

REVIEW ARTICLE



Impact of COVID-19 pandemic on mother and child health in Sub-Saharan Africa – a review

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Prior to the outbreak of the coronavirus disease 2019 (COVID-19) pandemic, there was a decrease in the maternal mortality rate in Sub-Saharan Africa (SSA) by 38%. This corresponds to a decline of 2.9% on average each year. In spite of this reduction, it falls short of the 6.4% annual rate required to reach the global Sustainable Development Goal of 70 maternal deaths per 100,000 live births. This study reviewed the impact of COVID-19 on maternal and child health. Due to the major challenge of the health systems and lack of strategies in preparation for emergencies, several studies have reported significant impacts of COVID-19 on women and children in SSA. Global estimates of the indirect impacts of COVID-19 suggested a 38.6% increase in maternal mortality and a 44.7% increase in child mortality per month across 118 low- and middle-income countries. The COVID-19 pandemic has threatened the continuity of essential mother-to-child healthcare service delivery in SSA. It is important for health systems to address these challenges as lessons learnt for future health crises and to develop adequate response policies and programs for emerging diseases of public health importance.

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IMPACTS:

- This literature review will provide in-depth insight into the impact of COVID-19 on maternal and child health, particularly in Sub-Saharan Africa.
- The findings of this literature review suggest to the concerned health systems the need to prioritize women's antenatal care for the safety of the baby.
- The findings of this literature review will aid the basis for intervention in maternal and child health and reproductive health in general.

BACKGROUND

Recently, an outbreak of a deadly disease called coronavirus disease 2019 (COVID-19) hit the globe, causing a pandemic worldwide. COVID-19 since then has a wide-ranging impact across people, communities, and societies.¹ Coronavirus belongs to a family of viruses that may cause various respiratory illnesses such as pneumonia, common cold, dyspnea or breathing difficulty, and acute respiratory distress syndrome.² These viruses are commonly found in animals worldwide, but few have been identified to infect humans. Beta coronavirus family is the causative agent of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, SARS-CoV-1 and Middle East respiratory syndrome virus (MERS)).^{2,3} SARS-CoV-2 apparently spanned the species barrier in recent times, different from both SARS-CoV-1 and MERS because it has modified to spreading easily from human to human. Its impact also underscores the limited progress made against non-communicable diseases. Children with co-morbidities, particularly under-nutrition and obesity, are most vulnerable to serious illness and death from COVID-19.⁴

The COVID-19 was announced by World Health Organization (WHO) on December 31, 2019, as the cause of an outburst of respiratory disease in Wuhan, Hubei Province, China.^{5,6} Patients

were epidemiologically linked to a seafood and wet animals wholesale market in Wuhan.⁷ As of January 31, 2020, this virus had spread to 19 countries with 11,791 confirmed cases, including 213 deaths.⁶ WHO declared COVID-19 a pandemic in March 2020, and as of October 11, 2020, there have been over 37 million cases globally and over 1 million deaths, of which 55% was reported across America, 23% in Europe, 12% in South-East Asia, 6% in Eastern Mediterranean, 3% in Africa and 1% in the Western Pacific region.⁸ The pandemic has been escalating and threatening the welfare of human beings globally with confirmed cases of 676,311,158, including 6,772,555 deaths as of February 6, 2023.⁹

About 46 countries within the Sub-Saharan African (SSA) region have a total population of approximately one billion people, accounting for 14% of the world's population. At the beginning of May 2021, a total of 3.2 million COVID-19 cases and around 83,000 fatalities were reported in SSA, representing about 2% of cases and fatalities recorded worldwide.¹⁰ The 55 African Union Member States have reported a total of 12,134,167 COVID-19 cases and 256,412 deaths case fatality rate (2.1%) as of December 12, 2022. This amounts to 2% of all cases and 4% of all deaths that have been documented internationally.¹¹

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One of the many ways COVID-19 has significantly impacted global health is in reproductive healthcare. Prior to the virus outbreak, the maternal mortality rate in sub-Saharan Africa decreased by 38%, from 342 deaths per 100,000 live births to 211 deaths per 100,000 live births, which was between the years 2000 and 2017, i.e., a decline of 2.9% on average each year. Despite this reduction, it falls short of the 6.4% annual rate required to reach the global Sustainable Development Goal (SDG) of 70 maternal deaths per 100,000 live births.¹² In 2020, the maternal mortality estimation interagency group reported 196,000 (66%) maternal deaths, which lead to 542 deaths per 100,000 live births maternal mortality ratio in SSA.¹³ The increase in maternal mortality in SSA could be attributed to the emergence of COVID-19.

From earlier investigation, COVID-19 among pregnant women has been identified to be of more severe compared to non-pregnant women.¹⁴ Although there are no evidence of increased severity of pneumonic signs in pregnant women as compared to non-pregnant women infected with SARS-CoV-2.^{15,16} Like others, pregnant women show common infection symptoms like fever and fatigue. With close monitoring, maternal and neonatal deaths are low, accounting for less than 1% of deaths due to SARS-CoV-2 infection.⁵ Hence, the Sub-Saharan Africa region reported an increased neonatal death rate (i.e., the death of an infant during the first month after birth) of 27 deaths per 1000 live births, accounting for 43% of all infant deaths worldwide ranging SSA the highest neonatal mortality rate in 2020.⁹

The novel COVID-19 has significantly impacted global health in diverse ways, not just the fragile health systems in the SSA countries. However, global estimates of the indirect impacts of COVID-19 reported an increase of 38.6% in maternal mortality and a 44.7% increase in child mortality per month across 118 low- and middle-income countries (LMICs) due to increased healthcare needs and delayed medical responses. The pandemic further impacted the utilization of health services, especially for women and children in SSA, where maternal mortality rates are high.¹⁷ The health system's ability to function efficiently has been challenged by the growing additional burden of COVID-19 management on healthcare institutions as well as healthcare providers.

A well-functioning healthcare system will ensure fair access to necessary medical care when faced with health crises such as the COVID-19 pandemic, whereas weak healthcare systems in developing nations struggle with organizational and resource challenges.¹⁸ There may be an increased risk of mother and child morbidity and mortality due to delayed healthcare services and resources diversion from vital reproductive healthcare needs where COVID-19 response is prioritized.¹⁹ Cumulative evidence from four LMICs with poor maternal and child healthcare indices suggest that the pandemic may have increased maternal and newborn mortality by over 30% due to reduced access to relevant essential services including family planning, antenatal care (ANC) and adequately supervised community and facility-based deliveries.²⁰ Furthermore, data analyzed from 118 LMICs estimated that the reduced use of maternal and child healthcare services following the pandemic had increased mortality in children under 5 years of age between 9.8 and 44.7% and maternal mortality between 8.3 and 38.6% monthly, depending on the degree of disruption.¹⁷ However, to maintain continuity in healthcare delivery and develop strategic plans to maximize limited resources and provide the greatest benefit for the populace, WHO had advised developing countries to identify setbacks and prioritize maternal, newborn, and child health (MNCH) essential services (such as routine vaccination, reproductive health services, childbirth, and care of infants and older adults).²¹

METHODS

A review of literature was searched for both population-based studies and non-population-based studies. Google search engine

was used to access Google Scholar, PubMed and Science Direct-related materials on the impacts of COVID-19 on mother and child healthcare in sub-Saharan Africa. Information was retrieved using the search terms, "COVID-19" "maternal health" child healthcare" and "Sub Sahara Africa" to gather articles relevant to the review topic and findings were presented in traditional literature review.

FINDINGS: IMPACT OF COVID-19 PANDEMIC ON MOTHER AND CHILD HEALTH

Antenatal care

The COVID-19 pandemic posed a severe threat to ANC, one of the core services of mother and child healthcare, considering the low utilization of essential maternal health services caused by pre-existing systemic obstacles that the majority of SSA women encounter in accessing ANC and facility-based deliveries.^{22,23} Prior to the outbreak of COVID-19, Adedokun and Yaya reported data from the Demographic and Health Survey of 31 African nations, that reported 13% of women did not use ANC services at all, while only 35% partially used the services.²⁴ Data from 28 other African nations also suggested that facility-based child births ranged from 23% to 66% on average. It is important to assess the impact of the pandemic on maternal and child health in ANC.

COVID-19 has a significant impact on the prevalence of maternal healthcare in nations like Liberia, Uganda, Zambia, and the Democratic Republic of the Congo. South Africa was one of the most affected countries in SSA, recording a 3.4% increase in perinatal mortality as a result of COVID-19.²⁵ It is worth noting that the United Nation Children Fund recommended the safest place for childbirth as a well-functioning health facility with the support of a skilled birth attendant.²⁶ Given sub-Saharan Africa's historically low number of skilled birth personnel in comparison to other regions, the global COVID-19 crisis compelled most pregnant women (particularly in rural settlements) to resort to homebirth without appropriate medical support.^{27,28}

There are currently numerous evidence of the severe impact of COVID-19 on maternal and child healthcare across the SSA region. For example, between April 2020 and April 2019, Burundi recorded a decrease in the number of child deliveries taken by experienced birth attendants within the health facilities from 30,826 to 4749 (i.e., 85%).²⁹

Prior to the pandemic, the WHO had increased the minimum number of ANC contacts from four to eight in November 2016. The revised recommendation highlights the importance of early ANC (especially in the first trimester of pregnancy) and the provision of other essential services.²⁹ In spite of this, a global report in 2017 revealed that only three of five women received at least four antenatal consultations, of which 52% of women in SSA made at least four ANC visits.³⁰ The provision of improved ANC services and increased uptake of those services will result in better health outcomes in SSA countries. A report from regions with consistently high maternal and neonatal mortality rates (such as Kenya, Tanzania, and Uganda) further established that the COVID-19 pandemic had grossly affected ANC services.³¹ Hence, with the emergence of the COVID-19 pandemic, it is undebatable that access to quality ANC services in the SSA region would be further threatened.

Postnatal care and family planning services

One of the most important moments in the lives of women and infants is the postpartum period. During this period, women are most in need of family planning services, as well as child welfare programs including immunizations against diseases that are fatal to their children.³² More than 90% of women in the postpartum period, according to WHO, desire to delay or prevent pregnancy, yet two-thirds do not use contraceptives. Research shows that the earlier outbreak of Ebola caused a decline in the provision of postnatal care (PNC) services, including family planning, in Sierra

Leone and Liberia.³³ Consequently, COVID-19 may have a direct impact on postpartum care.

One of the significant impacts of COVID-19 on family planning services is the inadequate supply of contraceptives. For instance, in South Africa, there was a 5% decrease in family planning services.²⁵ Primary data analyzed in a few studies from the SSA region revealed a significant decrease in the use of PNC services due to the COVID-19 pandemic; PNC service utilization ranges from 16 to 18% and 30 to 50% in Ethiopia and Nigeria, respectively.^{34–37} A multi-country analysis recorded a substantial decrease in PNC services in eight SSA countries between March 2020 and July 2020, by 10–25% every month, for a total drop of 17% over the period of five months.³⁸ United Nations Population Fund (UNFPA) had predicted such occurrences stating that during health emergencies, reproductive health needs are likely to be neglected and the more vulnerable groups (women and children) are at higher risk of adverse health outcomes.³⁹ Also, according to the UNFPA, the pandemic caused a decrease in the availability of key contraceptives such as implants, intrauterine contraceptive devices (IUCDs), condoms and oral contraceptive pills in about 46 countries that typically get funding for contraception.⁴⁰

Between March and June 2019 and 2020, Kenya recorded a decrease in the use of long-term contraceptives such as implants and IUCD and, an increase in both teen pregnancy and youth family planning uptake.⁴¹ A similar study conducted in South Ethiopia found an increase in the use of oral contraceptives during the COVID-19 pandemic, whereas the use of injectable, implantable, and IUCDs considerably declined. These resulted from inaccessibility to health facilities; diversion of resources to combat the COVID-19 pandemic; shortage of health providers; or closed clinics.⁴² It could also be a result of misinformation on the adoption of long-term family planning techniques on the part of the patients or the fear of contracting COVID-19 infections while using these techniques on the part of the healthcare providers, thereby making oral contraceptives to be the best option which involves little to no interaction with other people.⁴³

Maternal and reproductive health services

Past pandemics, like the Human Immunodeficiency Virus, Acquired Immune Deficiency Syndrome, and Ebola virus, among others, have revealed how vulnerable the healthcare systems in SSA nations are. Less access to prenatal and postpartum care during these pandemics increased the risk of maternal morbidity and mortality and further destabilized the health systems.^{27,44,45}

As of March 30, 2020, the pandemic had resulted in the complete or partial closure of borders in 46 of the 49 SSA nations. Forty-four nations in total had adopted social distancing measures, the closure of schools, and restrictions of movement.⁴⁶ The primary strategy used to mitigate the spread of the pandemic globally was lockdown, which threatened maternal and reproductive health services. Although the COVID-19 infection rate is similar between men and women, maternal health in SSA may have been more affected. Even though expectant mothers were permitted to access health facilities during emergencies, there were difficulties accessing the facilities during the curfew.⁴⁷

Social distancing during the pandemic led to inadequate social support for many pregnant women due to separation from their loved ones, whom they relied on during this critical phase. Insufficient social support is one of the significant risk factors for depression among pregnant women,⁴⁸ which further impact maternal health. An average increase of 16% in maternal hospital fatalities was found in a WHO analysis in 11 SSA nations from February to May 2020, but drop to an increase of 11% in 2021.⁴⁹ Pant et al.⁵⁰ reported that reduced access and utilization of maternal health services could have dire consequences for both mothers and children. Pregnant and postpartum women were at high risk of nutritional deficiency during the lockdown due to the shortage of nutritious food supply, they had irregular antenatal

and postnatal services, and were deprived of the micronutrient supplements from the clinics. In addition, without regular checkups, there were chances of certain danger signs being unidentified, making them vulnerable to pregnancy- and childbirth-related complications.

Over the last two decades, healthcare interventions have increased yearly from 1 to 2%;⁵¹ however, the pandemic interference since 2020 can be identified as a setback in maternal and child healthcare. There is a dearth of information on the impact of COVID-19 on maternal deaths, stillbirths, and pregnancy complications based on a few systematic reviews, which may likely have biases.^{52,53} Recurring evidence suggest that newer interventions and policies in response to the pandemic consequently disfavor women's sexual and reproductive health services, threatening increasing maternal mortality and morbidity,^{54,55} consistent with United Women's predictions.⁵⁶

The majority (97.4%) of the PHCs offered childhood immunization before the pandemic. There was a slight decline to 94.8% during the lockdown and a nearly 10% decline after the lockdown.

Child healthcare

Ensuring the healthy growth and development of children ought to be of utmost importance in all societies. Newborns and older children are vulnerable to malnutrition and infections, many of which can be prevented or treated early to avert complications. Children of all ages, and in all countries, are affected by COVID-19, particularly by its socio-economic impacts and, in some cases, by measures of restriction that inadvertently have grave consequences.

The pandemic impacted routine immunization, which has led to increased death and illnesses from vaccine-preventable diseases in countries with low vaccination rates.⁵⁷ About 2–3 million lives are preserved with vaccination, but the pandemic threatened to roll back decades of progress made in reducing preventable child mortality by hindering access to life-saving services. Nearly 14 million children had no vaccination in 2019,⁵⁸ measles immunizations were delayed in 24 SSA countries and canceled in 13 other countries.⁵⁹

The lockdown measures led to an inability to access proper nutrients and food products, thereby increasing cases of malnutrition among newborns and infants.⁴⁹ The vulnerable children became malnourished due to the deteriorating quality of their diets and the multiple pandemic shocks. Efforts to mitigate the transmission of COVID-19 grossly disrupted food systems, upended health and nutrition services, enervated livelihoods, and threatened food security.

An increase of 14.3% child wasting (translating to 128,000 additional cases) of child mortality was projected in 2020 among LMICs,⁶⁰ and in severe cases, this could increase by 50%, i.e., 2,313,900 additional fatalities.¹⁷ As a result of the COVID-19-related consequences on child malnutrition, future productivity losses and long-term loss of human capital are inevitable.⁶¹ Increased child malnutrition is attributable to reduced family incomes and limited financial resources, increased food insecurity and poor-quality diets, and limited or restricted health, nutrition, and sanitation services.⁶²

There are a few evidence on the inappropriate steps being made by some health facilities to separate mothers and their newborns and to discourage breastfeeding due to inaccurate information that COVID-19 may be transmitted through breastmilk.⁶³ This results in the reduction of early initiation of breastfeeding after birth—missing the child's first natural vaccine (colostrum)—and, in turn, exclusive breastfeeding. Such practices can result in the infants missing out on the nutritional benefits of breastmilk, thus compounding malnutrition and exposure to infants' illnesses.

In Ethiopia, clinic visits of sick children under 5 years of age declined over the first 6 months of the pandemic as compared

with the preceding year.⁶⁴ A survey of primary health clinics in rural South Africa also identified a decrease in child healthcare visits.⁶⁵ Overall, essential MNCH services such as family planning initiation and clinic visits for sick children under 5 years of age significantly declined during the COVID-19 pandemic.⁶⁵

Challenges to mother-to-child health

The healthcare systems in SSA are faced with a variety of challenges, including insufficient healthcare workforce, unequal health resource allocation, high disease burden, lack of political will, poor leadership, limited supply of vaccines, underdeveloped technology services, and obsolete infrastructure, among others. As a result, the overall effects of the pandemic may be prolonged in this region compared to other regions of the world.⁶⁶ Every component of the healthcare system, including family planning services, prenatal care, postpartum care, and maternal and healthcare, is impacted by these inadequacies.

Evidence from a comparative cross-sectional survey carried out at governmental health facilities in Southwest Ethiopia demonstrated the decreased use of ANC, health facility births, PNC, family planning visits, and newborn immunization services by 27.4%, 23.5%, 29.1%, 15.9%, and 28.5%, respectively between March–June 2019 and March–June 2020.⁶⁷ The availability and uptake of maternal, infant, and child healthcare services in SSA have been influenced by the COVID-19 pandemic. During the lockdown, many avoided healthcare facilities, including pregnant women who needed prompt and adequate support from medical personnel for the “fear” of being diagnosed with COVID-19 or contracting the virus from healthcare workers or other patients.⁶⁸

Other possible challenges faced during and even after the lockdown led to mistrust in the quality of health services and infodemics of the disease. WHO advised that if infodemics are well managed, it is aimed at enabling good health practices which could result in reducing disease impact on health behaviors in cases of health emergencies.⁶⁹ The Nigeria Centre for Disease Control is a good example of an organization that actualized this by sending health information to the populace via digital means. Its constraints could be illiteracy and limited coverage.

Ogunkola et al. highlighted the closure of 5633 static and mobile health clinics and community-based care centers of the International Planned Parenthood Federation across 64 countries due to the pandemic, while some health facilities were completely shut down and others operated at a very small capacity.⁷⁰ Healthcare workers who are known to be the front-liners of the pandemic are also prone, not only to infection with COVID-19 due to continuous exposure to infected people, but also to some psychological distress, long working hours, fatigue, occupational stigma, and physical violence, leading to their absence from work.⁷¹ All these pose a threat to the care of mother and child health.

The feasible actions to maintain and enhance the failing reproductive health system were omitted in the COVID-19 measures of African countries.⁷² Restrictions and other mitigation measures, which were aimed to limit the spread of the virus, resulted in poor access to healthcare and low utilization of maternal and child health services, including reproductive health services. Pallangyo et al. reported that rural areas had the worst hit by the strict stay-at-home measures put in places such as Kenya, Uganda, and Tanzania.³² Though strategies like phone and telehealth options were put in place to provide counseling services for new mothers and information for people with poor obstetric history and emergency medical problems, these strategies were inaccessible in rural areas, leading to late presentation of pregnant women to the hospitals and increased cases of preterm and stillbirths. In addition, reports of inadequate training for midwives on COVID-19 protocol and standard operational guidelines on MNCH care were a great challenge, which further worsened the delivery of service.³²

Another challenge was the lack of emergency policies for human and medical resources to be directed toward certain health system gaps within SSA. As recorded in literature, there are operational gaps in MNCH programs and services across the region.⁷³ This deficiency needs to be urgently fixed to prevent further adverse effects on maternal and child health during the outbreak of diseases of international concern. It is appallingly that human and medical resources were diverted away from MNCH to support the activities of COVID-19 emergency, neither was reproductive health prioritized.⁷⁴ This is projected to have a negative effect on the results of MNCH, not just in terms of its economic contraction but also to further restrict short- and long-term investments in the health sector, particularly in SSA continent. The overall impact of COVID-19 is predicted to cause not only interruption in improving MNCH outcomes in SSA, but to potentially setback decades of maternal health progress.⁷⁵

There are numerous challenges to maternal healthcare accessibility in SSA to mention but a few both prior to the pandemic, during, and post-pandemic era. For instance, in South Africa and Senegal, there is a disparity between the rich and the poor in accessing ANC,^{76,77} while transportation was the major challenge for countries like Ghana and Nigeria.^{78,79} This is in tandem with the fact sheet by WHO on maternal health in the African regions suggesting that the increase in maternal mortality rate in some regions of the world indicates unequal access to health services and focuses on wealth gaps. Almost all maternal deaths (99%) occur in developing countries, more than half in SSA and countries with poor health and humanitarian structures.

Recommendations/future perspective

It is important for health systems to consider the challenges faced with COVID-19 as lessons to be learned in the case of future health crisis, and to develop adequate response strategies and preparedness, both for human and material resources tailored toward MNCH, for emerging diseases of public health importance.

From earlier pandemic experiences such as COVID-19, it is almost important for SSA countries to establish a resilient health system that is adaptive enough to address pandemic-related issues by investing in pandemic preparedness. Health professionals should be recruited, trained and more prioritized than ever, establish effective surveillance and response system, particularly at the community level, and provision of adequate medical equipment.

Women's health should be prioritized against all odds, especially pregnant women and newborns during the pandemic and post-pandemic. In the case of a future lockdown, the women's reproductive health, maternal health, and newborn sectors should focus on planning means of transportation and the availability of maternal and child health services.

It is important for countries to align its health programs with WHO's COVID-19 management guidelines for updated information on novel scientific knowledge to assist the decision-makers in implementing rapid changes to health systems as it affects individual countries. SSA countries should also adopt WHO infection prevention and control guidelines in the management of potential future pandemic disease as these are helpful during and outside of emergencies.

It is suggested that SSA countries create sustainable ANC service delivery models applicable to their own country's context to ensure adequate collaboration of care across ANC contact points through defined mechanisms, as recommended by the UNFPA response to COVID-19. This will help to provide a profound solution to the reduction in the use of ANC services during pregnancy and may, in turn, reduce complications related to pregnancy and delivery for future pandemics.

There is a need to improve the circulation of technology toward adopting telemedicine to help cushion the impact of COVID-19 on maternal and child healthcare in SSA especially in rural areas. This

is pertinent in the case of subsequent public health emergencies. And time-sensitive programs such as maternity services, immunization and reproductive health services that are crucial to the welfare of mothers and children need to be prioritized.

Civil societies should be involved in monitoring the adherence to recommended COVID-19 guidelines, a good way to keep the government accountable. Since COVID-19 is a disease of Public Health Emergency, there is a need for multiple efforts to mitigate and reduce the adverse impact of the disease on MNCH and reproduction health as a whole. In order to better address public health emergencies both at the national and local levels and to further reach the most vulnerable population, particularly at the grassroots level, the maternal and reproductive health sector should collaborate with civil society organizations in response to outbreaks or future pandemics as it offers diverse new ideas.

Workable interventions to improve health facility delivery should focus on addressing inequalities associated with MNCH care, maternal education, women empowerment, increased accessibility to health facilities as well as reducing the need to travel from rural to urban areas. These efforts work toward accomplishing SDG 10 (to reduce inequalities) and SDG 3 (to reduce the global maternal mortality ratio to less than 70 per 100,000 live births between 2016 and 2030). By 2030, SDG 3 aims to end preventable deaths of newborns and children under 5 years of age, and all countries aim to reduce neonatal mortality to about 12 per 1000 live births and under 5 mortality to about 25 per 1000 live births. This 2030 Agenda “is a plan of action for people, for the planet and for prosperity.”

CONCLUSION

The COVID-19 pandemic has deeply threatened the continuity of the global health system service delivery and has already weakened the health systems of most of the developing nations in the SSA region. The pandemic has a huge impact on maternal and child healthcare that can be attributed to limitations in the provision of health resources in terms of skilled health workers and medical equipment, disruptions to the enabling environment, and increased reluctance by women to visit the available healthcare facilities.

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AUTHOR CONTRIBUTIONS

Q.K.A. initiated the idea and wrote the final draft of the manuscript. A.S.A. helped in literature collection and wrote the draft of the manuscript. O.O.K. and D.I.K.-A. corrected the final draft of the manuscript.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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