychiatric nurses (n=3), mhGAP trained primary health care workers (n=3), service users (n=4) and their family members (n=6) and community members (n=2). Four themes emerged from the data: reactions, consequences, coping mechanisms and lessons learned.

Reactions

The initial reaction of most respondents was to feel very stressed, due to insufficient information and difficulties with understanding what was being said in the news. They reported getting information about COVID-19 mostly from the media, from television or radio.

Health care professionals reported getting ready for COVID-19 by preparing soap and water for handwashing and wearing masks. However, they reported that these practices did not last long, and people quickly became inattentive.

> *"There is some carelessness among the community and among professionals, for example how to do mask properly and hand washing …people were getting distracted on these things. Before we used to wash our hands before coming to the hospital but not anymore …. the patients also looked up to us and say if they are not doing it, we are also not doing it"* [IDI_06_PHC worker]

Caregivers and health care professionals both reported that people with SMHCs were more susceptible to COVID-19; because it was perceived to be very hard to tell them or direct them not to go out of their house since they always wanted to go out. They also reported that people with SMHCs may not have the financial resources to buy protective equipment.

> *"… As I told you before there was a command post which prohibited people from leaving their house and due to the illness manifestations, it is difficult to control them [people with SMHCs]. If it is an acute case, they [caregivers] could not control them so they would tie them up and make them stay home"* [IDI_01_Psychiatric nurse]

Health care providers reported feeling more vulnerable to COVID-19, especially when they tried to help a person with SMHCs. They reported that people with SMHCs may not be able to comprehend and keep to the recommended physical distance. They also tried to greet them in the usual fashion.

Consequences

Family members of people with SMHCs reported the impact of the illness on their daily living. During the initial periods and the national precautionary measures, people were unable to go to the marketplace or carry out their daily work, which was the main source of income for many. Many also couldn't afford the mandatory masks.

> *"My mother [wife of the person with SMHCs] is a trader. She is the one who buy things for our family. When the illness [COVID-19) came, she could not go to the market. It was very difficult."* [IDI_07_Caregiver]

COVID-19 introduced a new type of stigma and discrimination in the community, especially directed towards people with a cough and people who came from urban areas. Stigma and discrimination against people with SMHCs was reported to have been heightened after COVID-19. People distanced from people with SMHCs because they were afraid of contracting the virus and perceived that people with SMHCs might not wear a mask or might spend time out of their house.

> *"I have seen people shouting at a person with SMHCs because he did not wear facemask during the state of emergency. A policeman came and took him to the police station. I did not know what happened then."* [IDI_13_caregiver, Butajira]

Regarding attendance for mental health care, reports were mixed. The overall patient flow was reported to have decreased while the number of new cases seemed to have increased. One frequently mentioned reason for decreased attendance in people with a pre-existing diagnosis of a mental health condition was the transportation cost. The sanctions placed on transportation to only carry half the usual number of passengers led to a doubling of the cost of transportation. This put a strain on people who needed to come to the hospital for their appointment.

> "At that time there was a feeling of shock among the patients. We used to get 30 up to 40 or an average of 35 patients, but after corona it reduced to 15 or 16 patients per day" [IDI_02_Psychiatric nurse, Sodo]

> *"Transportation cut down in half; means one passenger in two seats. For example, if he comes from far and used to pay 100 birr now he pays 200 birr and round trip means 400 birr, if it was 50 birr now it's 200 birr for round trip"* [IDI_02_psychiatry nurse, Butajira]

COVID-19 put a toll on people who did not have a mental illness prior to the pandemic. The psychiatric nurses reported an increased number of new cases. The cases were related to fear of contracting the virus, misinterpretation of symptoms such as cough and fear of losing people. The new cases ranged from mild obsessive-compulsive disorder to serious suicidal thoughts and attempts.

"If they have a cough, they will think that they have it [COVID-19]; they said take a look at me, my temperature is high. A banker said I have COVID take me to the hospital. She does not sleep, and she said if you are not going to give me any solution, I will commit suicide. She could not calm down, so we sedated her. It took me around 2 months to get her back to her usual self. Now she is fine" [IDI_03_psychiatry nurse]

Respondents also reported an increased number of relapses due to reduced follow-up or the medication being unavailable. In some towns, medication was not available for more than eight months. A few fortunate families tried to get medication from private pharmacies but struggled because of the scarcity of supplies.

"Previously, I would buy the medication from the hospital pharmacy but after the pandemic, it was not the case. I have tried here in Butajira, Sodo, Worabi and other places but I could not find medication. I have also tried in private pharmacies, and I only got 3 pills" [IDI_05_caregiver].

Responses and coping

Family members described trying to protect people with SMHCs from contracting the virus by fetching medicines on their behalf, supplying information about the virus, and even sometimes restraining the person at home to prevent them being exposed to transmission. Health care providers also made efforts to minimize the effect of the virus on their clients by giving longer time periods between appointments, reducing contact hours, dispensing medicines through their families, and providing health information through the community-based health extension workers.

"What we did at that time was, we extended appointment time a bit further. For those who used to have appointments weekly to monthly, monthly to 2 months to reduce the back-and-forth situation. After that, especially the health extension workers went home to home to give education and we prioritize on non-communicable and communicable disease. Especially NCD, hypertensive, diabetes, including mental illness since they have relation with COVID-19." [IDI_10_PHC worker]

Health care institutions established a response team, including a psychosocial support team, established new centers of outpatient treatment centers which included mental health care to minimize dropouts, gave training to health care workers, and formed a team for home care to cope with the virus.

Lesson learned

Participants reported the main lessons they took from the current pandemic. These included preparing for a potential future pandemic: availability of medicines, working as a health care team (involving a psychosocial

"It gave us an idea as a country and as a health sector how to tackle if there would be future pandemic. It taught us on decision making, on resource allocation, it also showed us the gaps" [IDI_01_psychiatric nurse]

All the participants reported that the most important lesson learned were the hygiene practices (frequent hand washing). Participants also reported psychological resilience as a good lesson learned.

Discussion

We conducted a mixed method study to describe the effect and explore the consequences of COVID -19 on people with SMHCs and the mental health service. People with SMHCs reported lower well-being and standard of living. The household economic situation was reported to have worsened after the pandemic. Participants reported stressful initial reactions. Caregivers, health care workers, and community members thought that people with SMHCs may be more susceptible to COVID-19 and its consequences such as economic problems and heightened stigma and discrimination. Health care professionals reported decreased patient flow, increased new cases and more relapses.

People with SMHCs were considered more susceptible to COVID-19 infections. The main reasons mentioned were lack of capacity to comprehend information and inability to afford face masks and other essential protective materials. These are essential areas of intervention for both the current and future pandemic. The intervention has to be directed at both people with SMHCs, who would benefit from better compliance with control measures, and the public and health professionals, regarding appropriate support of people with SMHCs. Consideration should also be given to ensure that pre-existing inequities are not exacerbated. The risk of exacerbating the treatment gap in low-income countries (34) and multidimensional poverty (8) should also be considered.

Economic consequences were reported both in the quantitative and the qualitative study. This included increased cost of transportation, loss of daily jobs, and inability to go to the market. These consequences will likely worsen the existing lower living standards of people with SMHCs and their family members (35, 36).

Service providers also reported a higher rate of relapse after COVID-19. They linked the relapse to the interrupted medication availability, inability to come to the health facility, economic problems, and the stress associated with the pandemic. Similar findings were also reported in other places (37-39). Increased relapse in the context of poor

access to care is a key factor contributing to people with SMHCs becoming homeless, abandoned at holy water sites or being chained up (40, 41). The centralized, facility-based nature of the existing mental health system in Ethiopia exacerbates this situation. More responsive care is needed, included the possibility of delivery of medication by health extension workers and home-based care for those who are most unwell and/or restrained. Establishing such models of care would be an important contribution to reducing human rights violations of people with SMHCs as well as increasing system resilience in the face of a pandemic.

Stigma and discrimination appear to have increased due to fear of contracting the virus from people with SMHCs. People with SMHCs were considered at increased risk because of concerns that they may not adhere with standard public health control measures, such as wearing of facemasks, washing hands frequently and staying on the streets, increasing the risk of exposure to the infection (42, 43). These assertions were based on a small number of examples and risked further ostracizing people with SMHCs from appropriate protection, even when it is known that people with SMHC are at risk of poorer outcomes from COVID-19 (44).

The health care professionals and institutions applied different adaptive coping mechanisms to reduce the impact of the pandemic on people with mental illness. These included dispensing medicines for family members, longer intervals between appointments, and setting up new centers. These are important lessons that need to be kept for future pandemics. On the other hand, some of the coping mechanisms used by family members, especially restraining the person with SMHCs at home need to be addressed as a matter of urgency and alternative support mechanisms need to be developed.

Though our study explored the effect of COVID-19 on people with SMHCs and the mental health service in well characterized cohorts, findings may not be transferable to more urban areas like Addis Ababa. Since the study was conducted before the introduction of vaccine, we did not report on vaccine access and use in people with SMHCs.

Conclusions

COVID-19 had negative consequences on people with SMHCs and the mental health service. These included increased perceived vulnerability to infection, economic problems, discrimination, and challenges of access to care. New studies are required to find out if these trends, particularly the poor access to care, have continued given the potential to exacerbate the substantial pre-existing treatment gap. New studies are also required to address dangerous practices, particularly restraining of people with SMHCs. Some of the coping mechanisms in the settings such as setting up new centers can be transferable to other settings and similar pandemics in the future.

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of the College of Health Sciences, Addis Ababa University (072/20/CDT). We provide detailed information for the participants before receiving consent.

Consent for publication

Not applicable

Availability of data and material

The datasets supporting the conclusions of this article are included within the article. Any additional material can be obtained upon reasonable request.

Competing interests

The authors have no conflict of interest to declare.

Funding

WF was supported by African Mental Health Research Initiative (AMARI) under the DELTAS Africa Initiative (DEL-15-01).This research received funding from Addis Ababa University through the Thematic Research Grant scheme [Grant ID: LT/PY-045/2021]. Additional support was obtained from the National Institute for Health Research (NIHR) Global Health Research Unit on Health System Strengthening in Sub-Saharan Africa, King's College London [Grant ID: GHRU 16/136/54] using UK aid from the UK Government to support global health research. The work is coordinated by the Unit for Health Evidence and Policy (UHEP) at CDT-Africa which is supported financially by the Wellcome Trust [Grant ID: 221576/Z/20/Z]. CDT-Africa is a world bank supported center of excellence [Grant Id: P151847-IDA57940]. The views expressed in this publication are those of the author(s) and not necessarily those of Addis Ababa University, the NIHR or the Department of Health and Social Care or the Wellcome Trust or the World Bank supporting CDT-Africa.

Authors' contribution

AF and WF conceived the study and they were part of the whole process of the study. CH, SS and EG participated in the design of the study, analysis of qualitative data, reviewed all versions and made corrections. All the authors read and approved the last version.

Supplementary Material

None

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Ethiopian Medical Journal 2022, 60 (Supplement 1)
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ISSN 0014-1755 eISSN 2415-2420
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Systematic Review

Efficacy and safety of chloroquine and hydroxychloroquine for the treatment of COVID-19 infection: An umbrella review

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Abstract

Introduction: *Among all therapeutic approaches for COVID-19, most controversies have been raised about the efficacy and safety hydroxychloroquine (HCQ) and chloroquine. We conducted an umbrella review to assess any potential benefits of hydroxychloroquine and chloroquine in treating COVID-19.*

Methods: *We searched the Cochrane Database of Systematic Reviews, PubMed and covid-evidence.org from December 2019 until July 2022. Time to viral clearance, need for mechanical ventilation and mortality were assessed as main efficacy outcomes. The analysis was performed using R package version 4.1.2.*

Result : *Hydroxychloroquine had no benefit in decreasing time to viral clearance at days 7 (RR 0.81; 95% CI 0.63, 1.03) and 14 (RR 1.00; 95% CI 0.90, 1.139). Chloroquine has no statistically significant effect in decreasing the time of viral negativity at days 7 (RR 1.20; 95%CI 0.64, 2.25) and 14 (RR 1.08; 95%CI 0.85, 1.36). There is no difference in the need for mechanical ventilation among hydroxychloroquine plus azithromycin versus standard of care groups. Hydroxychloroquine marginally increased the mortality rate compared to placebo but not statistically significant (RR 1.09; P-value 0.05). Adding azithromycin to hydroxychloroquine had no statistically significant effect of decreasing mortality (RR 0.52; 95%CI 0.13, 2.07). Treatments with hydroxychloroquine increased the risk of adverse effects (RR 2.71; 95%CI 1.66, 4.43; p-value <0.0001). Adding azithromycin to hydroxychloroquine increased the adverse events (RR 1.74; 95% CI 1.27, 2.38).*

Conclusion: *Though access to antivirals is an important challenge in developing countries, the decision to suspend hydroxychloroquine and chloroquine in treating COVID-19 appears right.*

.***Keywords****: Review; COVID-19; Hydroxychloroquine; Chloroquine; Efficacy; Safety; Mortality*
Citation : *Digamo K, Demissie M, Amogne W, et al ,Efficacy and safety of chloroquine and hydroxychlooquine for the treatment of COVID-19 infection: Umbrella Review. Special issue of Ethiop Med J 60 (Supplement 1) 76– 86*
Submission date *: 108 August 2022 Accepted: 29 October 2022 Published: 30 October 2022*

Introduction

In late December 2019, the novel coronavirus disease (COVID-19) was reported in the city of Wuhan, China and has since spread around the globe. The causative agent is β-coronavirus or SARS COV -(1, 2). The pandemic has infected more than 579 million people with 6 million deaths, as of 19thJuly, 2022(3). Due to the extraordinary impact of the pandemic on public health and society in many countries, there is high demand for effective treatments for COVID-19. The attempts to discover new drugs and repurpose previous medications for the treatment of COVID-19 have not been entirely satisfactory, and no preventive drugs have emerged except for the recent vaccines(4). The safety and efficacy of the antimalarial drugs, hydroxychloroquine and chloroquine, along with azithromycin, were among the top agents tested against COVID-19 (5-9). Chloroquine and hydroxychloroquine have been used widely for the

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treatment and prevention of malaria, and autoimmune diseases such as systemic lupus erythematosus (SLE) and rheumatoid arthritis (RA) (10-17). They have demonstrated antiviral effect through inhibiting the virus replication (18-23).

If found effective against COVID-19, the availability of these drugs at low cost would ensure equitable access to treatment, especially in low-and middle-income countries(24).Azithromycin is a safe and well -tolerated antibiotic approved in adults and children aged, 6 months and older (25). Azithromycin has demonstrated in vitro antiviral activity against Zika, Ebola, influenza H1N1 virus, enterovirus and rhinovirus (26, 27). In addition, it has antiviral effect against SARS COV by interfering the binding of the-SARS-CoV-2spike protein and host receptor angiotensin-converting enzyme-2 (ACE2) protein (12, 28).

Despite the uncertain evidence on hydroxychloroquine or chloroquine, some governments have recommended using hydroxychloroquine as prophylaxis and as a first line treatment for COVID-19 patients (29, 30).However, concerns regarding adverse effects have led tothe removal of hydroxychloroquine or chloroquine from several country guidelines.

There have been mixed results from systematic reviews and meta-analyses on the effect of chloroquine and hydroxychloroquine with or without azithromycin on various COVID-19 outcomes (31-35). For example, a review of hydroxychloroquine safety and efficacy in COVID-19 found it to reduce mortality in SARS-Cov-2 positive patients and improve clinical recovery in renal transplant recipients(31)whereas other reviews and meta-analyses reported that chloroquine and hydroxychloroquine had negative effects on COVID-19 hospitalized patients(33), and does not improve clinical outcomes in COVID-19 patients (34). An umbrella review that was carried out in 2020 and included three systematic reviews reported that hydroxychloroquine or chloroquine alone or in combination with azithromycin have no benefit for patients with COVID-19. Additionally, the review reported these medications could result in both statistically and clinically elevated risks of arrhythmias(36) This review was of narrow scope and did not report the broad range of benefits and safely issues related to these medications. Therefore, in the current review, we aimed to update the evidence by extending the review period and including broader efficacy and safety outcomes. We hoped that this would provide more robust evidence on evidence on the overall efficacy and safety of hydroxychloroquine or chloroquine in patients infected with COVID-19 for both policy makers and practitioners

Methods

Study design: This umbrella review was conducted guided by the preferred reporting items for overviews of reviews (PRIOR) statement that has 27 main items covering all steps and considerations involved in planning and conducting an overview of reviews of healthcare interventions (37) (see supplementary file-4), and methodological guidance on the conduct and reporting of an umbrella review approach (38),. The protocol of this review was registered on PROSPERO (CRD42021233069).We augmented the prior guideline with the PRISMA (Preferred Reporting Items for Systematic Reviews and meta-analyses) flow chart(39).

Search strategy and Selection of studies:

We searched Cochrane Database of Systematic Reviews (CDSR) (The Cochrane Library), Pub Med and covid-evidence.org from December 2019 to July 2022 to identify potentially eligible reviews that were published in the English language. We conducted the search using MeSH terms, free text words and word variants as Chloroquine; Hydroxychloroquine; Hydroxychloroquine sulfate; COVID-19; Coronavirus infection SARSCov-2 (**see Table 1**). All the retrieved papers were transferred to ENDNOTE version x7 and duplicates were removed.

Table 1: Search terms used in our umbrella review in the Pub Med database

	Search terms used
1	(("Hydroxychloroquine"[Mesh]) OR ("Chloroquine"[Mesh] OR "chloroquinediphosphate")
2	(("COVID-19"[Mesh] OR "SARS-CoV-2"[Mesh] OR "SARS-CoV-2 variants" OR "COVID-19 serotherapy"
3	(("Systematic Review" [Publication Type] OR "Systematic Reviews as Topic"[Mesh] OR "Meta-Analysis as Topic"[Mesh]) OR "Review"

Eligibility criteria

- Eligible articles were assessed against the following inclusion criteria:
- **Population:** participants with any clinical stage of confirmed COVID-19, all age and both sexes.
- **Intervention:** Hydroxychloroquine/ chloroquine with or without Azithromycin.
- **Comparison:** Standard of care or placebo.
- **Outcome: primary outcomes (**mortality, viral clearance and adverse events) and **secondary outcome** (disease progression).

Study design: Only systematic review and meta-analysis of randomized clinical trials were included..

Data extraction
Data extraction was performed by two independent reviewers. The data collection format was adopted from the Cochrane data extraction tool. Any discrepancies were reconciled through discussion and excluded articles and reasons for exclusion were documented. The information extracted from the reviews included: author name, year of publication, number of studies included in the review, total number of participants, setting of the studies, types of participates, the intervention and comparator groups, and outcomes of the studies included were extracted.

Methodological quality assessment
Two reviewers independently evaluated the methodological quality of the included studies using A Measurement Tool to Assess systematic Reviews2(AMSTAR 2) tool(40). Any discrepancy between the reviewers was resolved through discussion. AMSTAR 2 has 16 items (7 critical checklists and 9 noncritical checklists) for assessing systematic reviews and meta-analyses. The items are evaluated either with "yes" or "no" (items 1, 3, 5, 6, 10, 13,14, and 16); with "yes", "partial yes", or "no" (items 2, 4, 7, 8, and 9); or with "yes", "no", or "no meta-analysis conducted" (items 11, 12, and 15). Each of the 16 items a score of 0 (answer "no"), 1 (answer "yes") or 0.5 (answer "partial yes"). The rating criteria of AMSTAR 2 were divided into four levels: the presence of, 0–1 non-critical weakness is defined as high quality; more than, 1 non-critical weakness is defined as moderate quality; 1 critical flaw with or without non-critical weaknesses is defined as low quality; and the presence of more than, 1 critical flaw with or without non-critical weaknesses is defined as critically low quality. The evaluation was completed using the online version available on the AMSTAR website (https://amstar.ca/Amstar_Checklist.php)(40) and finally classified as high, moderate, low, or critically low quality.

Data Synthesis and Analysis
We summarized meta-level description and synthesis of the findings from the included reviews. We categorized into quantitative, qualitative and/or mixed-synthesis groups based on information about the design of primary studies provided in the reviews in tabular form. A narrative was structured around the type of evidence, selected population characteristics and type of outcome. After two reviewers extracted the outcomes on the efficacy and safety, the risk ratio (RR) with 95% confidence intervals (CIs) was calculated.

One of the articles reported hydroxychloroquine and hydroxychloroquine with azithromycin specific adverse effects. For this reason, we described findings of this paper separately(41). We evaluated the heterogeneity of the primary studies using statistical test I^2 considering as significant heterogeneity if I^2 value is greater than 50% by using both fixed-effects model and a random-effects model. The analysis was performed using R package

Assessment of the certainty of evidence
We used the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) approach to assess the level of evidence for all outcomes separately by employing GRADEpro GDT software (GRADEpro GDT).

Results

Literature search and selection process
A total of 184 articles were identified from the primary search. Of these, two were duplicates and excluded. Of the remaining 182, articles, 164 were excluded during title and abstract screening because they were not reviews or related to COVID-19. Eighteen full-text articles were reviewed with 12 papers excluded because they included individual studies with mixed design or non-RCT methodology. A total of six reviews with 76 RCTs were included in this umbrella review **(Figure 1).**

Study characteristics
Out of six included reviews, three of them reported the effect of hydroxychloroquine or chloroquine on the viral clearance rate(42-44), three reviews reported on the effect of hydroxychloroquine/ chloroquine and hydroxychloroquine with azithromycin on rate of mortality (42, 44, 45), two reviews reported the effect of hydroxychloroquine with and without azithromycin on disease progression(42, 44) and four reviews reported on adverse events of hydroxychloroquine with or without azithromycin(41, 42, 44, 46)**(see Table 2***)*.Some primary studies were included in more than one review: Two primary studies were included in two reviews, five in three reviews, one in four reviews, four in five reviews, and two in six reviews. The remaining 19, studies did not overlap. (See supplementary file-1**)**

Figure 1: PRISMA Flow chart of search strategy and selection study characteristics

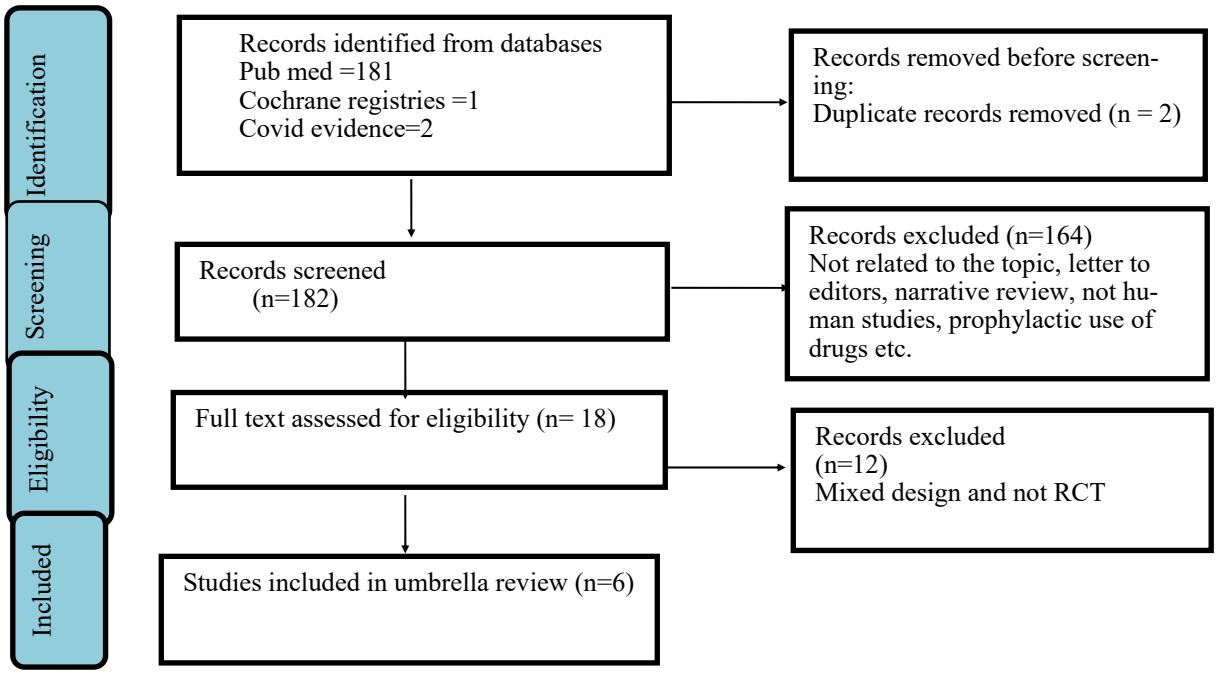

Table 2: characteristics of the included systematic review and meta-analysis studies

Author, year	Total Studies	Total Participants	Intervention drug	Comparator drug	Study Country	Outcomes	Study Quality
Bignardi et al, 2021	12	7,629	HCQ/CQ	not HCQ/CQ	Egypt,USA, Canada, Brazil, China, Taiwan, UK, Norway	Time to viral cure, time of clinical recovery,mortality, dverse events	Critically low
Lacerda et al, 2021	28	10,319	HCQ or CQ	placebo/no treatment	International multicenter	Mortality	Low
Maraolo- et al, 2021	5	2291	HCQ/CQ	Placebo/Standard of care	China, Canada, United states, Spain, Brazil	Adverse events	Critically low
Pathak et al, 2020	7	4984	HCQ/CQ	Standard of care, Lopinavir/ritonavir (400/100 mg) and SOC	China, Brazil, Spain	Clinical improvements and viral clearance	Critically low
Singh et al, 2021	14	11915	HCQ/CQ alone or with other treatment any routeof administration and dose	No treatment, supportive treatment, or other experimental antiviral treatment other than CQ or HCQ).	Brazil, Egypt, Iran, UK, USA, Canada, Spain, Taiwan	Clinical recovery, mechanical ventilation, length of hospital admission, adverse events	High
Izcovich et al 2022	10	3663	HCQ	placebo or standard care	USA,Canada, Brazil, China, Taiwan,UK, Norway	adverse effects	Critically low

Quality of included reviews

Of the six reviews, four reviews have critically low quality, one review has low quality and one review have high quality appraisal (supplementary file-2). The low quality resulted from the weakness in the study design of the reviews. Two of the studies lacked explicit statement that the review methods were established prior to the conduct of the review(42, 43), five reviews did not report list with reason for excluding studies(41-43, 45, 46); no assessments for potential impacts of risk of bias in individual studies on the result of meta-analysis in two of the studies(42, 43), and did not account for the risk of bias in individual studies when interpreting or discussing the result of the review(42, 43). Publication bias was also not reported in three reviews(43, 46). (See supplementary file-2). All articles were evaluated for certainty of evidence at primary data level using online GRADEpro software and the result is elaborated for each primary outcome separately (See supplementaryfile-3).

Mortality rate

A total of three reviews investigated and reported the pooled estimate of mortality.

Two of these reviews compared hydroxychloroquine or chloroquine with or without azithromycine to standard care. The pooled effect from two reviews with thirty-seven RCTs showed that the risk of mortality marginally increased for hydroxychloroquine compared to standard care, but the difference was not statistically significant (RR1.09; 95%CI 1.00, 1.19; I^2 = 0%; 37 RCTs; 13,394 patients; Moderate certainty of the evidence) **(see Figure 2).**The pooled estimate also showed no benefit of chloroquine treatment in decreasing the risk of mortality compared to standard care(OR 1.77; 95% CI0.15, 21.13; p-value 0.21; I^2 = 0%; 4RCTs; 307 patients; Very low certainty of evidence).

The third review showed that hydroxychloroquine plus azithromycin had no statistically significant benefit in decreasing the risk of mortality compared to standard care for COVID-19 patients (RR0.52; 95% CI 0.13, 2.07; 1RCT; 444 patients; Low Certainty of evidence).

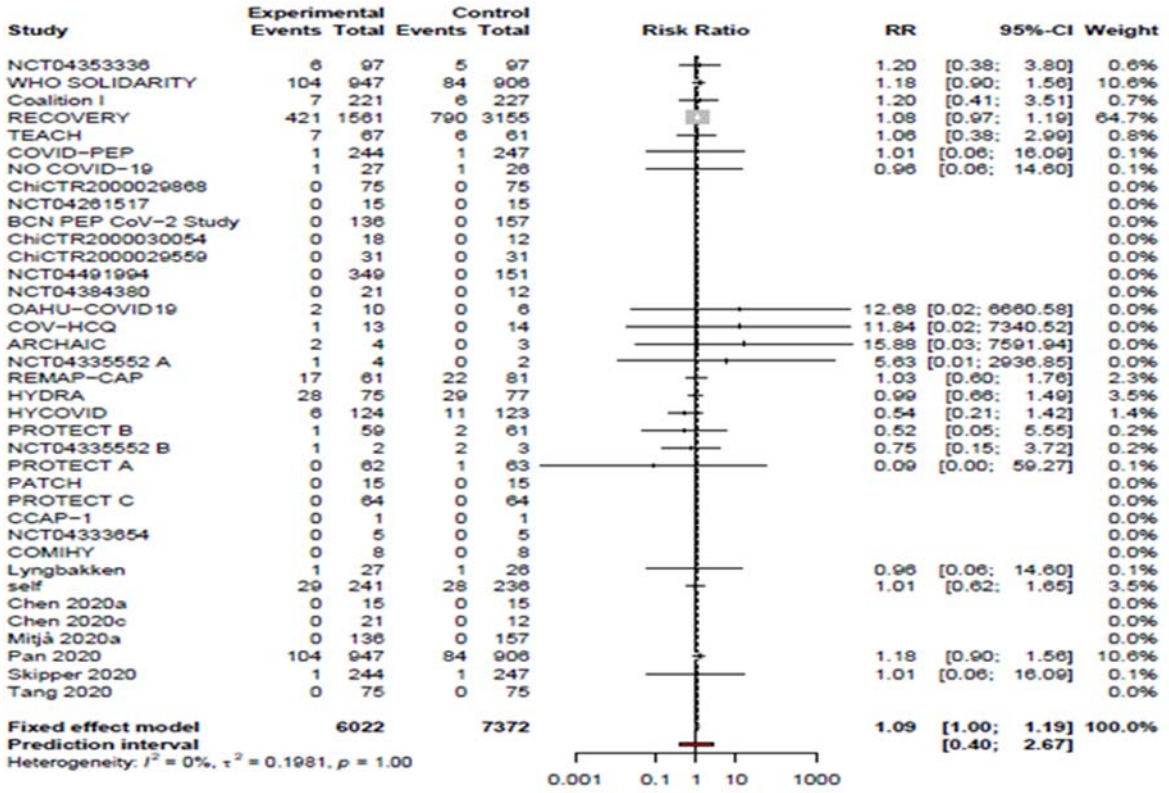

Figure 2: Forest plot of hydroxychloroquine alone versus standard of care in mortality

Viral clearance

The effect of hydroxychloroquine or chloroquine on time to viral clearance was reported in two of the six reviews (42, 44). In both reviews, time to viral clearance was measure time to negative PCR for SARS-CoV-2 on respiratory samples.Meta-analysis done from these two reviews with three overlapping RCTs showed that hydroxychloroquine alone had no statistically significant difference in viral clearance at day 7 (RR 0.81; 95% CI 0.63, 1.03; P value = 0.08; I^2 = 0%; 2RCTs; 180 participants; Very low certainty of evidence) and at day 14 (RR 1.00; 95% CI 0.90, 1.13; P = 0.99; I^2 = 0%;; 3RCTs; 213 participants; Very low certainty of evidence) when directly compared to standard of care **(Figure 3, Figure 4).**Chloroquine also showed no statistically significant effect in decreasing the time of viral negativity at both Day 7 (RR 1.20; 95%CI 0.64, 2.25; P = 0.57) and Day 14 (RR 1.08; 95%CI 0.85, 1.36; P = 0.53).

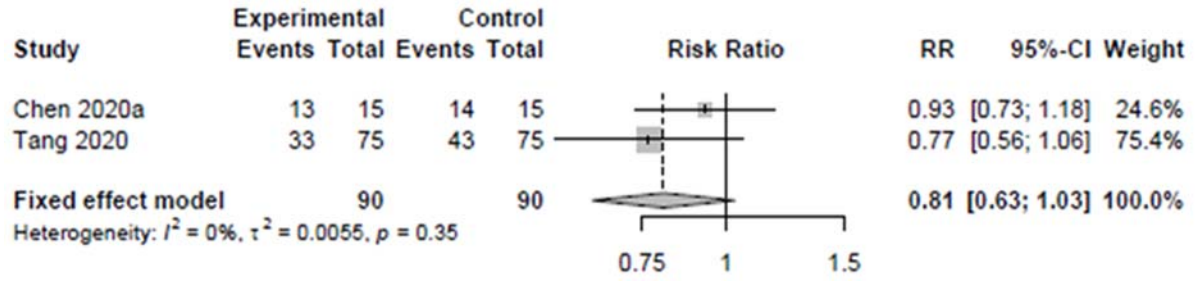

Figure 3: Forest plot of hydroxychloroquine versus standard of care in viral clearance at Day 7.

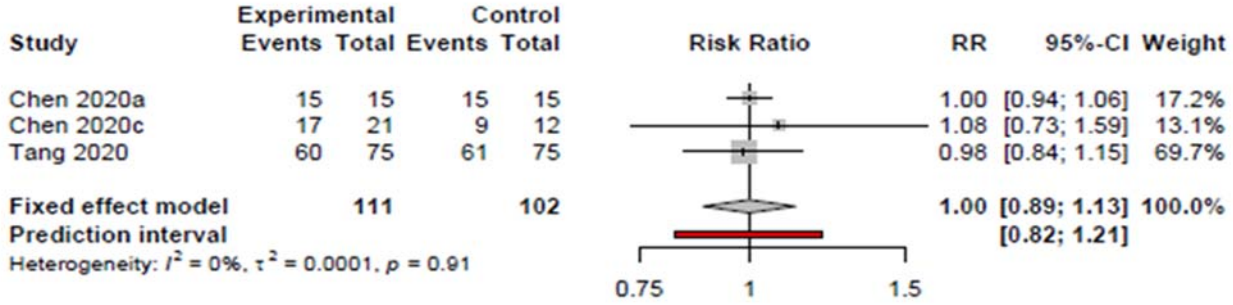

Figure 4: Forest plot of hydroxychloroquine versus standard of care in viral clearance at Day 14.

Disease progression

Two reviews (42, 44) reported on the need of mechanical ventilation for hydroxychloroquine and confirmed that hydroxychloroquine when used alone (RR1.15, 95%CI 0.92–1.38, P > 0.05;5339 participants;3 RCTs and RR 1.11,95%CI 0.91-1.37; 4521participants; 3 RCTs) or in combination with azithromycin (HCQ+AZI) (RR1.61; 95% CI 0.82, 3.15; 444 participants) demonstrated no statistically significant benefits.

Adverse events

A meta-analysis from three reviews indicated increased risk of adverse events of treatment with hydroxychloroquine compared to standard of care (RR2.71; 95%CI 1.66, 4.43; p-value <0.0001; I^2=81.4%;2802, participants; 8RCTs; Very low certainty of evidence).

Similarly, hydroxychloroquine plus azithromycin therapy versus usual care found a statistically significant increase in causing any adverse effects (RR1.74; 95%CI 1.27, 2.38,416 participants; 1RCT; Moderate certainty of evidence) (**Figure 5**). However, one review that included nine hydroxychloroquine trials and one hydroxychloroquine with azithromycin compared to standard care. The findings showed that hydroxychloroquine with or without azithromycin increased the risk of cardiac toxicity, nausea, and/or vomiting. Additionally, hydroxychloroquine alone increased the risk of cognitive dysfunction/delirium (41)

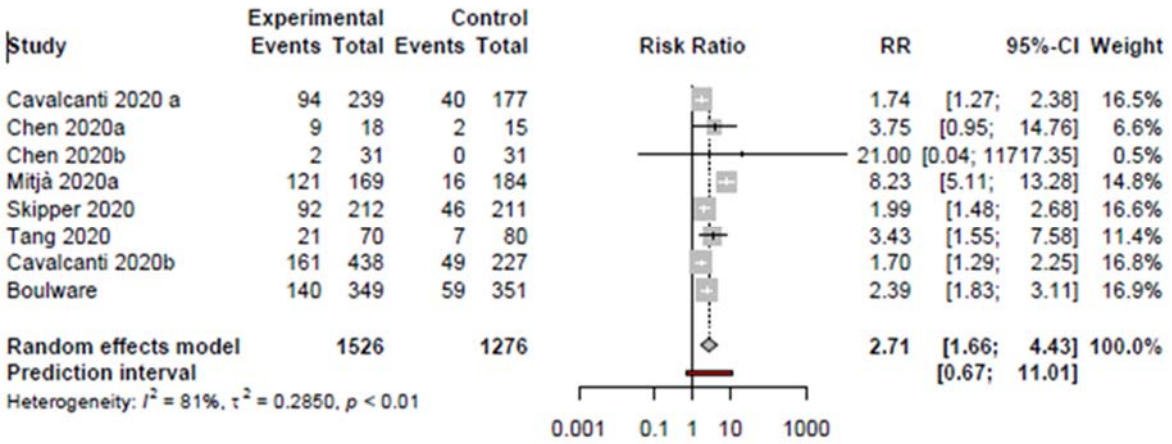

Figure **5: Forest plot of hydroxychloroquine versus standard of care in adverse events**

Discussion

In this umbrella review, we included systematic reviews and meta-analyses of RCTs to evaluate the relative efficacy of chloroquine and hydroxychloroquine, with or without adjunct azithromycin, against the standard of care among COVID-19 patients in terms of viral clearance, need for mechanical ventilation, mortality, and adverse events.

We find that hydroxychloroquine alone or in combination with azithromycin had no positive effect in reducing time to viral clearance compared to standard treatment. This was despite some clinical trials that indicating faster viral clearance(47)(48), and a meta-analysis reporting that treatment with hydroxychloroquine was associated with faster clinical and radiological improvement (49) and favorable safety profile (50).

The need for mechanical ventilation for hydroxychloroquine plus azithromycin was not better than standard care, which is in line with previous study that reported hydroxychloroquine alone was not better than standard care (51). In our review, hydroxychloroquine with or without azithromycin had no significantly difference in mortality reduction compared to standard care, , which is similar to findings reported to previous reports (52-61)..Further exploration of the effect of age (56)and other demographics and clinical characteristics that tend to be associated with increased risk of mortality (62) should be explored further. The umbrella review also showed hydroxychloroquine alone or in combination with azithromycin increases the risk of adverse effects compared to the standard of care. Although a review of 14 articles, including 5,048 patients treated with aminoquinolines alone or in combination with azithromycin, found no statistical difference in drug-related adverse critical cardiac events when compared to control groups, the result and interpretation are limited by the small sample size and study design (63).

Concerns about the efficacy and safety of hydroxychloroquine by many national health organizations(64),the European medicines(65) and the WHO were warranted. Many of these agencies, including the US' Food and Drug Administration (FDA) have removed the emergency use authorization of hydroxychloroquine for COVID-19 (66)**.**

This umbrella review has several limitations. First, methodological limitations in the included reviews, such as small number of randomized controlled trials, and small sample size affect the results of the umbrella review. Second, almost all reviews were of low quality, such as prespecified protocols, and risk bias assessments, which affect seriously the conclusions to be drawn from the main outcomes of efficacy and safety. Third, we only included systematic reviews and meta-analyses of RCTs. So, reviews of studies other than RCTs were excluded . However, the umbrella review method provides a useful route to achieving our aim of summarizing evidence from reviews relevant to the current and future implementation of the intervention.

Conclusion

The findings showed that chloroquine and hydroxychloroquine with or without azithromycin conferred no benefit in decreasing the risk of mortality and time to viral clearance at days 7&14. Similarly, hydroxychloroquine with or without azithromycine increased adverse events among COVID-19 patients. Though access to antivirals is an important challenge in developing countries, the decision to suspend hydroxychloroquine and chloroquine in treating COVID -19 appears right.

The review was conducted after the initial recommendation to not use hydroxychloroquine and chloroquine in the treatment of COVID-19.

Nevertheless, given the potential accessibility of these drugs, we believe it was important to confirm that these drugs have no potential utility through umbrella review.

Abbrvations

Azithromycin(AZI), A Measurement Tool to Assess Systematic Reviews (AMSTAR 2), Confidence Interval (CI), Corona Virus Disease 2019 (COVID-19), Chloroquine (CQ), Grading of Recommendations, Assessment, Development, and Evaluation (GRADE), Hydroxychloroquine (HCQ), Middle East Respiratory Syndrome-Corona Virus (MERS-COV), Medical Subject Heading (MeSH), Mechanical ventilation (MV), Polymerase Chain Reaction (PCR), Preferred Reporting Items for Overviews of Reviews (PRIOR), Randomized Clinical Trial (RCT), Sever Acute Respiratory Syndrome–Corona Virus (SARS-COV), Sever Acute Respiratory Syndrome-Corona Virus-2 (SARS-COV 2), Standard of care (SC), Systemic Lupus Erythematosus (SLE), World Health Organization (WHO).

Declarations

Ethics approval and consent to participate:
Not applicable

Consent for publication:
Not applicable

Availability of data and material:
The data supporting the conclusions of this review are included within the article and its additional files. Any additional materials are also attached in a separate file.

Competing interests:
The authors declare that they have no competing inter-

Funding:
This research received funding from CDT-Africa, Addis Ababa University, which is a world bank supported center of excellence [Grant Id: P151847-IDA57940]. The main study was supported by the Addis Ababa University through the Thematic Research Grant scheme [Grant ID: LT/PY-045/2021]. The work is coordinated by the Unit for Health Evidence and Policy (UHEP) at CDT-Africa which is supported financially by the Wellcome Trust [Grant ID: 221576/Z/20/Z]. The views expressed in this publication are those of the author(s) and not necessarily those of Addis Ababa University, the Wellcome Trust or the World Bank supporting CDT-Africa.

Acknowledgment:
The authors would like to acknowledge the staff at the Centre for Innovation and Drug Development and Therapeutic Trials for Africa (CDT-Africa), Addis Ababa University.

Authors' contributions
AF, MD and KD conceived and designed the study. KD and MD did the database searching. KD and DT did the screening, data extraction and quality assessment. KD, MD, and AF did the analysis. KD and MD drafted the manuscript. AF critically revised and substantially contributed throughout the writing of the manuscript. All authors approved the final manuscript to be submitted for publication.

Supplementary files:

Supplementary file 1: https://bit.ly/3Wik2Hn
Supplementary file 2: https://bit.ly/3sOr35i
Supplementary file 3: https://bit.ly/3ztABX9
Supplementary file 4: https://bit.ly/3DV38HA

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    - nforming officially the author's/reviewer's affiliating institution.
    - The formal, announced retraction of publications from the journal in accordance with the Retraction Policy.
    - The formal, announced retraction of publications from the journal in accordance with the Retraction Policy.
    - A ban on submissions from an individual for a defined period.
    - Referring a case to a professional organization or legal authority for further investigation and action
    - The above actions may be taken separately or jointly. If necessary, in the process of resolving the case relevant expert organizations, bodies, or individuals may be consulted.
- When dealing with unethical behavior, the Editorial Board will rely on the guidelines and recommendations provided by the Committee on Publication Ethics (COPE).

Plagiarism prevention

The Ethiopian Medical Journal does not publish plagiarized papers. The Editorial Board has adopted the stance that plagiarism, where someone assumes another's ideas, words, or other creative expression as one's own, is a clear violation of scientific ethics. Plagiarism may also involve a violation of copyright law, punishable by legal action. Plagiarism includes the following:

- Self-plagiarism, which is using one's own previous work in another context without citing that it was used previously;
- Verbatim (word for word), or almost verbatim copying, or purposely paraphrasing portions of another author's work without clearly indicating the source or marking the copied fragment (for example, using quotation marks) in a way described under Responsibilities of authors;

* Copying equations, figures or tables from someone else's paper without properly citing the source and/or without permission from the original author or the copyright holder.

Any manuscript which shows obvious signs of plagiarism will be automatically rejected. In case plagiarism is discovered in a paper that has already been published by the journal, it will be retracted in accordance with the procedure described under Retraction policy, including blacklisting the author(s). To prevent plagiarism, submitted manuscripts will go through rigorous plagiarism detection process using standard software. The results obtained are verified by the Editorial Board in accordance with the guidelines and recommendations of the Committee on Publication Ethics (COPE).

Confidentiality

EMJ is committed to ensuring the integrity of the peer review process, in accordance with COPE guidelines. Until publication, we strictly keep confidentiality of manuscripts or materials submitted. Reviewers are also required to treat all submitted manuscripts confidentially to make the review process strictly confidential. They should not share information about the manuscript under their review with any third parties. Any breach of confidentiality during the review process will follow COPE guidelines.

Conflict of interest

According to the World Association of Medical Editors (WAME), existence of conflict of interest should be reported if there is a divergence between an individual's private interests (competing interests) and his or her responsibilities to scientific and publishing activities such that a reasonable observer might wonder if the individual's behavior or judgment was motivated by considerations of his or her competing interests. It is the responsibility of authors to disclose any financial/other interest that may have influenced the development of the manuscript. If the reviewers perceive any possible conflict of interest for manuscripts they are assigned to review, they should disclose it and they should decline the review of such manuscripts if needed. The same also applies to the editors.

Retraction policy

Legal limitations of the publisher, copyright holder or author(s), infringements of professional ethical codes, such as multiple submissions, bogus claims of authorship, plagiarism, fraudulent use of data or any major misconduct require retraction of an article according to Retraction guidelines | COPE: Committee on Publication Ethics. Occasionally, a retraction can be used to correct numerous serious errors, which cannot be covered by publishing corrections. A retraction may be published by the Editor-in-Chief, the author(s), or both parties consensually. The retraction takes the form of a separate item listed in the contents and labeled as "Retraction". The original article is retained unchanged, except for a watermark on the PDF indicating on each page that it is "retracted".

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Authors are permitted to deposit publisher's version (PDF) of their work in an institutional repository, subject based repository, author's personal website (including social networking sites, such departmental websites at any time after publication. Full bibliographic information (authors, article title, journal title, volume, issue, pages) about the original publication must be provided and links must be made to the article's DOI and the license.

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GUIDELINES FOR AUTHORS

The *Ethiopian Medical Journal (EMJ)* is the official Journal of the Ethiopian Medical Association (EMA) devoted to the advancement and dissemination of knowledge pertaining to the broad field of medicine in Ethiopia and other developing countries. Prospective contributors to the Journal should take note of the instructions of Manuscript preparation and submission to EMJ as outlined below.

Article types acceptable by EMJ

Original Articles (*vide infra*) on experimental and observational studies with clinical relevance
Brief Communications
Case Series
Case Reports
Editorials, Review or Teaching Articles: by invitation of the Editorial Board.
Correspondences/Letters to the Editor
Monographs or set of articles on specific themes appearing in a Special Issues of the Journal
Book reviews
Perspectives,
Viewpoints
Hypothesis or discussion of an issue important to medical practice
Letter to the Editor
Commentaries
Advertisements
Obituaries

N.B. Articles are not acceptable if previously published or submitted elsewhere in print or electronic format, except in the form of abstracts in proceedings of conferences.

Content and format of articles:

Title: The title should be on a separate page. It should not have acronyms or abbreviations. The title should be descriptive and should `not exceed 20 words or 120 characters including space. The title page should include the name(s) and qualification of the author(s); the department or Institution to which the study/research is attributed and address of the corresponding Author. If the author has multiple affiliations only use the most preferred one.

1. Original Articles

2,500 words, excluding Abstracts, References, Figures and Tables. The manuscript of the Article, should appear under the following headings:

a) Abstract: The abstract of the Article is prepared on a separate paper, a maximum of 250 words; it should be structured under the titles: a) Background; b) Methods; c) Results; d) Conclusions. Briefly summarize the essential features of the article under above headings, respectively. Mention the problem being addressed in the study; how the study was conducted; the results and what the author(s) concluded from the results. Statistical method used can appear under Methods paragraph of the Abstract, but do not insert abbreviations or references in the Abstract section.

Keywords: Provide three to six key words, or short phrases at the end of abstract page. Use terms from medical subject heading of Index Medicus to assist in cross indexing the Article.

b) Introduction : Should provide a short background and context of the study and provide the rationale for doing the study. It should not be a detailed review of the subject and should not include conclusions from the paper.

c) Patients or (Materials) and Methods: should contain details to enable reproducibility of the study by others. This section must include a clear statement specifying that a free and informed consent of the subjects or their legal guardians was obtained. Corresponding author should submit a copy of institution review Board (IRB) clearance or letter of permission from the hospital or department (if IRB exempt)

with the manuscript. For manuscripts on clinical trials, a copy of ethical approval letter from the concerned body should be submitted with the Manuscript. If confidential data is being used for publication (such as student grades, medical board data, or federal ethics board data), then appropriate support/ agreement letter should be included. Photos of patients should disguise the identity or must have obtained their written consent. Reference number for ethical approval given by ethics committee should be stated. In general, the section should include only information that was available at the time the plan or protocol for the study was being written; all information obtained during the study belongs in the Results section.

d) Results: This section should present the experimental or observational data in text, tables or figures. The data in Tables and Figures should not be described extensively in the text.

e) Discussion: The first paragraph should provide a summary of key finding that will then be discussed one by one in the paragraphs to follow. The discussion should focus on the interpretation and significance of the results of the study with comments that compare and describe their relation to the work of others (with references) to the topic. Do not repeat information of Results in this section. Make sure the limitations of the study are clearly stated.

f) Tables and Figures: These should not be more than six. Tables should be typed in triplicate on separate sheets and given serial Arabic numbers. Titles should be clearly place underneath Tables and above Figures. Unnecessary and lengthy tables and figures are discouraged. Same results should not be presented in more than one form (choose either figure or table). Units should appear in parentheses in captions but not in the body of the table. Statistical procedures, if not in common use, should be detailed in the METHODS section or supported by references. Legends for figures should be typed on separate sheets, not stapled to the figures. Three dimensional histograms are discouraged. Recognizable photographs of patients should be disguised. Authors should submit editable soft versions of the tables and figures.

g) Acknowledgement: Appropriate recognition of contributors to the research, not included under Authors should be mentioned here; also add a note about source of the financial support or research funding, when applicable.

h) References:

- The titles of journals should be abbreviated according to the style used for MEDLINE (www.ncbi.nlm.nih.gov/nlmcatalog/journals).
- References should be numbered consecutively in the order in which they are first mentioned in the text and identify references in text, tables, and legends by Arabic numerals in parentheses.
- Type the References on a separate sheet, double spaced and keyed to the text.
- Personal communications should be placed NOT in the list of references but in the text in parentheses, giving name, date and place where the information was gathered or the work carried out (e.g. personal communication, Alasebu Berhanu, MD, 1984, Gondar College of Medical Sciences). Unpublished data should also be referred to in the text.
- References with six or less authors should all be listed. If more than six names, list the first three, followed by et al.
- Listing of a reference to a journal should be according to the guidelines of the International Committee of Medical Journal Editors ("Vancouver Style') and should include authors' name(s) and initial(s) separated by commas, full title of the article, correctly abbreviated name of the journal, year, volume number and first and last page numbers.
- Reference to a book should contain author's or authors' name(s) and initials, title of chapter, names of editors, title or book, city and name of publisher, year, first and last page numbers.

The following examples demonstrate the acceptable reference styles.

Articles:

- Gilbert C, Foster A. Childhood blindness in the context of Vision 2020: the right to sight. *Bull World Health Org 2001;79:227-32*
- Teklu B. Disease patterns amongst civil servants in Addis Ababa: an analysis of outpatient visits to a Bank employee's clinic. *Ethiop Med J 1980;18:1-6*

- Tsega E, Mengesha B, Nordenfelt E, Hansen B-G; Lindberg J. Serological survey of human immuno-deficiency virus infection in Ethiopia. *Ethiop Med J 1988; 26(4): 179-84*
- Laird M, Deen M, Brooks S, et al. Telemedicine diagnosis of diabetic retinopathy and glaucoma by direct ophthalmoscopy (Abstract). *Invest Ophthalmol Vis Sci 1996; 37:104-5*

Books and chapters from books:

- Henderson JW. Orbital Tumors, 3rd ed. Raven Press New York, 1994. Pp 125-136.
- Clipard JP. Dry Eye disorders. In Albert DM, Jakobiec FA (Eds). Principles and Practice of Ophthalmology. W.B Saunders: Philadelphia, PA 1994 pp257-76.

Website:

- David K Lynch; laser History: Masers and lasers. http://home.achilles.net/jtalbot/history/massers.htmAccessed 19/04/2001

2. Brief Communication

Short versions of Research and Applications articles, often describing focused approaches to solve a health problem, or prelnary evaluation of a novel system or methodology

- Word count: up to 2000 words
- Abstract up to 200 words; excluding: Abstract, Title, Tables/Figures and References
- Tables and Figures up to 5
- References (vide supra – Original Article)

3. Case Series

Minimum of three and maximum of 20 cases

- Up to 1,000 words; excluding: Abstract, Title, Tables/Figures and References
- Abstract of up to 200 words; structured; (vide supra)
- Statistical statements here are expressed as 5/8 (62.5%)
- Tables and Figures: no more than three
- References: maximum of 20

4. Case Report

Report on a rare case or uncommon manifestation of a disease of academic or practical significance

- Up to 750 words; excluding: Abstract, Title, Tables/Figures and References
- Abstract of up to 100 words; unstructured;
- Tables and Figures: no more than three
- References: maximum of 10

5. Systematic review

Review of the literature on topics of broad scientific interest and relevant to EMJ readers

- Abstract structured with headings as for an Original Article (*vide supra*)
- Text should follow the same format as what is required of an Original Article
- Word count: up to 8,000 words, excluding abstract, tables/Figures and references
- Structured abstract up to 250 words
- Tables and Figures up to 8

6. Teaching Article

A comprehensive treatise of a specific topic/subject, considered as relevant to clinical medicine and public health targeting EMJ readers

- By invitation of the Editorial Board; but an outline of proposal can be submitted
- Word limit of 8,000; excluding abstract, tables/Figures and references
- Unstructured Abstract up to 250 words

7. Editorial

- By invitation of the Editorial Board, but an editorial topic can be proposed and submitted
- Word limit of 1,000 words: excluding references and title; no Abstract
- References up to 15.

8. Perspectives

- By invitation of the Editorial board, but a topic can be proposed and submitted
- Word limit of 1,500
- References up to six

9. Obituaries

- By invitation of the Editorial board, but readers are welcome to suggest individuals (members of the EMA) to be featured.

Preparation of manuscripts

- Manuscripts must be prepared in English, the official language of the Journal.
- On a single separate sheet, there must be the title of the paper, with key words for indexing if required, and each author's full name and professional degrees, department where work was done, present address of any author if different from that where work was done, the name and full mailing address of the corresponding author, including email, and word count of the manuscript (excluding title page, abstract, references, figures and tables). Each table/figures/boxes or other illustrations, complete with title and footnotes, should be on a separate page.
- All pages should be numbered consecutively in the following order: Title page; Abstract and keywords page; main manuscript text pages; References pages; acknowledgment page; Figure-legends and Tables
- The Metric system of weights and measures must be used; temperature is indicated in degrees Centigrade.
- Generic names should be used for drugs, followed by propriety brand name; the manufacturer name in parenthesis, e.g. diazepam (Valium, Roche UK)
- Statistical estimates e.g. mean, median proportions and percentages should be given to one decimal place; standard deviations, odds ratios or relative risks and confidence intervals to two decimal places.
- Acronyms/Abbreviations should be used sparingly and must be given in full, at first mention in the text and at the head of Tables/foot of Figure, if used in tables/figures.eg. Blood Urea Nitrogen (BUN). Interstitial lung disease (ILD).
- Use the binomial nomenclature, reference to a bacterium must be given in full and underlined - underlining in typescript becomes italics in print (e.g. *Hemophilus influenzae)*, and later reference may show a capitalised initial for the genus (e.g. *H. influenzae)*
- In the text of an article, the first reference to any medical phrase must be given in full, with the initials following in parentheses, e.g., blood urea nitrogen (BUN); in later references, the initials may be used.
- Manuscripts for submission should be prepared in Microsoft Word document file format

Submission of manuscripts

- As part of the submission process, authors are required to check off their submission's compliance with journals requirements
- All manuscripts must be submitted to the Editor-in-Chief of the Journal with a statement signed by each author that the paper has not been published elsewhere in whole or in part and is not submitted elsewhere while offered to the *Ethiopian Medical Journal*. This does not refer to abstracts of oral communications at conferences/symposia or other proceedings.
- It is the author's responsibility to proof-read the typescript or off-print before submitting or resubmitting it to the Journal, and to ensure that the spelling and numerals in the text and tables are accurate.
- Authors should submit their work through the Ethiopian Medical Journal website; ema.emj@telecom.net.et.

Conflict of interest

Authors should disclose at the time of submission of manuscripts any conflict of interest, which refers to situations in which financial or other personal considerations may compromise, or have the appearance of compromising their professional judgment in conducting or reporting the research results They should declare that there is no conflict of interest to declare if there is none,

Manuscripts review procedures

The procedures for manuscripts review include:

- Within one week of receipt of a manuscript, the Editorial Board will review it in reference to (i) conformity with the Journal's "guidelines to authors (revised version available in all issues starting January 2020)", (ii) relevance of the article to the objectives of the *EMJ*, (iii) clarity of presentation, and (iv) plagiarism by using appropriate software
- The Editorial Board has three options: accept manuscripts for external review, return it to author for revision, or reject it. A manuscript not accepted by a board member is blindly reviewed by another board member. If not accepted by both, the manuscript is rejected by the Editorial Board. Decision will be made by the suggestion of a third Editorial Board member if the decisions of first two do not concur.
- Once accepted for external review, the Editorial Board identifies one (for brief communication, case reports, and teaching articles) or two (for original articles) reviewers with appropriate expertise. The reviewers will be asked to review and return manuscripts with their comments online within two weeks of their receipt. Reviewers have four options; accept, accept with major revision, accept with minor revision, or reject.
- A Manuscript accepted subject revision as suggested by reviewers will be returned to the corresponding author. Author(s) will be given four weeks to respond to reviewers' comments, make necessary changes, and return the manuscript to the Editorial Board. A Manuscript not returned within the specified time will be considered withdrawn by the author(s).
- Manuscripts with minor revisions will be cleared by the Editorial Board and accepted for publication. Those with major revisions will be returned to external reviewers and follow the procedures as outlined for the initial review.

General information

The Editorial Board reserves the right for final acceptance, rejection or editorial correction of papers submitted. However, authors are encouraged to write an appeal to the Editor-in-Chief for reconsideration of rejected manuscripts or any other complaints they might have.

Accepted papers are subject to Editorial revision as required and become the copy-right of the EMA Twenty-five reprints of published articles are supplied free to the first/corresponding author.

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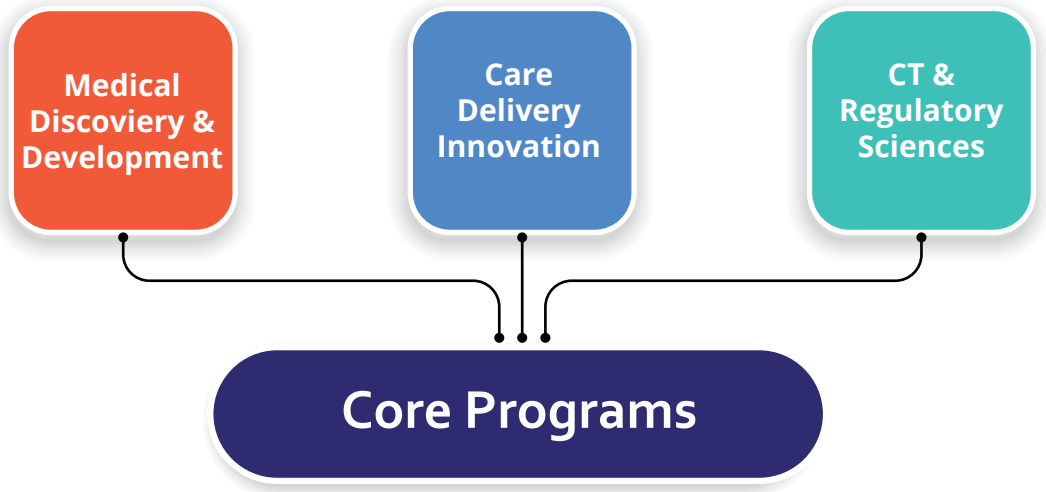

Priority & Programs

Disease focus area are those with high unmet need in Africa that are under-addressed by the global biomedical research and pharmaceutical R&D ecosystem. Cancer included as a neglected disease in the region.

- 1 MSc programme, 3 PhD fellowship tracks, 3 postdoctoral fellowship tracks
- 1 Virtual training short course on Moodle platform
- 10 skills based short courses
- Grassroots initiatives to improve innovation and science leadership
- 23 Research Projects

Operating Environment

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