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Towards Universal Health Coverage in sub-Saharan Africa: The need for inclusive, sustainable, and resilient health systems

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Summary

Universal health coverage (UHC), defined as all people receiving access to quality essential health services without fear of financial hardship due to health care costs, has influenced health reforms in many countries. Although UHC has increased worldwide over the last decades, limited access to health care and burdensome health spending persists, especially in sub-Saharan African (SSA) countries. Moreover, COVID-19 has halted progress by disrupting access to essential health services and increasing financial hardship. To move towards UHC—especially since more pandemics are expected to come—a better understanding is needed of how to strengthen health systems with inclusive protection schemes, sustainable financing structures, and resilient governance to leave no one behind.

This dissertation examines three aspects of moving towards UHC, focusing on SSA countries, where the most vulnerable population groups live, and where health care resources are particularly limited: the functioning of a mandatory health insurance scheme (chapter 2), the impact of the COVID-19 pandemic on the ability of the health system to provide ongoing essential health services (chapters 3 and 4), and impact of the COVID-19 pandemic on people's lives (chapters 5 and 6).

In chapter 2 (co-authored), we use rich administrative data of the National Health Insurance Fund in Tanzania to provide needed evidence on the usage patterns, cost drivers, and financial sustainability of a mandatory health insurance scheme. This study is the first comprehensive analysis of a mandatory health insurance database for an African country. The results emphasize that people still face barriers to health care access despite being covered and that not all accredited health facilities treat insured patients. Furthermore, the chapter identifies the most used and most expensive health services, highlighting that the cost structure and disease burdens differ substantially from high-income countries (HICs). Lastly, the study estimates that scaling up the insurance scheme to the entire Tanzanian population would not be financially sustainable given the current revenues and cost structure, indicating the need to find ways to increase revenues or decrease costs to make the system financially sustainable.

In chapters 3 (co-authored) and 4 (single-authored), we use the case of Ghana to provide evidence on the impact of COVID-19 and the corresponding government interventions on essential health service provision. Based on country-wide monthly administrative data from January 2018 to December 2021 of a set of essential health services aggregated by districts, these are the first two studies that measure the impact for an entire low-and middle-income country (LMIC), over a long period of time, across inter-regional differences and differentiating between the impact of government measures and the pandemic itself. Overall, we find fewer health service interruptions and a faster recovery than expected by the literature; however with a large variation by health service type. For

maternal health services and time-critical vaccines, we find no interruption at all. On the contrary, yellow fever vaccinations, services for diarrhea disease, and treatments of road accidents experienced large disruptions. We find that for child routine immunizations in Ghana (chapter 3), fear of COVID-19 early in the pandemic, a short public lockdown, and delayed vaccination outreach campaigns had a substantial impact. The declines in road accidents and diarrhea diseases (chapter 4) are both correlated with the stringency of the government measures in place. The results highlight that the population's adherence to the mobility restrictions and the general adherence to hygiene and social distancing measures most probably affected people's behavior, leading to this decline.

In chapters 5 (co-authored) and 6 (co-authored), we provide evidence on the impact of COVID-19 on the lives of the most vulnerable people in LMICs, the urban poor. We use the cases of Ghana and South Africa, two of the most COVID-19 affected countries in SSA, and collected three-wave survey panel from April 2020 up to one year later in March 2021. First, we study how the urban poor cope with the pandemic in the short term, during the national lockdowns (chapter 5). We find that the large majority adhered to the government interventions. However, adherence is highly correlated with available resources, such as infrastructure and financial means, knowledge about the interventions, and trust in the government. Thus, costly interventions are only effective if people have the infrastructure, the knowledge and the trust to follow them. Second, we study how the economic and mental health situation among the urban poor developed in the long term, over a year into the pandemic (chapter 6). We find that while the economic situation had recovered again over the course of a year, mental health issues increased and are stagnating. Aside from country-specific reasons for a slow recovery, such as worsened physical health and decreasing trust in government, we find that increasing worries about future income and decreasing knowledge about COVID-19 are the two broad reasons for the mental health stagnation.

This dissertation demonstrates that UHC demands strengthening health systems with inclusive protection schemes, sustainable financing structures, and resilient governance to leave no one behind. This research points out several barriers in the process of achieving UHC, providing important implications for academic research as well as for public policy. Chapter 2 demonstrates the need to make the health insurance schemes more inclusive and financially sustainable in order to achieve UHC. Chapters 3 and 4 demonstrate that in the case of Ghana and in the case of the analyzed health services COVID-19 caused no generally overburdened health system. However, as we also identified some highly affected districts, it is needed to put policies in place to target under-served population groups as well as to improve pandemic preparedness to achieve an inclusive and resilient health system. Chapters 5 and 6 demonstrate the need to establish social security systems, improve preventive infrastructure, build up government trust, and strengthening public communication in order to achieve inclusive, sustainable, and resilient UHC—also for future pandemics.

Zusammenfassung

Die universelle Gesundheitsversorgung (Universal Health Coverage, UHC) - dass alle Menschen Zugang zu qualitativ hochwertigen grundlegenden Gesundheitsdienstleistungen ohne Angst vor finanzieller Not aufgrund der Gesundheitskosten haben - hat die Gesundheitsreformen vieler Länder beeinflusst. Obwohl die UHC in den letzten Jahrzehnten weltweit zugenommen hat, ist insbesondere in den afrikanischen Ländern südlich der Sahara (SSA) nach wie vor die Gesundheitsversorgung eingeschränkt und hohe Gesundheitsausgaben bleiben bestehen. Darüber hinaus hat die COVID-19-Pandemie den Fortschritt von UHC gestoppt, indem es den Zugang zu grundlegenden Gesundheitsdienstleistungen behindert und die finanzielle Not vielfach verschärft hat. Auf dem Weg zu UHC ist ein besseres Verständnis erforderlich, wie Gesundheitssysteme mit inklusiven Schutzsystemen, nachhaltigen Finanzierungsstrukturen und einer resilienten Regierungsführung gestärkt werden können - zumal weitere Pandemien zu erwarten sind.

In dieser Dissertation werden drei Aspekte von UHC untersucht, wobei der Schwerpunkt auf SSA-Ländern liegt, in denen benachteiligte Bevölkerungsgruppen leben und Ressourcen für die Gesundheitsversorgung besonders begrenzt sind: (1.) die Funktionsweise eines obligatorischen Krankenversicherungssystems (Kapitel 2), (2.) die Auswirkungen der COVID-19-Pandemie auf die Möglichkeit des Gesundheitssystems kontinuierlich grundlegende Gesundheitsdienstleistungen bereitzustellen (Kapitel 3 und 4) sowie (3.) die Auswirkungen der COVID-19-Pandemie auf das gesundheitliche und wirtschaftliche Befinden der Menschen (Kapitel 5 und 6).

In Kapitel 2 (als Co-Autorin verfasst) verwenden wir umfangreiche Verwaltungsdaten des nationalen Krankenversicherungssystems in Tansania (NHIF), um wichtige Erkenntnisse über die Nutzungsmuster, die Kostentreiber und die finanzielle Nachhaltigkeit eines obligatorischen Krankenversicherungssystems zu gewinnen. Diese Studie ist die erste umfassende Analyse einer obligatorischen Krankenversicherungsdatenbank für ein afrikanisches Land. Die Ergebnisse zeigen, dass der Zugang zur Gesundheitsversorgung trotz Versicherungsschutz für Personen immer noch mit Hindernissen verbunden ist und dass nicht alle anerkannten Gesundheitseinrichtungen versicherte Patienten behandeln. Zusätzlich identifiziert die Analyse die am häufigsten in Anspruch genommenen und die teuersten Gesundheitsleistungen. Dabei wird aufgezeigt, dass sich die Kostenstruktur und die Krankheitslast erheblich von denen der Länder mit hohem Einkommen unterscheidet. Zuletzt legt die Studie dar, dass eine Ausweitung des Versicherungssystems auf die gesamte Bevölkerung in Tansania angesichts der derzeitigen Einnahmen- und Kostenstruktur finanziell nicht tragbar wäre. Dies bedeutet, dass Wege gefunden werden müssen, die Einnahmen zu erhöhen oder die Kosten zu senken, um das System finanziell nachhaltig zu gestalten.

In den Kapiteln 3 (als Co-Autorin verfasst) und 4 (als Einzelautorin verfasst) untersu-

chen wir am Beispiel von Ghana, wie sich COVID-19 und die entsprechenden staatlichen Maßnahmen auf die Bereitstellung grundlegender Gesundheitsdienstleistungen auswirken. Die Analyse basiert auf landesweiten monatlichen administrativen Daten zu einer Reihe grundlegender Gesundheitsdienstleistungen von Januar 2018 bis Dezember 2021, die auf Bezirksebene aggregiert wurden. Die Kapitel 3 und 4 sind die ersten beiden Studien, welche die Auswirkungen für ein Land mit geringem und mittlerem Einkommen (LMIC) über einen längeren Zeitraum und auf interregionaler Ebene messen sowie zwischen den Auswirkungen staatlicher Maßnahmen und der Pandemie selbst unterscheiden. Insgesamt finden wir weniger Unterbrechungen der Gesundheitsversorgung und eine schnellere Erholung als die Literatur erwartet, allerdings mit großen Unterschieden nach Art der Gesundheitsdienstleistungen. Bei den Gesundheitsdienstleistungen für Mütter und bei zeitkritischen Impfstoffen konnten keine Unterbrechungen festgestellt werden. Im Gegensatz dazu kam es bei Gelbfieberimpfungen, der Behandlung von Durchfallerkrankungen und der Behandlung von Verkehrsunfällen zu erheblichen Unterbrechungen. Bei den Routineimpfungen von Kindern in Ghana (Kapitel 3) zeigte sich, dass die Angst vor COVID-19 zu Beginn der Pandemie, ein kurzer Lockdown und verzögerte Impfkampagnen erhebliche Auswirkungen auf die Gesundheitsdienstleistungen hatten. Der Rückgang der Verkehrsunfälle und der Durchfallerkrankungen (Kapitel 4) korreliert mit der Strenge der staatlichen Maßnahmen. Die Ergebnisse zeigen, dass die Einhaltung der Mobilitätsbeschränkungen durch die Bevölkerung und die allgemeine Einhaltung von Hygiene- und sozialen Distanzierungsmaßnahmen höchstwahrscheinlich das Verhalten der Menschen beeinflusste und zu diesem Rückgang führte.

In den Kapiteln 5 (als Co-Autorin verfasst) und 6 (als Co-Autorin verfasst) analysieren wir die Auswirkungen von COVID-19 auf das Leben der verletzlichsten Menschen in LMICs, den städtischen Armen. Dazu verwenden wir die Fälle von Ghana und Südafrika, zwei der am stärksten von COVID-19 betroffenen Länder in SSA, wo wir ein drei-teiliges Befragungspanel von April 2020 bis März 2021 durchgeführt haben. Zunächst untersuchen wir, wie die arme Stadtbevölkerung kurzfristig mit der Pandemie zurechtkommt, d.h. während den nationalen Lockdowns (Kapitel 5). Wir stellen fest, dass sich die große Mehrheit an die staatlichen Maßnahmen hält. Die Befolgung der Maßnahmen hängt jedoch in hohem Maße von den verfügbaren Ressourcen wie Infrastruktur und finanzielle Mittel, dem Wissen über die Maßnahmen sowie dem Vertrauen in die Regierung ab. Kostspielige Interventionen sind also nur dann wirksam, wenn die Menschen über die Infrastruktur, das Wissen und das Vertrauen verfügen, um sie zu befolgen. Zweitens untersuchen wir, wie sich die wirtschaftliche und psychische Situation der armen Stadtbevölkerung langfristig, d.h. über ein Jahr nach der Pandemie, entwickelt hat (Kapitel 6). Wir stellen fest, dass sich die wirtschaftliche Lage im Laufe eines Jahres wieder erholt hat, während die psychische Gesundheit abgenommen hat und stagniert. Neben den länderspezifischen Gründen für die langsame Erholung der psychischen Gesundheit, wie z.B. die Verschlechterung der körperlichen Gesundheit und das abnehmende Vertrauen in die Regierung, stellen wir fest, dass die zunehmende Sorge um das künftige Einkommen und das abnehmende Wissen über

COVID-19 die beiden Hauptgründe für die Stagnation sind.

Diese Dissertation zeigt, dass UHC eine Stärkung der Gesundheitssysteme mit inklusiven Schutzsystemen, nachhaltigen Finanzierungsstrukturen und einer resilienten Regierungsführung erfordert. Die Dissertation zeigt mehrere Hindernisse auf dem Weg zur Erfüllung von UHC auf und liefert wichtige Erkenntnisse für die akademische Forschung und die Politik. Kapitel 2 zeigt auf, dass die Krankenversicherungssysteme integrativer und finanziell nachhaltiger gestaltet werden müssen, um UHC zu erreichen. Die Kapitel 3 und 4 zeigen anhand der analysierten Gesundheitsdienstleistungen in Ghana, dass COVID-19 generell zu keiner Überlastung des Gesundheitssystems geführt hat. Da wir jedoch auch einige stark betroffene Bezirke identifiziert haben, müssen Maßnahmen ergriffen werden, um unterversorgte Bevölkerungsgruppen zu erreichen und die Vorbereitung auf künftige Pandemien zu verbessern, mit dem Ziel ein integratives und resilientes Gesundheitssystem zu schaffen. Die Kapitel 5 und 6 zeigen, dass es notwendig ist Sozialversicherungssysteme einzurichten, die präventive Infrastruktur zu verbessern, das Vertrauen in die Regierung zu stärken sowie die öffentliche Kommunikation zu verbessern, um eine inklusive, nachhaltige und resiliente UHC zu erreichen - auch für zukünftige Pandemien.

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Chapter 1

Introduction

Universal health coverage (UHC), one of the health targets agreed upon in the United Nations Sustainable Development Goals (SDGs) in 2015, became a major goal to ensure healthy lives and promote well-being and influenced health reforms in many countries (WHO, 2005). The aim of UHC is that all people receive access to quality essential health services without fear of financial hardship by 2030 (WHO, 2010). Inadequate financial protection occurs if a household must pay a large percentage of its budget for health services out-of-pocket (OOP) at the time of use, pushing them below the poverty line or creating a financial barrier to accessing health care at all.

Over the last decades, access to essential health services and financial protection has increased worldwide (WorldBank, 2021b). However, at least half of the world's population still does not have full access to the essential health services they need and about 100 million people are pushed into extreme poverty each year due to large health expenditures (WHO, 2022). Especially across low- and middle-income countries (LMICs), low access to service and high OOP health spending persists, limiting access to health care and impoverishing households (WHO, 2022).

As past epidemics have shown, such as West Africa's Ebola epidemic in 2014 and 2015, health shocks cruelly expose the weaknesses of health systems and widen the UHC gap (TheNewHumaritan, 2015). Therefore, not only inclusive and financially sustainable, but also resilient health systems, which are able to quickly deal with the unexpected, are needed to achieve UHC.

The most recent pandemic, COVID-19, once again dramatically demonstrated the importance of preparedness for impending health emergencies and highlighted that not only LMICs, but countries worldwide need to rapidly scale up investments. COVID-19 is still threatening decades of global health achievements and has halted the progress of UHC by disrupting access to essential health services, increasing inequalities, and raising financial hardship (UNDS, 2022). By the end of 2021, interruption in essential health service provision was report in 92% of 129 countries, but especially in LMICs (WHO 2020a). Rising global income inequality and the weak recovery of LMICs is expected to partly reverse the improvements achieved over the last two decades (GEP, 2022). For the first time in two decades, extreme poverty increased, in particular in sub-Saharan African (SSA) countries and among the most vulnerable groups—women, those with little education, and those who are informally employed in urban areas (Sanchez-Paramo et al., 2021).

As more pandemics are expected to affect the world globally, governments need to ensure resilient health systems so that everyone, also the most vulnerable populations, can access health care at any time without financial hardship (CGD, 2021). This dissertation will contribute to the current discussion about the process of moving towards UHC. I focus on SSA countries, where the most vulnerable population groups are located, and where health care resources are particularly limited.

In the remainder of this introductory chapter, I will first describe the relevance and research gap along the following three aspects of moving towards UHC: the functioning of a health insurance scheme, the health system during COVID-19, and the population during COVID-19. In the third and fourth sections, I outline the structure of the dissertation, followed by the presentation of the research approach, main findings, and research contribution for each of the five dissertation papers. In the fifth section, I describe my contribution to each of the dissertation papers. Finally, in the sixth section, I highlight other research activities I carried out during my doctoral studies in the context of this dissertation.

1.1 Moving towards Universal Health Coverage

Moving towards UHC demands strengthening health systems with robust financing structures and public health infrastructure that leave no one behind. Several strategies are implemented by governments to increase financial protection. Reduced OOP health service expenditures can be accomplished in various ways, including by expanding free health care services at the point of use, scaling up health insurance coverage, or, most frequently, a mixture of both (WHO, 2020c). The strategies aim for a prepayment system, which can be based on either tax or insurance contributions, that protects an individual who falls ill from paying a large amount for healthcare costs.

Over the last decades, the number of countries in SSA with social health insurance schemes is gradually increasing (WHO, 2019). Research shows that health insurance coverage is correlated with decreased OOP expenditure (e.g., Aryeetey et al., 2016; King et al., 2009; Thornton et al., 2010) and decreased catastrophic health expenditure (e.g., Barasa et al., 2017; Kusi et al., 2015). However, the percentage of the population enrolled in health insurance remains low, with enrollment rates below 10%. Two exceptions are Rwanda, with about 90% in 2015 (Chemouni, 2018), and Ghana, with 56% in 2014 (Amu et al., 2018), which are two of just a few African countries where enrollment is mandatory for the whole population, including the informal sector and rural workers (McIntyre et al., 2018). Particularly in countries with a large informal sector, the expansion of social health insurance schemes is difficult because information on working status or individual tax base is limited (Lagomarsino et al., 2012). Various studies have examined factors associated with health insurance enrollment, concluding that, among others, higher wealth, education, age, formal occupations, and distance to health facilities are important determinants (e.g., Amu et al., 2018; Salari et al., 2019). As a result, health insurance schemes

in LMICs still predominantly protect better-off population groups, leaving out the most vulnerable ones (Afriyie et al., 2022). Nevertheless, in general, studies find that health insurance enrollment increased health service usage (e.g., Fiestas Navarrete et al., 2019; Simon et al., 2017) and mostly improved health service take-up (Abrokwah et al., 2014; Mensah et al., 2010; Robyn et al., 2012; Sommers et al., 2017, 2016; H. Wang et al., 2009)

However, even if a person is covered by a health insurance scheme, some barriers accessing quality health care and financial protection still remain. For example, studies find that insured patients sometimes experience poor quality health service provision (e.g., Alhassan et al., 2015; Duku et al., 2018) or have to pay unauthorized charges for services (e.g., Aikins et al., 2019; Macha et al., 2014), limiting access and financial protection. Due to data availability in LMICs, only little is known about who of the insured benefits from the scheme, and what type of services are used in which health facilities (Ankrah et al., 2018; Kolbe-Alexander et al., 2008; Nachega et al., 2010).

Understanding the type of services provided to insured patients is particularly important and has not yet been done for a mandatory insurance scheme in an LMIC. Overall trends of disease burdens in LMICs show that preventable diseases, such as malaria and diarrhea, are still responsible for many deaths (WHO, 2016). In the literature, many studies discuss how raising awareness, preventing certain behaviors, and providing better infrastructure could protect people from suffering from these diseases (Deressa et al., 2014; Karinja et al., 2020; Yaya et al., 2018). On the other hand, following the trend of high-income countries (HICs), non-communicable diseases (NCD) such as cancer, kidney-related diseases, or cardiovascular diseases are also increasing in LMICs (Roman et al., 2019). In 2016, deaths related to NCDs accounted for about one-third of all deaths (WHO, 2016). Since many of the NCDs are related to lifestyle factors and are easier to treat at an early stage of detection, it is essential to improve access to care and diagnostic capabilities as well as promote healthier lifestyles in LMICs (e.g., Lyimo et al., 2020). More empirical research to fully understand the utilization and structure of such disease burdens would provide important insights into the functioning of a health insurance scheme in LMICs.

Looking at the aspect of costs, little information is available in health insurance schemes in LMICs on where costs occur and what drives them. As in many countries worldwide, and as a consequence of increasing NCDs, rising health care costs present a challenge in LMICs (Lee et al., 2018, 2019). Since governments and health insurance schemes must balance revenues and expenses to ensure financially sustainable provision of services, there are many possible pathways to increase revenues, such as increased tax-based revenues, international funds, increased insurance premiums, and/or extended contribution groups. On the other hand, complementary policies to reduce costs are also possible pathways, such as reducing the health services benefit package, improving preventative behavior, and/or increasing the efficiency of the system (Lee et al., 2018, 2019; Renggli et al., 2019). As discussed at the beginning of the section, many different schemes are in place to achieve financial protection in LMICs. Each country must—based on the financial resources and shaped by political, social, and ethical principles, and the underlying health system—define

their mix of revenue and costs sources as well as benefit package (Meremo et al., 2017; Mushi et al., 2015; Verguet et al., 2021; WHO, 2013). However, given limited knowledge about utilization and costs in the literature about health insurance schemes in LMICs, it is challenging to estimate the implications of expanding schemes to the entire population in order to achieve UHC; thus, more evidence is needed.

1.2 Health system resilience during the COVID-19 pandemic

The COVID-19 pandemic spread globally with astonishing speed, overrunning many health systems in LMICs, but also in HICs. Government interventions that were used to curb the spread varied considerably from one country to another in terms of stringency and length (Hale et al., 2022). LMICs generally implemented stricter policy measures early in the pandemic, given the poor sanitation conditions, densely populated areas, and underfinanced health systems in many countries. There is a broad discussion on how effective the various government interventions are at curbing the spread of the disease itself (e.g., Borri et al., 2021; Courtemanche et al., 2020; Cronin & Evans, 2020; DiPorto et al., 2022; Flaxman et al., 2020; GEP, 2022; Hsiang et al., 2020), but the interventions also came with costs. Several studies highlight that the COVID-19 pandemic and the corresponding government intervention impacted health care provision and imposed economic costs (GEP, 2022; Sanchez-Paramo et al., 2021; UN, 2020b; UNDS, 2022; WHO, 2020j). However, given the novelty of the disease, the global spread, and the uncertainty about future development, it is difficult to predict the total costs.

Early in the pandemic, several modeling studies predicted large negative indirect effects on health care provision, especially in LMICs (Abbas et al., 2020; Hogan et al., 2020; Roberton et al., 2020). Surveys with health ministries from more than 100 countries in April 2020 showed that nearly all countries reported disruptions in basic health services (WHO, 2018a). In HICs, mainly preventative and non-essential services declined, whereas in LMICs, essential health services were also affected (e.g., Moynihan et al., 2020). However, the effects differ considerably depending on what health service is observed, over which period, and for which sample (e.g., Arsenault et al., 2022; Cantor et al., 2022; Hategeka et al., 2021; Jain & Dupas, 2022; Kc et al., 2022; Kumari et al., 2020; Siedner et al., 2020; Smith et al., 2020). The disruptions caused major public health concerns, presumably leading to an increase in many preventable deaths (Clark et al., 2020; Roberton et al., 2020; Roberts, 2020). So far, only little is known about how the health systems recover from the interruptions (Arsenault et al., 2022). Due to the lack of data availability, especially in LMICs, more evidence is needed on the impact across an entire country, interregional and district differences within a nation, and the longer-term effects two years into the pandemic. In particular, it is important to better understand where the most affected population groups are and support them with additional policies.

Additionally, more evidence is needed to determine what drives the observed interruptions. Potential reasons discussed in the literature are a mix of supply- and demand-side

factors. Supply-side factors include logistical barriers, such as the supply of medicines, shifting resources to mitigate the impact of the COVID-19 pandemic, staff shortages, delays of outreach and disease control campaigns, and the closure of health facilities (WHO, 2020h). On the demand side, fear of COVID-19, difficulties in traveling, and inability to afford healthcare services are some of the possible factors (Alsuhaibani & Alaqeel, 2020; Chandir et al., 2020, 2021; WHO, 2018a, 2020h,e). The factors highlight that cross-country comparisons should be made with care and might not be generalizable to other countries due to the country-specific situation and people's behavior.

Moreover, given differences in exposure to COVID-19 across countries and the various country-specific government interventions, it is not clear if the interruptions were mainly due to the number of COVID-19 cases, the government interventions, or a mix of the two. A few studies find that besides the lockdown itself, the COVID-19 exposure level significantly worsened the disruption early in the pandemic (Cantor et al., 2022; Rabbani, 2021). Another finds that the stringency of policies and the COVID-19 incidence is only moderately correlated with interruptions (Arsenault et al., 2022). And a few studies show that the fear of COVID-19 infection, rather than the lockdown itself, held patients back from visiting the hospital to use services (Caston et al., 2021; Kumagai, 2021; Tsafack Nanfosso & Tadadjeu, 2022). Thus, global evidence and consensus is lacking. To prepare for future pandemics, it is essential to better understand the mechanisms behind the observed interruptions.

1.3 People's lives during the COVID-19 pandemic

Pandemics in general, but especially the COVID-19 pandemic, not only affected health systems, but also people's socioeconomic situation and the economy, in general. Both could then also influence individuals' medical-seeking behavior (Belchior & Gomez, 2022; Krauss et al., 2021) or health insurance coverage (UN, 2020b), affecting health access and financial protection.

The economic downturn following the pandemic is estimated to be much worse than during the 2008–09 financial crisis (UN, 2020c), especially for the most vulnerable groups. In the COVID-19 pandemic, because of the large share of the population working in the informal economy, low incomes, and limited social security in LMICs, studies show that earnings decreased, and unemployment and food insecurity increased (e.g., Durizzo et al., 2021; D. Egger et al., 2021; IPA, 2020; Mahmud & Riley, 2021; Warren et al., 2020a,b). However, especially early in the pandemic, only little was known about how the most vulnerable population groups experienced government interventions and what barriers to social distancing and hygienic behavior they faced.

Ultimately, the extraordinarily high economic burden on the poor caused social unrest in many countries (Akinwotu & Asiedu, 2020; E. Egger et al., 2020; Ward, 2020), which sometimes led to police and military brutality (Lamb, 2020; Ngqakamba, 2020; Wemakor, 2020). As a result, many governments had to relax their government interventions despite

rising COVID-19 cases (Giles & Mwai, 2020; Tih, 2020). Those challenges have highlighted that government interventions are only effective if the population fully cooperates. As a result, the topic of trust in government to take appropriate action to curb the virus was highly discussed (Briscese et al., 2020; E. Egger et al., 2020; Painter & Qiu, 2020), emphasizing the trade-off between the benefits of curbing the virus versus the costs of government interventions (Günther et al., 2022).

Information is critical for people to cooperate with government interventions and to know what measures to follow. However, especially early in the pandemic, given the novelty of the virus and the uncertainty of the scientific community about the infection, symptoms and protective measures, misinformation and an "infodemic" were also rapidly spreading (DeWitte, 2020; Wanga et al., 2020; WHO, 2020g). Due to this "infodemic" and spreading of misinformation, it is necessary early in a pandemic to understand how people are informed, from which sources, and how information provision can influence people's behavior.

Two years into the pandemic, many economies showed fast macroeconomic recovery. However, the recovery for LMICs, especially in Africa, has been slower (IMF, 2021). Studies from a few months after government lockdowns were lifted find that the economy seems to recover, but the recovery varies substantially from one country to another (Rönkkö et al., 2021; Schotte et al., 2021; WorldBank, 2021a). This situation raises the question of which factors are needed for a faster recovery and how much did the length and stringency of government interventions play a role.

As known from previous global financial crises, economic downturns can also be associated with an increase in mental health issues and anxieties (Avdic et al., 2020; Black et al., 2022). In the wake of an economic downturn caused by a pandemic, for example, health-related anxieties (Banks et al., 2021; Perrin et al., 2009; Pfefferbaum & North, 2020), limited knowledge about the pandemic (Bäuerle et al., 2020), reduced mobility (Burdett et al., 2021) and limited social interactions (Pancani et al., 2021) could have a negative effect on mental health. Other reasons for an increase in mental health issues include domestic abuse and violence during strict national lockdowns (Banks et al., 2021; Peterman et al., 2020) or overburdening guardians due to long school closures (Sadique et al., 2008; Shevlin et al., 2020; Pierce et al., 2020). In addition, stress could increase due to the political challenges related to managing a pandemic, political uncertainty and public distrust in the government (Bäuerle et al., 2020; Olagoke et al., 2020; Perrin et al., 2009). Early in the pandemic, the focus was on the health or economic dimensions rather than mental health. However, due to the enormous impact—the global prevalence of anxiety and depression is estimated to have increased by 25%, with young people and women most affected—the topic has risen in importance as COVID-19 has become more endemic (UNDS, 2022). Nevertheless, the consequences of the COVID-19 pandemic on mental health are less frequently analyzed for LMICs and if so only for the short term. Longer-term evidence, after a public lockdown has lifted, is needed.

1.4 Structure of the dissertation

This dissertation addresses various research gaps identified in the literature about the process of moving towards UHC. The chapters are organized in three parts (see Figure 1.1). In the first part (chapter 2), the service and cost dimension of UHC are addressed in the context of health protection schemes to better understand the functioning of a mandatory health insurance scheme in a SSA country. In the second part (chapters 3-4, health system resilience during a pandemic is addressed to better understand how COVID-19 and the corresponding government interventions affected the essential health service provision. In the third part (chapters 5-6), the resilience of the population is addressed to better understand how the most vulnerable people, the urban poor, cope with the pandemic. Chapter 7 summarizes the findings of this dissertation, outlines contributions to the literature, suggests lessons for public policy, and discusses the limitations of this research. The chapter closes by indicating some pathways for future research.

Fig. 1.1: Structure of dissertation.

1.5 Research approach and main findings

Table 1.1 provides an overview of the five dissertation papers and the method and data used in each.

In chapter 2, my co-authors and I contribute to the service and cost dimension of UHC (see Figure 1.1), providing evidence for one country's insurance scheme—the mandatory National Health Insurance Fund (NHIF) of Tanzania. We use a rich administrative dataset consisting of NHIF claim, NHIF beneficiary, and health facility data, to study (i) which policyholders have the greatest utilization and costs of health care services, (ii) what is the financial sustainability for national scale-up of a mandatory health insurance, (iii) which services are used the most and at what cost, and (iv) which health facilities have the greatest utilization and at what cost? This study is the first comprehensive analysis of a large-scale mandatory health insurance database for any African country.

We find that only half of the beneficiaries made at least one claim during a year, where men, children, elderly and the poorest and richest policyholders had the lowest take-up of

health services. These results emphasize that people still face barriers to accessing health care despite being covered by a health insurance scheme, contributing to studies about challenges of health insurance enrollment and usage of health care (Aikins et al., 2019; Amasha, 2015; Ashigbie et al., 2016). Due to the limited availability of claim data in LMICs, this study is the first to analyze service utilization, contributing to the studies from HICs, where it has been shown that take-up rates are much higher (Cicero et al., 2009; Kotzan et al., 2001). Additionally, we find that given the current costs and revenues associated with the health insurance scheme, a national scale-up would not be financially sustainable. The findings contribute to the ongoing research about the expansion of health insurance in general and the implications for UHC (Lee et al., 2018; Borghi et al., 2012; Mathauer, Doetinchem et al., 2011; Mathauer, Musango et al., 2011; Carrin et al., 2007). Discussing different forms of costs and revenues adds to the current debates on potential national scale-up processes in LMICs (Lee et al., 2018, 2019; Renggli et al., 2019). The results on which services are used the most and at what cost improve our understanding of the cost side, contributing to the few studies analyzing only a small sub-sample of claims to get insights into specific diseases (Kolbe-Alexander et al., 2008; Nachega et al., 2010; Ankrah et al., 2018). We find that painkillers, antibiotics, anti-malaria drugs and diagnostic services are most used, whereas the most expensive claims are often related to non-communicable diseases (NCDs). The results also highlight that disease burdens substantially differ from those found in HICs (Dieleman et al., 2020; EDI, 2020; Wieser et al., 2014). Lastly, the analysis of which health facilities provided what kind of services to insured patients reveals that not all health facilities have the same likelihood of treating insured patients at least once a year. The public-owned facilities, particularly, have less often treated at least one NHIF patient within a year, highlighting that health facilities might have different incentives to treat patients. Such misplaced incentives could potentially cause more barriers for the insured, such as lower quality of care (Aikins et al., 2019; Amasha, 2015; Ashigbie et al., 2016).

In chapters 3 and 4, we provide evidence on the impact of the COVID-19 pandemic and the corresponding government interventions on essential health service provision in one LMIC, Ghana (see Figure 1.1). We analyze administrative data containing administered health services from all health facilities in all of Ghana's 260 districts from January 2018 to December 2021. The analysis not only focuses on the effects during the lockdown, but also explores potential catch-up effects 20 months after the lockdown was lifted. Additionally, given the variation in social distancing regulations across districts in Ghana, it is possible to further differentiate between the impact of lockdown, the exposure of COVID-19 cases, and the general effect of the pandemic.

In chapter 3, we analyze the impact of the COVID-19 pandemic on routine child immunization services, covering all 15 recommended child vaccines. We find that the total number of child vaccines dropped by 6% during the public lockdown in April 2020 across Ghana, but started to recover already a few months afterwards, in June 2020. Over the course of 2021, the number of vaccines fully recovered to a pre-pandemic vaccine growth

rate. These results show a substantially lower drop than other studies observed early in the pandemic (Chandir et al., 2021; Nyabor, 2020) and a faster catch-up effect than expected (Abbas et al., 2020; Roberton et al., 2020) despite still increasing COVID-19 cases. Due to our extensive dataset, spanning two years before and after the lockdown, we are the first study to be able to highlight that the drop already started in February 2020, before the first COVID-19 case occurred and a lockdown was implemented. The results indicate that uncertainty has an important impact, whereas the monthly number of COVID-19 cases is not significantly correlated with vaccine disruptions, in line with some cross-country studies about COVID-19 cases and health service disruptions (Arsenault et al., 2022). Lastly, we find large differences in the impacts across districts and vaccine types. The lockdown-affected districts had substantially larger disruptions and a slower recovery than non-lockdown-affected districts. Yellow fever vaccinations had the largest disruptions, whereas time-critical vaccines given at birth, such as polio 0, were not affected at all. Both results emphasize the need for data from a whole country and all vaccine types in order to fully understand the effects. Contributing to the studies about drivers of health service interruptions during the pandemic (Alsuhaibani & Alaqeel, 2020; Chandir et al., 2020, 2021; WHO, 2018a, 2020h,e), our results indicate that fear of COVID-19 early in the pandemic, a short public lockdown, and delayed vaccination outreach campaigns, rather than overburdened health systems or moderate social distancing regulations, had a substantial impact on routine child immunization in Ghana.

In chapter 4, I analyze the impact of the COVID-19 pandemic and the corresponding government interventions on four essential health care services, covering two maternal health services, C-sections and birth at a health facility, as well as diarrhea treatment for children and road accident treatments. I find that the two maternal health services were not interrupted at all during the COVID-19 pandemic. On the contrary, the number of road accidents experienced a short-term drop in April 2020, during the lockdown. This result highlights that mobility restrictions in place in lockdown-affected districts as well as general mobility reductions in non-lockdown-affected districts with COVID-19 cases effectively reduced traffic and therefore the number of road accident treatments. Finally, diarrhea services was the only health care service I analyzed that showed a substantial long-term drop (9%) over the course of 2020. The analysis finds that the interruption was mainly affected by the stringency of the policy measures and not by the COVID-19 cases or the implemented lockdown. Thus, populations' adherence to moderate hygiene and social distancing measures most probably affected health behavior, which led to lower incidences of diarrhea diseases. This finding is in line with a few studies observing lower incidences of infectious diseases (Gómez-Pérez et al., 2022), and contributes to literature providing mixed evidence that COVID-19 incidence had no direct effect on health care provision (Arsenault et al., 2022; Cantor et al., 2022; Rabbani, 2021).

In chapters 5 and 6, my co-authors and I provide evidence on the impact of the COVID-19 pandemic and the corresponding government interventions on socioeconomic and economic characteristics of the most vulnerable groups—the urban poor (see Figure

1.1). We therefore collected a phone survey in two African cities with the most COVID-19 infections: Accra and Greater Johannesburg.

For chapter 5, using a phone survey with more than 1,400 households, we study how the urban poor mitigate their risk of infection early in the pandemic and during national lockdowns, in particular we (i) investigate people's knowledge about COVID-19, (ii) their trust in the government to take appropriate action to curb COVID-19, and (iii) the costs of and/or barriers to social distancing and hygienic behavior they face. We find that, in both countries, people knew about the COVID-19 pandemic, but knew little about its symptoms and the preventative measures. Nevertheless, misinformation—a serious concern during the pandemic (WHO, 2020g)—was less prevalent in Ghana and South Africa than in other countries (Wanga et al., 2020; DeWitte, 2020). Additionally, people had a rather high degree of trust in the government, and a large majority reported that they think the implemented government measures are appropriate. Still, the government lockdown led to large negative effects on economic, mental, and social well-being. Both countries enforced strict lockdowns, however, Ghana's urban poor were more affected by the loss of income and increased food prices. In South Africa, loss of income was less of a problem due to the many people relying on government grants. We find that the large majority of the urban poor in Ghana and South Africa adhered to the social distancing and hygiene measures, and that the lack of adherence seemed more related to a lack of infrastructure or poverty. Moreover, we find that better knowledge and trust in the government also substantially contribute to more adherence.

For chapter 6, we extended the phone survey of chapter 5 to a three-wave panel. Thus, we contacted the same respondents three times: first, early in each country's lockdown in April 2020, second, about four months later in August 2020, when regulations had been substantially relaxed in Ghana and to some extent also in South Africa, and third, almost one year later in March 2021 when all social distancing regulations were lifted and only hygienic measures were still in place, and vaccine campaigns had begun in Ghana and South Africa. We analyze poor urban households' mental and economic well-being as they started to re-enter public life with the global pandemic still ongoing. We find that economic factors have recovered for the urban poor in Ghana and South Africa one year into the pandemic. On the contrary, mental health indicators, such as life satisfaction and feeling depressed have not recovered and are after an improvement shortly after the lockdown, back to lockdown levels. This analysis contributes to the small literature on the relationship between the global pandemic and mental health in LMICs (Cheng et al., 2020; Mahmud & Riley, 2021; Posel et al., 2021) and provides insights from a long-term panel. Since we have panel data, we are the first study to identify the drivers of mental health during a global pandemic between two different LMICs and across time. The results show that increasing worries about future income and decreasing knowledge about the COVID-19 pandemic are two reasons why mental health has not recovered in both countries, besides some country-specific reasons, such as worsened physical health in South Africa and decreasing trust in government in Ghana.

Tab. 1.1: Overview of the chapters of this dissertation.

Ch.	Title	Method/Data	Authorship	Presented at Conferences
2	Towards mandatory health insurance in low-income countries: An analysis of claims data in Tanzania	Quantitative analyses with insurance data	Kathrin Durizzo Kenneth Harttgen Fabrizio Tediosi Maitreyi Sahu August Kuwawenaruwa Paola Salari Isabel Günther	2021 SSGOE, online 2020 DENS, St.Gallen 2020 EUDN PhD Workshop, online
3	Effects of the COVID-19 pandemic on routine child immunizatio:n Evidence from Ghana	Quantitative analyses with administrative data	Kathrin Durizzo Koku Awoonor-Williams Kenneth Harttgen Isabel Günther	2022 EEA-ESEM, Milano 2022 GDEC, Stuttgart-Hohenheim 2021 IHEA, online 2021 World Sustainability Forum, online 2021 EUHEA PhD Conference, online
4	Indirect health effects of government interventions during COVID-19: Evidence from essential health services in Ghana	Quantitative analyses with administrative data	Kathrin Durizzo	2022 EUHEA, Oslo
5	Managing the COVID-19 pandemic: Evidence from urban poor in Ghana and South Africa	Quantitative analyses with own survey data	Kathrin Durizzo Edward Asiedu Antoinette van der Merwe Attie van Niekerk Isabel Günther	
6	Recovering from the COVID-19 pandemic: Evidence from urban poor in Ghana and South Africa	Quantitative analyses with own survey data	Kathrin Durizzo Edward Asiedu Antoinette van der Merwe Isabel Günther	

Note: Details about the list of attended conferences can be found in the attached CV.

1.6 Statement of own and co-authors' contribution

This doctoral research was funded by the Swiss Programme for Research on Global Issues for Development (r4d) as part of the research project "Health system governance for an inclusive and sustainable social health protection in Ghana and Tanzania". Additionally, during the COVID-19 pandemic, due to delays in planned fieldwork, the team from the Development Economics Group at ETH Zurich initiated a research project with colleagues from the University of Ghana and the University of Pretoria, South Africa, to better understand how vulnerable populations in South Africa and Ghana are affected by the COVID-19 health shock (see Table 1.1).

Chapter 2 was done in close collaboration with the r4d project team. I conducted the statistical analysis, interpreted the results, and mainly wrote the paper. Additionally, as a corresponding author, I was in charge of revising the paper and implementing the reviewers' and journal's feedback. Kenneth Harttgen, Fabrizio Tediosi, and Isabel Günther conceptualized the study and contributed to the analytical strategy, interpretation of the results, and writing of the paper. Paola Salari and August Kuwawenaruwa contributed to the interpretation of the results. Maitreyi Sahu contributed to the statistical analysis and writing the paper in the first stage of the project phase. The paper has been published in Health Economics (Durizzo, Harttgen et al., 2022).

During the COVID-19 pandemic, Koku Awoonor-Williams provided access to District Health Information Management System data from the Ghana Health Services. The data serves as the basis for the analysis of chapters 3 and 4. For chapter 3, I conceptualized the study, developed the analytical strategy, executed the statistical analysis, interpreted the results, and mainly wrote the paper. Additionally, I created an online dashboard to improve the visualization of the results and make the research findings more accessible for policymakers and practitioners. Kenneth Harttgen supported me with the data analysis and writing of the paper and Isabel Gïther supported the conceptualization of the study and the analytical strategy. Koku Awoonor-Williams contributed to the interpretation of the results. Chapter 4 is a follow-up paper to chapter 3 and is a single-authored paper.

Chapters 5 and 6 were done during the COVID-19 pandemic, in collaboration with colleagues from the Development Economics Group at ETH Zurich, the University of Ghana, and the University of Pretoria, South Africa. Edward Asiedu and Attie Van Niekerk provided the contact details and sample for the phone survey in Ghana and South Africa used in both chapters, respectively. For chapter 5, Antoinette van der Merwe, Isabel Gïther, and I conceptualized the study and set up the survey. Due to travel restrictions, I remotely managed the fieldwork in Ghana, whereas Antoinette van der Merwe managed the fieldwork in South Africa. However, the enumerator teams in both countries were trained and supported by Edward Asiedu and Attie van Niekerk. I conducted the statistical analysis, interpreted the results, and mainly wrote the paper. Antoinette van der Merwe contributed to the statistical analysis and writing of the paper. Isabel Günther contributed to the analytical strategy. The paper has been published in World Develop-

ment (Durizzo et al., 2021). Chapter 6 is a follow-up paper to chapter 5. For this chapter, I adapted the survey, managed the fieldwork, developed the analytical strategy, executed the statistical analysis, interpreted the results, and mainly wrote the paper. Edward Asiedu and Antoinette van der Merwe supported managing the fieldwork. Isabel Günther contributed to the analytical strategy and the interpretation of the results. The paper has been published in the Review of Income and Wealth (Durizzo, Asiedu et al., 2022). Additionally, as a corresponding author for both papers, I was in charge of revising the papers and implementing the reviewers' and journal's feedback.

Moreover, due to the opportunity to present my research internally at the Development Economics Group of ETH Zurich and externally at several national and international conferences (see Table 1.1), I am thankful to have received useful feedback from several colleagues to improve the quality of the chapters.

1.7 Other research activities during doctoral studies

The COVID-19-related research led to great interest from policymakers and practitioners. Based on the results of chapters 5 and 6, I co-authored several policy briefs and media publications (Asiedu, Durizzo & Günther, 2021; Schlaefli, 2021; News, 2020). Additionally, based on further findings of the phone survey collected for chapters 5 and 6, I co-authored a policy brief about learning loss during the COVID-19 pandemic in poor urban neighborhoods (Asiedu, Durizzo, Günther & Polakova, 2021).

In addition to our research project for chapters 5 and 6, we collected one more round of household panel data (total four waves) from about 5,550 households in Ghana and South Africa. With the last round, I conceptualized and implemented a persuasive message experiment to better understand people's attitudes, misinformation, demand, and hesitancy toward COVID-19 vaccines. I plan to finalize the paper in 2023, together with the support of the co-authors of this paper. However, we already published a policy brief containing some preliminary results (Awoonor-Williams et al., 2021).

Related to the topic of improving UHC (chapter 2), I also conceptualized and implemented a randomized controlled trial with own data collection in April/May 2022 and October/November 2022. The study aims to improve our understanding of where out-of-pocket health expenditures occur in the health care provision process and how the information provided to the patient can reduce it. The study consists of a baseline study with around 2,300 patients and 60 health facilities in the South of Ghana and an intervention study with around 2,500 patients in about 50 health facilities. I plan to finalize both papers in 2023, together with the support of the co-authors.

Lastly, contributing to the population aspect of UHC—who is covered and benefits from services?—colleagues at the Development Economics Group at ETH Zurich and I are working on a paper applying innovative Machine Learning methods to better understand and accurately predict who and where people are that benefit from health insurance coverage and health services utilization in LMICs. We plan to finalize the paper in 2023.

Chapter 2

Towards mandatory health insurance in low-income countries: An analysis of claims data in Tanzania

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Abstract: Many low-income countries are in the process of scaling up health insurance with the goal of achieving universal coverage. However, little is known about the usage and financial sustainability of mandatory health insurance. This study analyzes 26 million claims submitted to the Tanzanian National Health Insurance Fund (NHIF), which covers two million public servants for whom public insurance is mandatory, to understand insurance usage patterns, cost drivers, and financial sustainability. We find that in 2016, half of policyholders used a health service within a single year, with an average annual cost of 33 US$ per policyholder. About 10% of the population was responsible for 80% of the health costs, and women, middle-age and middle-income groups had the highest costs. Out of 7,390 health centers, only five health centers are responsible for 30% of total costs. Estimating the expected health expenditures for the entire population based on the NHIF cost structure, we find that for a sustainable national scale-up, policymakers will have to decide between reducing the health benefit package or increasing revenues. We also show that the cost structure of a mandatory insurance scheme in a low-income country differs substantially from high-income settings. Replication studies for other countries are warranted.

Keywords: claims data, health insurance, scale-up, Tanzania, universal health coverage

JEL code: C01, I13, I15, I18

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2.1 Introduction

Universal health coverage has been high on the global health agenda for the last decade (Boerma et al., 2014; WHO, 2005). Universal health coverage means that all people obtain quality health services without suffering financially as a result of seeking health care (WHO, 2010). However, across low- and middle-income countries (LMICs), high out-of-pocket (OOP) health spending still persists and impoverishes households (Wagstaff et al., 2020). Reducing OOP health service expenditure can be accomplished by expanding free health care services at point of use, scaling up of health insurance coverage, or—most frequently—a mixture of both (WHO, 2020c).

The number of countries in Africa with national health insurance is gradually increasing (WHO, 2019). However, the percentage of the population enrolled in health insurance remains low. Many African countries have enrollment rates below 10%, with the notable exceptions of Rwanda, which reached enrollment rates of about 90% in 2015 (Chemouni, 2018) and Ghana with an enrollment rate of 56% in 2014 (Amu et al., 2018). Ghana and Rwanda are two of the very few countries in Africa where enrollment is mandatory for the whole population, including the informal sector and rural workers (McIntyre et al., 2018).

But several challenges exist for LMICs trying to scale up health insurance coverage. On the demand side, poor populations may be unable to pay insurance premiums (Msuya et al., 2007), do not trust the health system (Kamuzora & Gilson, 2007; Maluka & Bukagile, 2014), perceive the quality of care to be low (e.g., due to frequent drug stock-outs) (Linje, 2015; Macha et al., 2014), struggle to understand the benefits of health insurance (Kapologwe et al., 2017; Panda et al., 2015; Obrist et al., 2007), have limited awareness of benefit packages (Kapologwe et al., 2017; Kumburu, 2015) or are discouraged by prolonged registration processes (Banerjee et al., 2021; Kumburu, 2015). From the insurers' perspective, large informal sectors make it difficult to target and enroll people through employers and to calculate affordable income-based premiums (Borghi et al., 2013; Fenny et al., 2018). Moreover, since coverage rates are still very low and the voluntary enrollment in most countries leads to adverse selection of the population insured, it is hard to estimate which health services would be used most often in LMICs and the costs of covering the entire population.

Previous studies on health insurance in LMICs have mainly relied on household survey data. Various studies have examined factors associated with health insurance enrollment (Amu et al., 2018; Proaño Falconi & Bernabé, 2018; Salari et al., 2019). Other studies have shown that health insurance coverage in LMICs is correlated with decreased OOP expenditure (Aryeetey et al., 2016; Chua & Sommers, 2014; King et al., 2009; Thornton et al., 2010), decreased catastrophic health expenditure (Baicker et al., 2013; Barasa et al., 2017; Kusi et al., 2015) and increased health service usage (Blanchet et al., 2012; Chomi et al., 2014; Fiestas Navarrete et al., 2019; Ghislandi et al., 2015; Simon et al., 2017). There is mixed evidence of improved health outcomes (Abrokwah et al., 2014; Mensah et al., 2010; Robyn et al., 2012; Sommers et al., 2017, 2016; H. Wang et al., 2009).

For high-income countries (HICs), insurance claims data are also frequently used to study service utilization (Cicero et al., 2009; Kotzan et al., 2001) and health care costs (Cai et al., 2014; Nasseh et al., 2016; Schwarzkopf et al., 2013). Claims data have several advantages compared to survey data, including lower costs for data collection, larger sample sizes, more frequent data points, greater detail and accuracy related to diseases and medicines prescribed. Moreover, such administrative data has lower susceptibility to survey biases linked to attrition, social desirability or recall (Finkelstein & Taubman, 2015). Disadvantages of using claims data include fewer variables than household surveys and that they only cover insured people.

To our knowledge, few studies have analyzed health insurance claims data for African countries. Two studies in South Africa use a small sub-sample of claims data to determine chronic disease risk factors (Kolbe-Alexander et al., 2008) and to predict survival rates of HIV-infected adults (Nachega et al., 2010). In Ghana, claims from the National Health Insurance Scheme have been analyzed to determine the most frequently used medicines (Ankrah et al., 2018).

In this study we use a rich administrative dataset from the Tanzanian National Health Insurance Fund (NHIF) to study which policyholders use which types of services, drugs, and health facilities, how often and the associated costs. We merge the NHIF policyholder data with the 2016 NHIF claims data and data on the geographic location of health facilities in Tanzania. This analysis is unique in that it is the first comprehensive analysis of a large-scale mandatory health insurance database for any African country. Moreover, as the health insurance we analyze is mandatory for an entire population group in Tanzania, the results should also be less biased by adverse selection of high-risk groups. Hence, this study should substantially advance our understanding about the opportunities and barriers to scaling up health insurance coverage in a low-income setting. Although only data from 2016 is available, we assume that the general insights and implications are still relevant today: NHIF coverage rates have stayed almost the same over the last five years (7% in 2016 and 8% in 2021) and a Single National Health Insurance (SNHI) is under discussion.[1]

2.2 Study setting and context

Tanzania has experienced relatively high economic growth per capita since the year 2000, averaging 4% per year (see Table 2.1). But in 2016, the Gross Domestic Product (GDP) per capita was still only 2,926 US$ and the national poverty rate at 28% (WorldBank, 2021b). Indicators of health outcomes and health care access have also improved for Tanzania over the last decade (see Table 2.1). Between 2007 and 2016, life expectancy at birth increased from 56 to 64 years, the under-five mortality rate decreased from 84 to 57 per 1,000 live births and maternal mortality from 685 to 539 per 100,000 live births. Health access indicators are still lower than in neighboring Kenya and Rwanda, but higher

[1] Discussion with representatives for health financing technical working group.

than the average on the African continent (WorldBank, 2021b).

Total annual health expenditure per capita for Tanzania is 112 US$, similar to other African countries, corresponding to around 4% of the GDP per capita (WorldBank, 2021b). Average per capita OOP expenditure in Tanzania (25 US$ per year) is lower than in other African countries (73 US$). However, neighboring Rwanda, with the highest insurance coverage in sub-Saharan Africa (SSA), has significantly lower per capita OOP expenditure (8 US$ per year). Rwanda also shows that it is technically possible for a country to include the informal sector and rural workers into a mandatory health insurance scheme, with 80% of these sectors being enrolled, and 90% of the total population (Chemouni, 2018).

Tanzania's main voluntary insurance for informal rural sector workers, the Community Health Fund (CHF)[2], covers around 25% of the population (NHIF, 2018). In total, 32% of the Tanzanian population possesses health insurance. The health insurance structure in Tanzania is highly fragmented, however, with many small schemes targeting different population groups (Amu et al., 2018; Chomi et al., 2014; McIntyre et al., 2008). The government aims to unify existing schemes into one national health insurance fund and to extend health insurance coverage to the entire Tanzanian population (MoHCDGEC, 2019). In addition to reaching the entire population, a major question is how to set affordable premiums for various socio-economic groups while keeping the national scheme financially solvent (Renggli et al., 2019; Lee et al., 2018, 2019).

In this study, we analyze claims data from the NHIF, a mandatory health insurance for all Tanzanian public sector employees covering 7% of the population[3]. Employees contribute 6% of their monthly salary as a premium (on average 669,109 Tanzanian shilling (TZS); around 288 US$ per year), 3% paid by them and 3% paid by their employer. Compared to the 15% on wages paid in Rwanda, this premium is low, especially for a scheme covering formal sector workers.[4] The premium covers public servants, but also the spouse, parents of both sides, and up to four children younger than 18 years within the household. The NHIF currently provides a wide range of benefits (see Appendix 2.B) and only few health services require special approval from the NHIF.[5] These include cancer, dialysis, dental treatments, scan diagnostics and reading glasses. NHIF members are entitled to use care from the network of accredited health facilities, including both public and private facilities. According to official records, 79% (n=7,390) of all health facilities

[2]Since 2018 restructured to improved Community Health Fund (iCHF) (Lee et al., 2018).

[3]NHIF coverage rates are constant on a 7% level since 2012. 2018 is the most recent year coverage rates are published by NHIF.

[4]In Rwanda, formal employees (members of RAMA) pay a monthly premium of 7.5% of their gross income, matched with 7.5% payed by the employer. Members of the military (MMI members) pay 17.5% of their monthly salary, with 5% matched by their employer. Rural and informal sector workers are covered by the Community- based Health Insurance (CBHI) where the premium depends on the socio-economic status – the poorest population groups are exempted from paying any premiums (McIntyre et al., 2018).

[5]In 2018, the proportion of special approvals was around 7% of total payments (NHIF, 2018). The procedure to get a special approval is as follows: Doctors fill out a form and send it to the NHIF for approval. Once approved, the beneficiary may access the service within the desired facility or another facility, based on availability.

Tab. 2.1: Country characteristics from Tanzania and neighboring countries for the year 2016.

	Tanzania	Kenya	Rwanda	SSA
Macroeconomic indicators				
GDP per capita, PPP (current international $)	2,926	3,122	1,978	3,802
GDP per capita growth (annual %)	4	3	3	-1
Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population)	49	37	56	41
Population growth (annual %)	3	2	3	3
Fertility rate, total (births per woman)	5	4	4	5
Health (access) indicators				
Life expectancy at birth, total (years)	64	65	68	60
<5 mortality rate (per 1,000 live births)	57	44	39	82
Maternal mortality ratio (per 100,000 live births)	539	346	260	545
Births attended by skilled health staff (% of total)	64	62	91	58
Pregnant women receiving prenatal care (%)	98	96	99	82
Health finance indicators				
Government health expenditure per capita, PPP (current international $)	45	52	44	69
Current health expenditure per capita, PPP (current international $)	112	144	130	198
Current health expenditure (% of GDP)	4	5	7	5
Out-of-pocket expenditure per capita, PPP (current international $)	25	40	8	73
Out-of-pocket expenditure (% of current health expenditure)	22	28	6	37
Health insurance indicator				
Coverage of health insurance schemes (% population)	32%	20%	87%	–

Notes: Health insurance coverage consists in Tanzania of 7% National Health Insurance Fund and 25% Community Health Fund (2018); Kenya 19% National Health Fund and 1.3% Community-based Health Insurance (2016); Rwanda 82% Community Based Health Insurance and 5% formal sector insurance (MMI, RAMA) (2016).
Source: Barasa et al. (2017); Fenny et al. (2018); Hinson et al. (2020); NHIF (2019); WorldBank (2021b).

in Tanzania were accredited in 2019 (MOH, 2019). All covered services are provided free of charge to members of the NHIF in accredited health facilities. The health facility then submits a claim to NHIF for reimbursement of any costs incurred.

From a financial perspective, the NHIF is by far the largest insurance scheme in Tanzania, with over 480,000 million TZS (around 206 million US$) in annual revenue in 2018 (NHIF, 2018). The scheme's annual surplus has, however, decreased every year since 2014/2015, from 148,000 million down to 32,000 million TZS in 2017/2018 (NHIF, 2018). Although this trend is not an immediate problem, it has already raised concerns related to long-term financial sustainability, especially since there are discussions about whether to subsidize insurance premiums or services for informal and rural populations (Lee et al., 2019). If NHIF barely generates annual surplus, the opportunity for cross-subsidy will be lost and the ultimate aim to extend health insurance coverage to the entire Tanzanian population becomes financially unfeasible. The key objective of this analysis is to better understand the financial sustainability of NHIF and to identify cost drivers for insurance scheme.

2.3 Data and analytic strategy

The analysis is based on three data sources: the NHIF policyholder database (2016 and 2017), the NHIF claims database (2016), and the Health Facility Registry database (for more details, see Figure 2.A.1 in the Appendix). To receive the NHIF policyholder and the NHIF claims database, ethical clearance was obtained from the Ifakara Health Institute (IHI) Institutional Review Board (IHI/IRB/EXT/No:028 - 2016) and the Tanzanian National Institute for Medical Research (NIMR/HQ/R.8a/Vol.IX/2340). The Health Facility Registry database is publicly available on the internet (MOH, 2019).

2.3.1 NHIF policyholder data

The NHIF policyholder dataset includes all persons registered in the NHIF in 2016 and 2017. The original sample is comprised of 3,005,169 insured (including both premium-paying principals and their dependents). Although originally designed and implemented to provide compulsory health insurance for public servants, the NHIF started to expand its coverage in 2012 to other groups who can join on a voluntary basis, as part of an effort to merge Tanzanian health insurance schemes and cover the entire population. For the study, only the mandatory membership group "public servants" (including police, councilor, member of parliament and public employees) and their dependents is used to keep adverse selection due to self-selected, high-risk individuals from biasing the results.[6] In fact, we observe adverse selection for the voluntarily insured, as the 586,506 individuals who are not public servants have significantly higher costs per person than the mandatory insured public servant group: 7,160 TZS versus 4,833 TZS. Moreover, 76,407 entries were duplicates (2.5%) and were excluded from the analysis.

This leaves a total of 2,342,256 policyholders, or 4.42% of the Tanzanian population. The database includes the following information: anonymized membership number, birth date, gender, whether the person is the premium-paying principal or a dependent (spouse, child, parent, others), the insurance contribution per year (premium) and the principal's salary. A limitation of this dataset is that the region where the policyholder lives is not recorded. However, the location of a health facility is available for persons with a claim in 2016.

The sample of mandatory public servants and their dependents is different from the Tanzanian population as follows (see Table 2.2). First, it is older: whereas the age group 0-19 years old is underrepresented, the age groups 20-69 and especially 50-69 are overrepresented. One reason could be that public servants have fewer children, on average, than the general population (Mturi & Hinde, 1994; Vavrus & Larsen, 2003). No significant gender differences in the distribution can been detected. However, public servant employees receive, on average, a higher monthly salary salary of 500,001-900,000 TZS (around 215-386 US$, or 2,580-4,632 US$ per year) compared to the average formal sector worker

[6] Beside public sector employees, NHIF also covers voluntary groups, which are not covered in this paper.

Tab. 2.2: Distribution of NHIF public servant policyholder by age, gender (2016/2017) compared to the total population.

	Distribution NHIF policyholder 2016/17, %	NHIF policyholder 2016/17, % population	Distribution total population based on CENSUS 2012, %
Age			
<5	9.72	2.32	18.54
5-9	10.19	2.64	17.05
10-19	14.14	2.68	23.30
20-29	21.73	6.28	15.28
30-39	15.02	6.21	10.68
40-49	10.02	6.29	7.03
50-59	10.54	12.47	3.73
60-69	5.24	10.28	2.25
70-79	2.35	8.05	1.29
80-89	0.88	8.11	0.48
90+	0.17	1.99	0.38
Gender			
Male	48.45	4.43	48.28
Female	51.55	4.40	51.72
Total	100.00	4.42	100.00

Notes: Unit is per person (NHIF policyholder n = 2,342,256). The NHIF policyholder 2016/17 and % population was calculated as: number of NHIF policyholder 2016/2017 in a certain age/gender group divided by number of total population based on CENSUS 2012 in a certain age/gender group. The Census data was retrieved from IPUMS (2020).

in Tanzania (300,000-500,000 TZS) (TNBS, 2018a). The informal sector, which accounts for 76% of non-agricultural workforce in Tanzania, is very likely to have even lower incomes (OxfordBusinessGroup, 2021).

A comparison of the number of public servant employees enrolled (principal members) with data from the official public employee and earnings survey (EES) from 2016 (TNBS, 2018a) suggests that although enrollment is mandatory for public servant employees, in practice 72%[7] of all public servants are enrolled under NHIF. However, the younger public servants (between 15–35 years old) show almost full coverage rates (94%), whereas older public servants (36+ years) have a lower enrollment rate. This implies that some public servants seem to be able to choose not to be insured (e.g., contract not yet renewed). Thus, unobserved adverse selection where low health risk individuals do not insure cannot be completely ruled out. However, it is substantially lower than in any voluntary insurance schemes, in particular given that we observe nearly full coverage among young public servants.

[7]This rate might be even slightly lower since the EES does not include public servants from Tanzania islands. A bias due to different definitions of public servants can be excluded because EES defines the group as “Central Government, Local Government and Parastatal Organization”.

2.3.2 NHIF claims data

The NHIF claims database includes all NHIF claims for health services used by NHIF policyholders in the year 2016. The original number of claims is 36,141,911.[8] Since we only focus on the mandatory membership group of public servants for the final analysis, which represent 73% of the total claim data for 2016, the total sample size is 26,299,491 claims. The claims database includes the following information: anonymized membership number, birth date, gender, treatment date, claim value, facility registered name, facility type, facility ownership, region, district and claim details (treatment type, e.g., X-Ray, Ibuprofen).[9] A limitation of the data is that the claim details only describe the treatment without reporting a diagnosis. Therefore, we can only make reasonable assumptions regarding the underlining disease for a selected number of claim types, for example, anti-malaria drug to treat malaria or dialysis in case of kidney-related diseases. In contrast, antibiotics could be used for all kinds of bacterial diseases.

2.3.3 Health facility registry

The Health Facility Registry, maintained by the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC), provides information on the main characteristics of all health facilities in Tanzania in 2018 (MOH, 2019). This dataset lists a total of 8,943 health facilities from mainland Tanzania[10], of which 7,100 (79.8%) are NHIF accredited, suggesting that the NHIF accreditation process is relatively easy. For each health facility, we have information on the facility ID, the registered name, the common name, the facility type (dispensary/pharmacy, health center, hospital, clinic,[11] health lab), ownership (public, private), and the geographical location (region, district, council, ward, village/street), including GPS coordinates. Information on 39 accredited health facilities for the islands Pemba and Zanzibar are also included. Moreover, 251 health facilities that are listed in the claims dataset from 2016 were included in our final dataset, although they have not been listed in the Health Facility Registry of 2018. The final analysis thus covers 7,390 NHIF accredited health facilities. Policyholders covered by

[8] Of these, 21,529 (0.06%) were identified as duplicates and dropped from the analysis. 2,252,387 claims (6.2%) have the same membership number (1,000,000) and are assumed to be wrongly entered into the system. In order to validate the claim values per treatment the price schedule for NHIF accredited health facilities was used to create an upper boundary of claim values. Claims which were above this boundary were excluded (69,978 claims, 0.2% of all claims). 107,890 claims (0.3%) were assumed to be double entries since the same policyholder had the same treatment on the same day at the same health facility – once with a claim value of 0 and once with a claim value > 0. The claims with the 0 value were excluded from the analysis of the claim values.

[9] For very few claims, also the claim and reimbursement date is given; but this information cannot be used for the analysis because of many missing data entries.

[10] Comparing our dataset of health facilities to the study from Maina et al. (2019), where they use multiple geocoding methods to provide a comprehensive spatial inventory of all health facilities in SSA, including Tanzania, our dataset has many more health facilities (6,304 vs. 8,943).

[11] Clinics are specialized health facilities, whereas hospitals include district, regional referral, zone referral and national referral hospitals.

the NHIF can only access health services through accredited health facilities in Tanzania.

Around 75% of all NHIF-accredited health facilities are public health facilities and the remainder are private. Primary health care, such as dispensaries and pharmacies (84.4%), account for the vast majority of NHIF-accredited health facilities. NHIF-accredited health facilities are scattered all over Tanzania, but are also concentrated in certain regions: the number of NHIF-accredited health facilities is particularly high in the regions of Dar es Salaam (7% of all accredited facilities), Dodoma (5.3%), Tanga (5.2%) and Morogoro (5%), and low in Katavi (1.1%), Geita (2.2%) and the islands (below 1%). Accounting for population density, regions with a high number of health facilities per 100,000 inhabitants are Dodoma, Morogoro and Kilimanjaro (more than 23 health facilities per 100,000 inhabitants), whereas low rates can be found in Katavi, Geita, Simiyu and Shinyanga (less than 10 health facilities per 100,000 inhabitants) (see Figure 2.A.2 in the Appendix). Hospitals, clinics, and health labs are more frequent in Tanzania's largest city, Dar es Salaam.

2.3.4 Analytical strategy

In a first step, we merged the three databases. The NHIF policyholder and claims databases were merged using three uniquely identifying variables: anonymized membership number, birth date and gender. Forty-seven percent of policyholders were matched with at least one claim, meaning that 53% of people enrolled in the health insurance appeared not to have used any health services in 2016. In addition, 14% of all claims (corresponding to around 204,751 unique membership numbers) could not be matched to the policyholder database. These claims were excluded from the final analysis for the policyholders because no information about membership characteristics were available. The claims and health facility databases were merged using five uniquely identifying variables: facility name, region, district, facility type and ownership. OpenRefine software was used in order to clean identifying variables, since different naming and misspelling made it impossible to merge all facilities directly.

In a second step, we analyzed the three datasets to answer the following four questions with the objective of better understanding the usage pattern, cost drivers, and financial sustainability of a mandatory insurance scheme in a low-income setting:

1. Which policyholders have the greatest utilization and costs of health care services?
2. What is the financial sustainability for national scale-up of a mandatory health insurance?
3. Which services are used the most and at what cost?
4. Which health facilities have the greatest utilization and at what cost?

The first research question, "Which policyholders have the greatest utilization and costs of health care services?", contributes to existing studies showing that health insurance enrollment increases health care utilization among the insured compared to the uninsured (Chomi et al., 2014; Fiestas Navarrete et al., 2019; Ghislandi et al., 2015; Simon et al., 2017). To answer it, we first show the distribution of policyholders and their

utilization in a concentration curve. Then, we estimate three regressions to explain which people with insurance take up at least one health care service per year, how many times health care services are used and, the total claim value per policyholder (in log scale, see Section 2.4.1). A logistic regression is used to analyze what type of policyholder is more likely to make a claim and a Tobit-model[12] is used to assess the drivers of the number of claims per person.

The second research question, "What is the financial sustainability for national scale-up of a mandatory health insurance?", contributes to the discussion of scaling up health insurances in many LMICs (e.g., WHO, 2019). We estimate the expected total health expenditures as well as the required premiums if such insurance is made mandatory for the entire population (see Section 2.4.2). We apply a simple back-of-the-envelope calculation using the coefficients (on age, gender, and income) from our results in Section 2.4.1 (see Table 2.3) and the population shares from Table 2.2 and extrapolate it to Tanzania Census Data (IPUMS, 2020) from 2012, which provides information on population characteristics. We assume that disease burdens and behavior are the same for the entire population as they are for public servants—controlling for differences in age, gender, and income. Since we only include the mandatory membership group in our analysis, we avoid possible biases due to adverse selection in the form of self-selected high-risk individuals into the insurance (see Section 2.3.1) when predicting mandatory national health insurance costs.

The third research question, "Which services are used the most and at what cost?", provides insights into the claim details to learn more about drug and health service utilization in low-income settings that has so far been hampered by a lack of access to such databases (Ankrah et al., 2018). In two descriptive tables, we first analyze the cost structure of claims by service type and second, we analyze the most frequent service details (see Section 2.4.3).

Finally, the fourth research question, "Which health facilities have the greatest utilization and at what cost?", contributes to the few studies about equity in access to health services examining the general utilization of health care facilities based on household surveys (Chomi et al., 2014; Fiestas Navarrete et al., 2019; Ghislandi et al., 2015; Simon et al., 2017) and health facility surveys (Baker et al., 2015; Do et al., 2016; Kanyangarara et al., 2018). We first provide descriptive insights about all health facilities in Tanzania by type and ownership status. Second, we show the distribution of health facilities and their costs in a concentration curve. Third, we analyze in three regressions which health facilities had at least one NHIF claim per year, how many times health care services are used, and the total claim value per health facility (in log scale, see Section 2.4.4). Similar to the method used to answer the first research question, a logistic regression is used to analyze what type of health facility is more likely to receive a claim and a Tobit-model is used to assess the drivers of the number of claims per health facility.

Overall, the results of the four research questions will be put in context of the findings from other countries to better understand the magnitude of the results. Since access to

[12]Tobit-model is used because outcomes are left-censored to 0 (Wooldridge, 2020).

such databases in LMICs is still lacking, we mostly compare our results with data from HICs that is publicly available (e.g., AOK-Bundesverband, 2019; Dieleman et al., 2020; EDI, 2020; Vuffray, 2018; Wieser et al., 2014). These results will highlight whether we can rely on studies from HICs or if more studies from LMICs are warranted.

2.4 Results

2.4.1 Usage and costs of the mandatory insurance by policyholders

In 2016, out of the 2,342,256 public servants and their dependents enrolled in the mandatory NHIF, only 47% made at least one claim during the year. From these 1,100,860 beneficiaries, 26,299,491 claims were recorded in our database. To our knowledge, such information is not available for any other LMIC. Compared to HICs for which data is available for some selected countries, this is a rather low percentage of policyholders using any health services. In Switzerland[13], for example, 84% of people enrolled in mandatory health insurance used at least one service in 2018 (EDI, 2020). Moreover, only a small percentage of policyholders (10%) in the NHIF account for most of the health care expenditure (80%) (see Figure 2.1). Expenditures appear to be somewhat less concentrated in mandatory health insurances in HICs. For example, claims data from the mandatory Swiss health insurance shows that 20% of the insured accounted for 80% of the costs (Vuffray, 2018).

On average, the total claim value of a policyholder (including those with zero claims) in a single year was 76,166 TZS (33 US$). This corresponds to about 1% of the average yearly income of a public servant and around 20% of the yearly insurance fee paid by employer and employee. However, only 26% of policyholders actually pay an insurance premium, whereas 74% are non-paying "dependents" (including spouse, up to four children and parents). Therefore, the average total claim value for each family (with on average 3.6 members) consists of 3.6% of the average salary of principal public servant and about 60% of the estimated yearly insurance fee. While, this rate is still low compared to some HICs, such as Switzerland, where total claim value per policyholder was on average 90% of the yearly mandatory insurance fee (EDI, 2020; Dieleman et al., 2020; AOK-Bundesverband, 2019), it is important for NHIF to run a surplus with public servants in order to achieve universal health coverage, as insurance schemes for poor informal and rural populations need to be subsidized (Lee et al., 2019).

Analyzing which policyholder characteristics are more likely to be associated with at least one claim within a year (Table 2.3, column I), we show that women are 1.3 times more likely to have a claim than men, and people in the older working age population (30–59 years old) are around 1.2 times more likely than younger professionals (20–29 years old) and the oldest age groups to have a claim. Moreover, the lowest- and highest-

[13]We compare our results to Switzerland as we were able to obtain similar statistics that are not available for other HICs. The Swiss system is private but still mandatory.

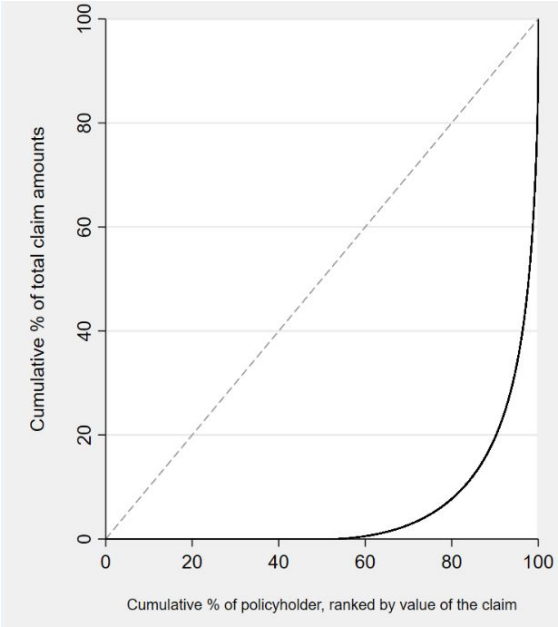

Fig. 2.1: Concentration curve of total NHIF claim amounts by policyholder.
Note: The 45 degree line would indicate that each policyholder accounts for the same amount of costs.

income groups have significant lower probability to take up at least one health care service than the reference middle-income category. The results for women are in line with other countries, whereas the differences between age groups are surprising. In other countries, children under five years old and the elderly usually use more health services than working-age adults (EDI, 2020; Dieleman et al., 2020). However, comparing the result to the nationally representative Demographic and Health Survey of 2015 in Tanzania, we find a similar pattern for the age groups (DHS, 2021). It is possible that lower recorded usage rates for children below five in Tanzania occur because some health services for children are provided for free. The result for income groups might be driven by the highest-salary group having enough money to visit private non-accredited health facilities and/or being in better health (Fichera & Savage, 2015). On the contrary, the lowest-salary group might sometimes not even be able to afford to travel to a health provider and/or miss work and/or live in a rural area with worse health care access (see Figure 2.A.2 in Appendix and Salari et al. (2019)).[14]

Each beneficiary who took up a health service had a median of 15 claims per year and an average of 24 claims. Since several claims can be recorded per visit, the results seem plausible. Overall, all policyholders (including those with zero claims) had an average of 11 claims. Each beneficiary who took up at least on health service (i.e., had a recorded claim) had a median of 3 visits per year (average is 4.5 visits). As a result of high take-up rates and a high number of claims, again women, the middle-income group and the population

[14]Since no data is available on the beneficiary home location or services received outside of the official NHIF health care, we cannot test which channel drives the results.

Tab. 2.3: Factors correlated with take-up of services, number of claims and value of claim per policyholder.

	(I) Policyholder had a claim Logit odds ratio	(II) Number of claims per policyholder Tobit-Coefficient	(III) Total value of claims (log) per policyholder Tobit-Coefficient
Status (ref. Principal)			
Dependent	1.000 (0.997)	0.412 (0.000)	0.053 (0.003)
Gender (ref. Male)			
Female	1.337 (0.000)	7.691 (0.000)	1.724 (0.000)
Age (ref. 20-29 years)			
<5	0.822 (0.000)	-1.564 (0.000)	-0.968 (0.000)
5-9	1.140 (0.000)	1.464 (0.000)	0.538 (0.000)
10-19	0.969 (0.000)	-3.501 (0.000)	-0.388 (0.000)
20-29 ref. group			
30-39	1.256 (0.000)	5.122 (0.000)	1.318 (0.000)
40-49	1.239 (0.000)	6.230 (0.000)	1.357 (0.000)
50-59	1.107 (0.000)	6.386 (0.000)	0.854 (0.000)
60-69	0.896 (0.000)	4.618 (0.000)	-0.142 (0.000)
70+	0.928 (0.000)	7.119 (0.000)	0.201 (0.000)
Monthly salary (ref. 500,001 – 900,000 TZS)			
<150,000	0.570 (0.000)	-9.605 (0.000)	-2.999 (0.000)
150,001 – 300,000	1.202 (0.000)	4.078 (0.000)	0.988 (0.000)
300,001 – 500,000	0.893 (0.000)	-1.964 (0.000)	-0.579 (0.000)
500,001 – 900,000 ref. group			
900,001 – 1,200,000	0.920 (0.000)	-1.127 (0.000)	-0.421 (0.000)
1,200,001 – 1,500,000	0.903 (0.000)	-1.096 (0.000)	-0.281 (0.000)
>1,500,000	0.247 (0.000)	-25.041 (0.000)	-7.965 (0.000)
Constant	0.979 (0.000)	-6.747 (0.000)	1.301 (0.000)
Observations	2,342,255	2,342,255	2,342,255
Pseudo R-squared	0.054	0.013	0.019

Notes: Unit is per policyholder (n = 2,342,256). P-values in parenthesis. Average age (20–29) and average salary (500,001–900,000 TZS) category were used as reference categories.

group aged 30–59 had the highest total costs (see column III in Table 2.3). This result is particularly surprising for the age groups. For example, in Switzerland, costs increase with age and the elderly incur costs up to 15 times higher than young adults (EDI, 2020), while in the US, children below the age of one incur costs almost 10 times higher than children aged 5–9 years (Dieleman et al., 2020).

2.4.2 The costs of scaling up a health insurance

If covered health services would not change (see Section 2.4.1), total health claims for Tanzania would amount annually to 3,300 billion TZS (1.4 billion US$) or 62,350 TZS (27 US$) per person. Revenues could rise to around 750 billion TZS (320 million US$) per year if all formal sector employees (5% of Tanzanians) would contribute similarly as

currently public servants, that is, 6% of their average salary.[15] If formal sector employees would contribute 15% of their salaries (as in Rwanda, see footnote 4) collected funds would increase to 1,900 billion TZS (820 million US$). Hence, a mandatory scheme would require additional funding of between 1,400 and 2,500 billion TZS (0.6–1.0 billion US$) per year.[16] This would correspond to about 25%–45% of current annual government health expenditures (Purchasing Power Parity, see Table 2.1) that would have to be financed out of taxes or international contributions to the Tanzanian health budget.

Another option would be to ask the remaining informal workforce (42% of the total Tanzanian population) to contribute with 65,000–116,000 TZS or 25–50 US$ per year to the insurance fund, which might be difficult, given that 26% of the population in Tanzania lives on less than 589,703 TZS (256 US$) a year (TNBS, 2018b), that is, they would have to contribute 10%–20% of their annual income. In Rwanda, the country with by far the highest health insurance coverage rate on the African continent, premiums for the lowest-income group in the informal sector are entirely paid by the government, the middle-income group in the informal sector pays 3,000 RwF per person per year (3 US$), and the highest-income group in the informal sector pays 7,000 RwF per person per year (7 US$). Moreover, the informal workforce has a more limited service package in Rwanda than the full paying formal employees (15% of gross salary), which raises equity concerns. Policymakers in Tanzania could decrease costs by redefining the essential service package (for the entire population) or health facilities to be covered (gatekeeping).[17] Sections 2.4.3 and 2.4.4 will provide some first insights for possible avenues to consider.

2.4.3 Cost drivers of the mandatory insurance by health services

Three-fourths of all claims were made for medicines (e.g., paracetamol), consumables (e.g., dispensing bag), and diagnostic examinations (e.g., malaria blood smear test) (Table 2.4). The mean claim values for these three categories are, however, rather low, at around 5,000–6,000 TZS (2–3 US$) per claim. In contrast, inpatient and surgical charges, which account for fewer than 1% of total claims, are much more expensive per claim, and thus these claims together account for 14% of the total claim value. For example, the mean claim value for surgical charges (e.g., C-sections) is 259,948 TZS (112 US$), over 50 times higher than the mean claim value for medicine. Since no similar data is currently available for other LMICs, we can again only compare to HICs. Total claim amounts for medicines and consumables are twice as high as a share of total costs in Tanzania (40%) compared to HICs, where they account for less than 20% of total costs (AOK-Bundesverband, 2019; Dieleman et al., 2020; EDI, 2020). One reason for this difference could be that costs of

[15] Very simple estimation based on the EES report of formal workers wage: 300,000-500,000 TZS average monthly income in the formal sector in Tanzania (TNBS, 2018a).

[16] There is one major limitation to this calculation. The financial report of the NHIF shows that costs rose in the following years (NHIF, 2018). Therefore, our projected costs for future universal health coverage might be underestimated.

[17] The term gatekeeping describes the role of primary health care practitioners in authorizing access to specialized care in higher health facility levels.

Tab. 2.4: NHIF claims by service types.

	Number of claims		Claim amount (in TZS)				
	Frequency	Percent	Sum (million)	Percent	Mean	Median	Max (million)
Consultation Charges	4,666,349	17.75	28,459	16.03	6,099	2,000	1.96
Medicine & Consumables	14,225,609	54.12	74,328	41.86	5,225	1,500	23.69
Diagnostic Examination	6,848,748	26.06	35,017	19.72	5,113	2,000	2.00
Inpatient Charges	123,210	0.47	11,472	6.46	93,110	32,500	32.50
Surgical Charges	53,662	0.20	13,949	7.86	259,948	130,000	6.00
Procedural Charges	243,254	0.93	12,121	6.83	49,827	10,000	15.45
Other Charges	124,642	0.47	2,206	1.24	17,697	15,000	8.00
Total	26,285,474	100.00	177,531	100.00	6,754	2,000	32.50

Notes: Unit is per claim (n = 26,299,491). 14,017 claims have missing values for service type.

inpatient services are higher in HICs; another reason is that they conduct more inpatient procedures. We do not expect that the observed difference is caused by higher prices for medicines or higher use of medicines in HICs (Ankrah et al., 2018; Horumpende et al., 2018; Klein et al., 2018).

We are further able to investigate the frequency and costs of specific health treatments. Table 2.5 shows the 10 most frequently used health services, the 10 most expensive health services, and the 10 health services that account for the highest total costs.[18] The most often used medicines are pain killers (e.g., Ibuprofen + Paracetamol, 7.1%), antibiotics (e.g., Amoxycillin, 2.4%), anti-malaria drugs (e.g., Artemether + Lumefantrine, 1.5%) and treatments for eye infections (e.g., Ciprofloxacin, 1.3%). These findings are consistent with an analysis of the National Health Insurance Scheme in Ghana, which showed that painkillers, anti-malaria drugs, anti-infectives and antihypertensives are the most prescribed drugs (Ankrah et al., 2018). In addition, diagnostics for a broad variety of disease detection such as urine (5.7%), malaria blood smear (5.1%), and stool analysis (2.3%) are often used.

The claims with the highest mean value per claim mostly belong to the procedural charges category for non-communicable diseases (NCDs) and are often related to cardiovascular or cancer treatments. For example, Trastuzumab/Herceptin, a cancer drug used primarily to treat breast cancer, costs up to 9.8 million TZS (4,200 US$), more than an average yearly salary of a public servant (CDC, 2021b). Due to the high costs, such treatments must be specially approved by the NHIF (see footnote 5). Since NCDs in Tanzania are increasing (Roman et al., 2019)—in 2016, deaths related to NCDs already accounted for as many as 33% of all deaths in Tanzania (WHO, 2016)—it will be essential to decrease the rising trend of NCDs and the corresponding rising costs by increasing awareness campaigns for early detection of NCDs, improving access to care and diagnostic capabilities, as well as promoting healthier lifestyles (for similar arguments see e.g., Katalambula et al., 2018; Lyimo et al., 2020; Roman et al., 2019).

[18] Two service types, registration/consultation charges and inpatient charges, were excluded from this analysis.

Tab. 2.5: List of Top 10 service details (in TZS).

Servicedetail	Service type	Number of claim [% total]	Mean claim value (in TZS)	Total claim value (in million TZS) [% total]
Top 10 service details: sorted by number of claims				
Ibuprofen + Paracetamol (pain)	Medicine	**1,859,265** [7.1%]	444	826 [0.5%]
Dispensing bag	Consumables	**1,535,436** [5.8%]	38	58 [0%]
Urine analysis	Diagnostic	**1,503,470** [5.7%]	1,680	2,527 [1.4%]
Malaria blood smear (B/S)	Diagnostic	**1,352,523** [5.1%]	1,701	2,301 [1.3%]
Amoxycillin (antibiotics)	Medicine	**638,543** [2.4%]	2,466	1,575 [0.9%]
Stool analysis	Diagnostic	**604,499** [2.3%]	1,588	960 [0.5%]
Full blood picture (FBP)	Diagnostic	**412,369** [1.6%]	6,220	2,565 [1.4%]
Artemether + Lumefantrine (malaria)	Medicine	**397,579** [1.5%]	1,739	691 [0.4%]
Metronidazole (antibiotics)	Medicine	**382,269** [1.5%]	1,588	607 [0.3%]
Ciprofloxacin (eye drops)	Medicine	**340,153** [1.3%]	2,589	881 [0.5%]
Top 10 service details: sorted by mean claim value				
CABG - coronary artery bypass graft	Procedural	1 [0%]	**15,450,000**	15 [0%]
Mitral valve replacement	Procedural	4 [0%]	**10,780,000**	43 [0%]
Mitral valve replacement + tricuspid valve repair - devega's	Procedural	1 [0%]	**10,780,000**	11 [0%]
Dual chamber pace maker insertion (incl. pace maker device)	Procedural	3 [0%]	**10,500,000**	32 [0%]
Trastuzumab/Herceptin (cancer)	Medicine	224 [0%]	**9,836,429**	2,203 [1.2%]
Mitral valve repair	Procedural	4 [0%]	**9,650,000**	39 [0%]
Ventral septal defect (VSD) closure	Procedural	11 [0%]	**8,850,000**	97 [0.1%]
Tetralogy of fallot (TOF) repair	Procedural	7 [0%]	**8,850,000**	62 [0%]
Atrial septal defect (ASD) closure	Procedural	1 [0%]	**8,850,000**	9 [0%]
Atrio-ventricular canal repair	Procedural	1 [0%]	**8,850,000**	9 [0%]
Top 10 service details per service type: sorted by total claim value				
Haemo dialysis per session	Procedural	16,434 [0.1%]	384,005	**6,311** [3.5%]
Amoxycillin + Clavulanic acid (antibiotics)	Medicine	169,797 [0.6%]	19,743	**3,352** [1.9%]
Caesarian section (C/S)	Surgical	8,189 [0%]	392,593	**3,215** [1.8%]
Full blood picture (FBP)	Diagnostic	412,369 [1.6%]	6,220	**2,565** [1.4%]
Urine analysis	Diagnostic	1,503,470 [5.7%]	1,680	**2,527** [1.4%]
Malaria blood smear (B/S)	Diagnostic	1,352,523 [5.1%]	1,701	**2,301** [1.3%]
Trastuzumab/Herceptin (cancer)	Medicine	224 [0.0%]	9,836,429	**2,203** [1.2%]
Hydrochlorthiazide + Losartan (blood pressure)	Medicine	100,859 [0.4%]	21,823	**2,201** [1.2%]
Gabapectin/Gabatin-300 (neuropathic pain related diseases)	Medicine	52,036 [0.2%]	37,893	**1,972** [1.1%]
Raberprazole/Rabeloc (stomache acid related diseases)	Medicine	58,081 [0.2%]	32,520	**1,889** [1.1%]

Notes: Registration and consultation charges included registration and consultation fees; Inpatient charges included accommodation fees or intensitive care unit service charges. Both categories are not included in the table. Total number of claims in 2016 is 26,299,491 and total claim value is 178,400 million TZS.

Lastly, with regard to the NHIF's total expenditure, treatments for kidney diseases, C-sections, cancer, and high blood pressure are the driving forces, even though they are only used by a small fraction of beneficiaries (see Table 2.5). Hence, there are disconcerting discussions in the literature on whether poorer countries should include these treatments in "essential" health care packages because doing so benefits a selected few at a high cost for policyholders in resource-poor countries, particularly since fatality rates are still high for kidney disease and cancer, even with treatment (Meremo et al., 2017; Mushi et al., 2015; WHO, 2013). On the other hand, these are exactly the treatments that no household could conceivably afford, whereas households are more likely to pay for essential medicines in most cases. Antibacterial and malaria-related treatments and general screening tests also generate high total costs, but benefit many and are effective in reducing the death rates of malaria and diarrheal diseases that are still responsible for 6% and 8% of child deaths, respectively, in Tanzania (WHO, 2016). However, raising awareness and prevention behavior (e.g., hygiene practice, usage and maintenance of long-lasting insecticidal nets) and providing better infrastructure (e.g., water and sanitation) could also prevent people from suffering from these diseases and, thus, could also substantially reduce the costs for health insurance schemes (Deressa et al., 2014; Karinja et al., 2020; Yaya et al., 2018).

2.4.4 Usage and costs of the mandatory insurance by health facility

Sixty-two percent of all accredited health facilities had at least one NHIF claim and can, therefore, be considered as active NHIF facilities.[19] The rate of active NHIF health facilities differs substantially among health facility type and ownership (see Table 2.6). It is particularly interesting that private health facilities are active NHIF facilities at a much lower rate than publicly-owned facilities (46% vs. 67%). It seems surprising that within a year almost half of the private NHIF-accredited health facilities had not treated even one NHIF patient. Delayed reimbursements from the national insurance scheme to the service provider appear to influence the decision of whether and how a health facility is going to treat an insured person—even when the health facility is technically accredited to treat the patient and submit the claims (Aikins et al., 2019; Amasha, 2015; Ashigbie et al., 2016). However, we could not quantitatively evaluate this effect with the data at hand.

The distribution of the costs per health facility also reveals very high costs for a few health facilities compared to many facilities with very low costs (see Figure 2.2). In particular, the five health facilities (out of 7,390) with the highest claim values represent 30% of the total NHIF claim value. These five health facilities are all hospitals located in Dar es Salaam, and include some specializing in special treatments, for example, for cancer, and therefore have extremely high claim values per treatment. More generally, 90% of health costs occur in only 5% of all health facilities (see Figure 2.2).

In Table 2.7, we further analyze the factors correlated with the probability that an

[19] 70.5% if taking claims from all membership groups are into account. The patterns stay the same.

Tab. 2.6: NHIF-accredited health facilities by type and ownership.

	Total NHIF-accredited health facilities		Active NHIF- accredited health facilities
	Number	%	%
Facility type			
Dispensary/Pharmacy	6,236	84.40	60.36
Health Center	750	10.15	75.07
Hospital	307	4.15	79.15
Clinic	90	1.22	25.56
Total	7,389	100.00	62.15
Ownership			
Private	1,823	24.67	46.30
Public	5,567	75.33	67.34
Total	7,390	100.00	62.15

Notes: Unit is per health facility (n = 7,390). One health facility has a missing value for the facility type. Clinics are specialized health facilities, whereas hospitals include district, regional referral, zone referral and national referral hospitals.

NHIF-accredited health facility is active, the number of claims, and total claim value. Results are very similar across these three variables. Compared to dispensaries and pharmacies, health centers had 3.4 times the odds of being active, and hospitals had 6.9 times the odds. It appears that the higher the care level of the NHIF-accredited health facility, the more likely the facility was to have at least one claim. One possible reason is that the claim and reimbursement process is quite time- and resource-intensive. Lower-care health facilities may thus choose to not treat NHIF patients or to ask them to pay in cash, rather than submitting an official claim to the NHIF (Ashigbie et al., 2016). National Health Insurance Fund-accredited hospitals and health centers also have by far the most claims and highest total costs compared to dispensaries and pharmacies. This finding is expected since treatments in hospitals and health centers require many more service details (e.g., various drugs, consumables and tests are required for surgeries) and are more complex and expensive, whereas in pharmacies beneficiaries mostly pick up single drug packages only. As the model in Table 2.7 with region fixed effects shows, in addition to having a high number of NHIF-accredited health facilities, urban regions such as Dar es Salaam and Kilimanjaro had much higher numbers of claims resulting in a higher total claim amount, whereas more rural and poorer regions, such as Katavi and Geita, had a lower number of claims and costs. The high values are mostly driven by very expensive and specialized treatments, for example, cancer or heart disease, which are mostly offered in special hospitals located in Dar es Salaam or other urban and richer regions.

2.5 Discussion

This study is one of the first using administrative health insurance claims data to provide insights into the usage and cost structure of a mandatory national health insurance in a low-income setting and the financial sustainability that would be associated with scaling

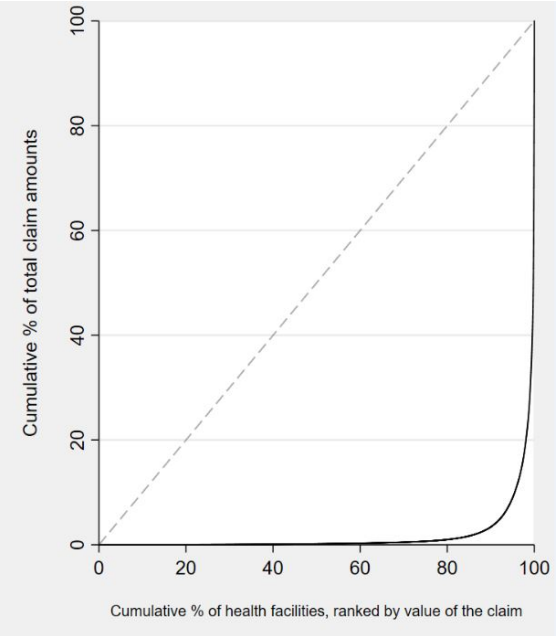

Fig. 2.2: Concentration curve of total NHIF claim amounts by health facilities.
Note: The 45 degree line would indicate that each policyholder accounts for the same amount of costs.

Tab. 2.7: Factors correlated with take-up of services, number of claims and value of claim per health facility.

	(I) Health facility made a claim Logit odds ratio	(II) Number of claims per health facility Tobit-Coefficient	(III) Total value of claims (log) per health facility Tobit-Coefficient
Health facility type (ref. Dispensary/Pharmacy)			
Health center	3.45 (0.000)	10,042.3 (0.000)	5.462 (0.000)
Hospital	6.934 (0.000)	48,637.2 (0.000)	10.397 (0.000)
Clinic	0.580 (0.038)	-5,763.6 (0.057)	-2.578 (0.016)
Health facility ownership (ref. Public)			
Private	0.272 (0.000)	-2,733.4 (0.000)	- 4.225 (0.000)
Constant	1.860 (0.000)	842.3 (0.000)	6.589 (0.000)
Control for region	X	X	X
Observations	6,766	6,771	6,771
Pseudo R-squared	0.130	0.013	0.034

Notes: Unit is per health facility (n = 7,390). P-values in parenthesis. Health labs excluded due to few observations.

up the NHIF to a national health insurance scheme. The NHIF in Tanzania has 2.3 million policyholders, corresponding to about 4% of the population in Tanzania. Since the NHIF is mandatory for all Tanzanian public servants, we avoid possible biases in the results due to adverse selection in the form of self-selected high–risk individuals into the insurance.

Of all mandatory NHIF insured, 47% made at least one claim within a year, with an average annual cost of 76,166 TZS (33 US$) per policyholder and 161,049 TZS (69 US$) per beneficiary (excluding policyholders that did not make any claims). This amounts to about 60% of premiums a family pays per year (as dependents do not have to pay) and in total 3.6% of the yearly income of a public servant. Interestingly, women and individuals between 30 and 59 and middle-income households use health facilities more often with their insurance card than men and children, the elderly, and the poorest and richest policyholders in our sample.

Our extrapolation of NHIF costs and revenue if health insurance coverage were to be extended to the entire Tanzanian population shows that the NHIF is currently not financially sustainable (see also Lee et al., 2019; NHIF, 2018). The Tanzanian government will need to subsidize the insurance, for example, with tax-based revenues or international funds, or by increased insurance premiums charged to the formal sector or extended contribution groups, such as informal sector workers. As an alternative or complementary policies, the government might want to aim to reduce costs by reducing the health services covered and/or increase efficiency by gatekeeping.

It is also interesting to see that the cost structure in Tanzania is extremely skewed. Five hospitals (out of 7,390 health facilities) account for 30% of the costs reimbursed through NHIF and 10% of the policyholders account for 80% of total health costs. The most frequently used health services are painkillers, antibiotics and anti-malaria drugs, together with diagnostics (stool, urine and blood, and malaria blood smears). The most expensive services as a share of total NHIF costs are procedures and surgeries related to cancer, cardiovascular diseases, and hemodialysis. The high costs are a huge challenge for resource-poor countries because only very few policyholders with high mean costs can benefit. The most frequent services reflect the high burden placed on insurance schemes by diseases such as malaria and diarrhea, which could at least partly be prevented through better infrastructure and hygiene. Investments in preventive services for malaria, hygiene-related infections, and NCDs could be very cost-effective interventions for mandatory health insurances.

Of all NHIF-accredited health facilities across the country, 62% had at least one NHIF claim from public servants within a year and could, therefore, be considered active NHIF facilities. Interestingly, privately-owned health facilities were less likely to be active compared to publicly-owned facilities. This evidence suggests that treating insured patients is not particularly profitable because of for example, delayed reimbursement of insurance, unfavorable reimbursement prices, labor-intensive claim processing as well as a large enough patient population that can afford paying cash (Aikins et al., 2019; Amasha, 2015; Ashigbie et al., 2016). It will be important for future research to understand if and to what

extent health facilities withhold service provision from insured patients, or only accept them if they pay cash. If service provision remains low, scaling up health insurance enrollment would not necessarily contribute to the overall aim of universal health coverage, since insured patients would still not be financially protected.

In general, the health services incurring the highest costs in Tanzania are quite different from those in HICs (Dieleman et al., 2020; EDI, 2020; Wieser et al., 2014). First, tropical diseases such as malaria and diseases due to bacterial infection are much less prevalent in HICs. Second, lower back and neck pain, other musculoskeletal disorders, and diabetes are cost drivers in HICs (Dieleman et al., 2020; Wieser et al., 2014), whereas in Tanzania, due to the different lifestyles, these categories are not (yet) driving a large proportion of the overall costs. Nevertheless, costs related to cardiovascular diseases, cancer, and kidney-related treatments are also high in HICs (Dieleman et al., 2020; Wieser et al., 2014). We are aware that the contexts of HICs and LMICs are very different in terms of age structure, disease burden, health infrastructure, income levels, and health systems. Nevertheless, the comparison shows that analyses of claims data in LMICs are essential to better understand the functioning of mandatory health insurances in these settings, rather than simply extrapolating from HIC data.

There are two key limitations of the paper. First, since the claims data is from 2016, it could be that the health insurance system, coverage and behavior have changed. However, data from 2021 show that NHIF coverage rates stayed almost the same over the last five years (7% in 2016 and 8% in 2021). Moreover, a SNHI is still under discussion and not yet implemented. Secondly, it could be that utilization and claims reimbursement trends vary across population groups (e.g., between public servants and informal workers). Indeed, we show that public servants are on average older, have higher wages, and live in more urban areas, with better (higher income) or worse (older) health outcomes and easier access to health services in urban centers. Hence, the projected costs for future universal health coverage might be under- or overestimated.

2.6 Conclusion

This study indicates that scaling up the coverage of the NHIF will be extremely challenging. To do so, policymakers will have to decide between reducing the essential package of health care covered by the scheme, deepening financial resources, asking poorer populations to also contribute through insurance premiums which will be administratively and logistically challenging—or investing in disease prevention or some combination of the above. Our analysis also indicates that privately-accredited health facilities show fewer claims, and that the poorest and richest policyholders use their health insurance less—both results suggesting that out-of-pocket expenditures (despite carrying insurance) might still be an issue. Moreover, this first comprehensive study of claims data of a mandatory health insurance from a LMIC shows the benefits and shortcomings of administrative data in analyzing the health system. On the one hand, it provides much deeper insight

into the utilization of the health care services, and their costs, than any survey data could ever reveal. On the other hand, administrative data might be incomplete. Last, our analysis has shown the large differences in health care utilization and cost structure that exist between Tanzania and several HICs (Switzerland, Germany and the United States). The results emphasize, that we can learn little about low-income settings from the multiple insurance claims studies from HICs (e.g., Aljunid et al., 2012; UN, 2007), demonstrating the need for further studies using health provision data in LMICs.

2.A Supplementary Figures

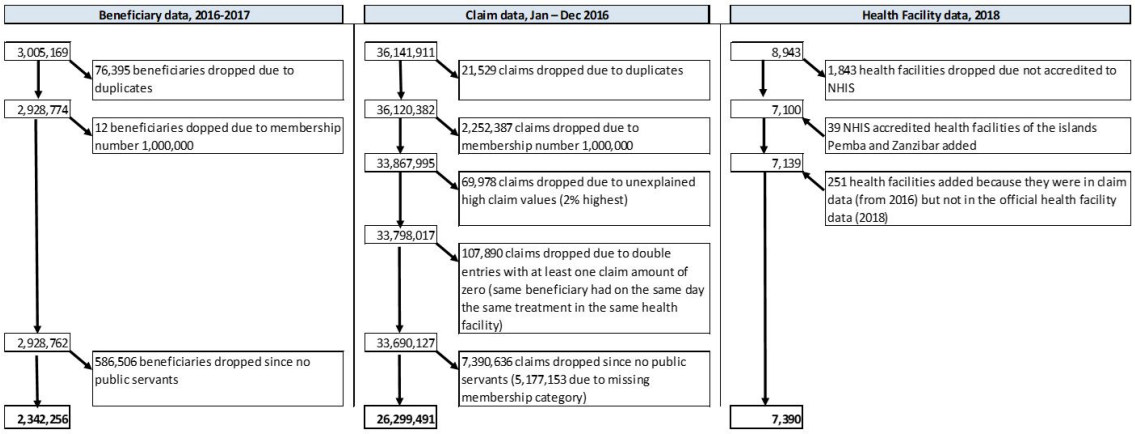

Fig. 2.A.1: Sample deduction of NHIF policyholder and claim data.

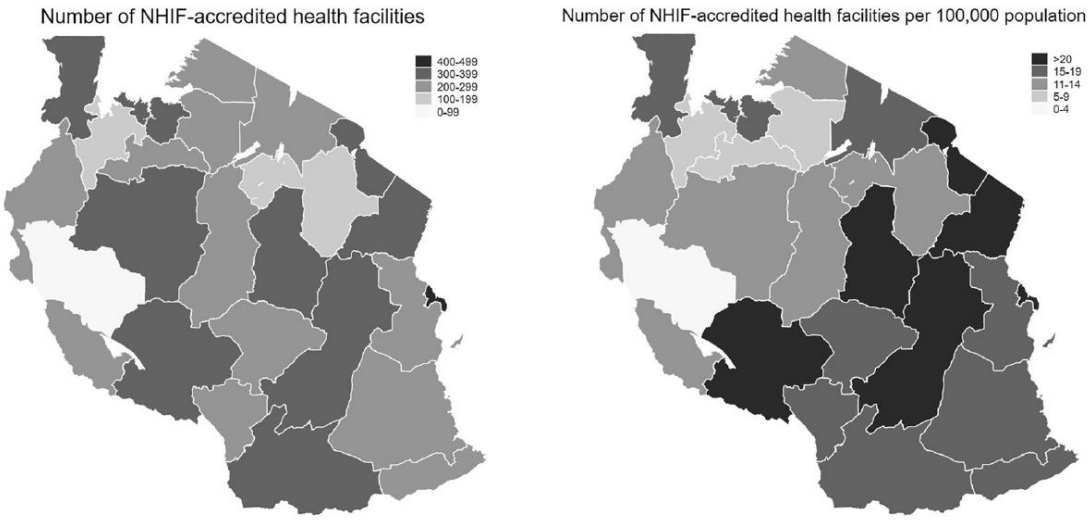

Fig. 2.A.2: Map of Tanzania with number of National Health Insurance Fund (NHIF)-accredited health facilities as well as health facilities per 1,000 population.
Note: GPS-coordinates for Pemba and Zanzibar were not available and therefore cannot be shown in the map.

2.B List of benefit package of NHIF

The National Health Insurance Fund (NHIF) has an benefits package that is offered to its policyholders through accredited health facilities countrywide. This package has a total of eleven (11) benefits that are offered to beneficiaries as per Standard Treatment Guidelines issued by the Ministry of Health alongside the Fund‘s regulations. The package includes (based on NHIF (2019)):

1. Consultation – This covers for costs related to Consultations.
2. Medicines and medical supplies – The Fund covers for the costs relating to medicines prescribed in Generic names and medical consumables as per the National Essential Medicines List (NEMLIT) and additional medicine list recommended (to NHIF) by experts and stakeholders.
3. Investigations – The Fund covers for the costs of Investigations and Diagnostic tests as per the Investigation List in the benefits package. There are 321 Investigations including Ultrasound, Echocardiography, CT-Scan, MRI and Ultrasound.
4. Surgical Services – Includes Minor, Major and Specialized surgical services performed from Health centers to Referral level hospitals.
5. Inpatient Care Services including ICU and HDU – The Fund covers for the daily admission costs depending on the level of the facility and the agreed daily rates as per the Fee Schedule, Investigations, Medicines and Medical Consumables dispensed while the member is admitted.
6. Physiotherapy and rehabilitation services – This is provided to inpatients and outpatients where the facility has specialists for the related services.
7. Eye and Optical Services – NHIF covers the costs for optical services to all beneficiaries. Treatment of Eye diseases and refraction for visual defects.
8. Spectacles – The Fund also pays for visual corrective spectacles to the principle member (one pair for a period of 3 years).
9. Dental and Oral health Services – This is provided to inpatients and outpatients where the facility has specialists for the same. This includes dental conservation surgeries (Carries and dental filling), gum diseases, dental extractions, root canal treatment, Orthodontics and denture.
10. Retirees Health Benefits – Comprehensive Medical Services are offered to the Retired principle members and their spouses, for their entire lives.
11. Medical/Orthopedic Appliances – The Fund provides supportive orthopedic and medical appliances including White Cane for blind people, Neck and Thoracic Spine Collars, Hearing Aids, Lumbar Cossets and Braces, Walking Crutches and leg orthopedic Supports, (ankle, knee and above knee orthopedic supports).

These are services that are offered through a special permit, these include:

- Cancer chemotherapy for cancer patients
- Immunosuppressant medicines for patients, who have organ transplants,
- Hemodialysis and erythropoietin for patients with renal failure,
- Reading glasses and special radiological imaging such as CT scan and MRI
- Medical and Orthopedic appliances
- Complex Implants
- Advanced Cardiac Services
- Some selected Medicines
- Polypropylene Mesh
- EMG needle
- Dentures
- Orthodontic Services
- Radiotherapy services

Chapter 3

Effects of the COVID-19 pandemic on routine child immunization: Evidence from Ghana

Kathrin Durizzo*, J. Koku Awoonor-Williams†, Kenneth Harttgen*, Isabel Günther*

Abstract: Over the last decades, vaccination of children against, for example, measles and tetanus has contributed to major decreases in child morbidity and mortality. Studies show that the outbreak of the COVID-19 pandemic severely interrupted national routine immunization programs in spring 2020. It remains unclear whether this was due to social distancing regulations to limit the spread of the disease or the pandemic itself. Moreover, it remains unclear how fast countries' health systems recovered. We analyze four years (2018-2021) of monthly administrative data on child vaccination rates across all of the 260 administrative districts in Ghana. We are, hence, able to study the impact of COVID-19 across time, space, and 15 different vaccines. Given variations in social distancing regulations across Ghanaian districts, we can further differentiate between the effect of public lockdowns and the effect of the pandemic. We find that child vaccinations in Ghana dropped by 6% during the public lockdown in April 2020. However, time-critical vaccines, such as polio, were not affected and Ghana compensated with higher vaccination rates in June, such that at the national level vaccination rates in 2020 were only 1% lower than in 2019. Immunization services recovered to a normal pre-pandemic growth level throughout 2021. We do find a substantially larger disruption in April 2020 (14%) and a slower recovery in 2020 in the 40 lockdown-affected districts, but general social distancing regulations did not seem to have an effect. Interestingly, vaccination rates already decreased in February and March by about 5% before the public lockdown and before the pandemic had reached Ghana, but with the pandemic already spreading globally and in the news. In contrast, higher COVID-19 cases in Ghana were not correlated with lower vaccination rates. Last, we find a generally large variance of impacts across vaccine types and districts—28 districts had not even recovered to pre-pandemic levels in 2021, and yellow fever vaccinations witnessed the largest disruption in April 2020 with a 22% decline. Our results indicate that the negative effect on child immunization was less severe and shorter than predicted by experts. Fear of COVID-19 early in the pandemic and delayed vaccination campaigns had a substantial impact on routine child immunization services in Ghana, whereas rising COVID-19 cases and continuing moderate social distancing regulations did not seem to affect child immunization rates.

Keywords: COVID-19, vaccines, child immunization, administrative data, Ghana

JEL code: C2, I1, O10

Online dashboard: published at `https://nadel.shinyapps.io/Immunization_Dashboard`

Status: working paper

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3.1 Introduction

Routine immunizations against childhood illnesses, such as polio, are an essential component of basic health services. Over the last several decades, routine child immunizations have contributed to a decrease in the number of vaccine-preventable illnesses and deaths (Andre et al., 2008; Li et al., 2019; Ozawa et al., 2012; WorldBank, 2021b). Despite this progress, ensuring that every child has access to basic immunization services remains challenging in many low- and middle-income countries (LMICs) (Bangura et al., 2020; Chopra et al., 2020; WHO, 2018a). During the COVID-19 pandemic, universal child immunization became even more challenging.

To investigate the impact of the COVID-19 pandemic on essential health services, the World Health Organization (WHO) conducted a survey with health ministries from more than 100 countries early in the pandemic, between May and July 2020. They found that nearly all countries reported disruptions in basic health services, particularly LMICs (WHO, 2020h). Routine child immunizations were reportedly among the most frequently disrupted services. Similarly, a cross-country study of ten countries shows that child immunizations were the most disrupted health service in spring 2020 (Arsenault et al., 2022). The reasons for the disruptions include a mix of supply- and demand-side factors. Supply-side factors include logistical barriers, such as the supply of medicines, shifting resources to mitigate the impact of the COVID-19 pandemic, staff shortages because of sick leave, and the closure of health facilities (WHO, 2020h). On the demand side, disruptions might have been linked to fear of COVID-19 and the inability to afford health care services (Alsuhaibani & Alaqeel, 2020; Chandir et al., 2020, 2021; WHO, 2018a, 2020h,e). Most importantly, it was feared that social distancing regulations, travel bans or complete public lockdowns lead to a limitation of outreach and vaccination campaigns on the supply side and difficulties in traveling to health facilities on the demand side.

Disruptions in child immunization resulted in major public health concerns in 2020 (Clark et al., 2020; Roberton et al., 2020; Roberts, 2020), particularly for LMICs (Abbas et al., 2020; Chandir et al., 2020, 2021; Rabbani, 2021). Lack of routine child immunization services can lead to an increase in vaccine-preventable diseases such as diphtheria, measles, or polio (WHO, 2020a,f). Abbas et al. (2020) even predicted that protecting adults against COVID-19 by not maintaining routine child immunizations in Africa would lead to more childhood deaths than COVID-19. In addition, Roberton et al. (2020) simulated COVID-19 related disruptions of essential children's health services and access to food in 118 LMICs on the mortality rate of children under five and found a dramatic excess of 9-45% additional under-five child deaths.

To our knowledge, no study has analyzed the impact of the COVID-19 pandemic on (i) different child vaccinations, (ii) for an entire LMIC country, (iii) over a long period of time, (iv) inter-regional differences, and (v) differentiating between the impact of social distancing regulations and the pandemic itself. Previous studies only provide evidence on the impact on child immunizations during the lockdown or shortly after the lockdown was

lifted (Lassi et al., 2021; Chandir et al., 2020, 2021; Rabbani, 2021), while only one study analyzes a longer-term impact of 15 months into the pandemic covering Ethiopia, Laos, Mexico, and South Africa (Arsenault et al., 2022). It finds that by mid-2020 substantial interruptions remained in most of the countries. But this study did not have data on the pre-pandemic yearly trends, hence, the authors cannot compare the trend to the two years before COVID-19. Further, to our knowledge, only one study from Sierra Leone analyzes all recommended children vaccine types separately, not just the aggregated vaccination coverage rate or a few vaccine types (Buonsenso et al., 2020). However, the study from Sierra Leone only provides insights for one single area and only for two months. Lastly, many studies conclude, that at the country level it is difficult to disentangle the potential reasons for vaccination disruptions, as social distancing regulations went hand in hand with increasing numbers of COVID-19 cases. One study uses cross-country variance and finds that the stringency of social distancing policies or the COVID-19 incidence is only moderately correlated with health-service disruptions (Arsenault et al., 2022).

To fill these gaps and to study the impact of the COVID-19 pandemic on routine child immunization for one middle-income country, we analyze administrative data from all 260 Ghanaian districts on all 15 recommended child vaccines over four years (January 2018 to December 2021). Using this extensive data allows us to analyze the impact of the pandemic on routine child immunizations for an entire country over a long time (covering pre-pandemic months and the most severe COVID-19 wave in early 2021), and explore inter-district differences. We compare the effects during the lockdown in April 2020 with later and earlier months to explore the speed of recovery and the impact of COVID-19 incidence on immunization rates. In addition, since Ghana introduced a public lockdown in only 40 out of 260 districts, Ghana provides a unique case to explore the impact of the lockdown as a mitigation response to the COVID-19 pandemic on immunization services in comparison to the general effects of the pandemic.

We further created a freely available online dashboard with all descriptive results for policymakers (`https://nadel.shinyapps.io/Immunization_Dashboard`).

3.2 Data and methods

3.2.1 Context

The first two cases in Ghana were reported on March 12, 2020 (Figure 3.A.1; Hasell et al., 2020). To reduce the spread of COVID-19, on March 15, 2020 the Ghanaian government banned all public gatherings such as conferences, festivals, political rallies, and church activities and closed schools (Figure 3.A.2; Nyabor, 2020). On March 29, 2020 the total number of cases in Ghana per day was 152. In order to avoid an escalation in the number of cases, on March 30, 2020 the government also introduced a geographically concentrated public lockdown in 40 of the most affected districts in the Greater Accra metropolitan area and Greater Kumasi metropolitan area (Figure 3.A.3; RepublicGhana, 2020a). The

lockdown banned all non-essential movement, work, and services. Inter-city movement of vehicles and aircraft for private or commercial purposes was forbidden (RepublicGhana, 2020b). Traveling to essential health services, such as routine child immunizations, was still allowed, however, people living in a lockdown area were not allowed to travel to other districts for these services. The geographically concentrated public lockdown was lifted on April 19, 2020, while the social distancing and hygienic regulations, such as capacity limitations for events and church services or wearing face masks, remained in effect until March 28, 2022 (Figure 3.A.2; Haider et al., 2020).

After the lockdown was lifted at the end of April 2020, COVID-19 cases in Ghana were still increasing until August 2020 (Figure 3.A.1). Between August and December 2020, the daily number of new confirmed cases dropped considerably. However, starting in December 2020, the number of cases increased again, resulting in a second large wave in January 2021, a third wave in August 2021, and a fourth wave in January 2022 (JohnsHopkins, 2022). Vaccination against COVID-19 started in March 1, 2021 for essential staff (such as health workers and frontline executive staff) and for populations vulnerable to COVID-19 (such as adults of more than 60 years and people with underlying health conditions).

For our analysis, it is important to mention that a polio campaign scheduled for April and May 2020 in eight regions in Ghana, as well as a national yellow fever campaign scheduled in April 2020, both had to be postponed to September and October 2020 and to November 2020 (Gavi, 2020), respectively, due to the COVID-19 pandemic. The re-launch was only possible since all vaccinators, volunteers, and supervisors were trained on COVID-19 prevention protocols and had been provided with personal protective equipment (PPE) to ensure optimal infection prevention (WHO, 2020k).

3.2.2 Routine child immunization data

We use time-series data from the District Health Information Management System (DHIMS) provided by the Ghana Health Service on 15 vaccination types aggregated by month from January 2018 to December 2021. The monthly values for each vaccination type are available for all 16 regions and 260 districts in Ghana. All indicators measure the number of children (below five years) receiving vaccinations within a given month administered in all health facilities throughout the country. We analyze the vaccinations recommended by the Ghana Health Service: measles rubella 1, measles rubella 2, OPV/polio 0, OPV/polio 1, OPV/polio 2, OPV/polio 3, PCV 1, PCV 2, PCV 3, penta 1, penta 2, penta 3, rotavirus 1, rotavirus 2, and yellow fever. Although we cannot control for whether the vaccination was given at the recommended time or in the recommended interval (see Appendix 3.B), we can investigate the total number of doses given in each district over the 48 months between 2018 and 2021. We do not have information on the number of immunizations planned by each district in a given month. However, we assume that the number of vaccinations should grow similar to the yearly population growth rate of children below the age of five. Due to the lack of data at the district level, we assume the same population growth rate for all districts, which was 1.1% annually between 2018 and 2019 (WHO,

2020k).

In addition, we use four other datasets to create the following variables: a lockdown and COVID-19 impact status variable (see details in Section 3.2.3), a regional COVID-19 cases variable, and district control variables such as monthly number of births, population density in 2020, and poverty rate in 2015. Data on the monthly regional number of COVID-19 cases, COVID-19 cases at the district level in April 2020, and data on public lockdowns in districts in April 2020 are retrieved from Ghana's outbreak response management updates (GHS, 2020a). The monthly number of births from January 2018 to December 2021 at the district level is extracted from the DHIMS. The estimated population density at the district level for 2020 is from the Ghana COVID-19 monitoring dashboard (GHS, 2020b). The poverty rates at the district level are extracted from the Ghana Poverty Mapping Report 2015 (GSS, 2015). A more detailed description of the data can be found in Appendix 3.B and 3.C.

3.2.3 Statistical analysis

In our analysis, we have a balanced sample with 48 time periods (number of months 2018-2021) and 260 districts in Ghana. Our main outcome variable is the total number of routine child immunizations ($Y_{i,m,t}$) for a district (i), month (m), and year (t), adjusted by a yearly population growth rate of 1.1% (WHO, 2020k). This means that for a nominal change in the number of vaccinations of 1.1%, the calculated real growth rate over time of vaccinations would be 0%. Due to strong seasonal variation in vaccination rates within years (see Figure 3.2), we compare only the number of immunizations for the same month over the years or the total yearly changes. Comparing the number of doses from one month to the next within the same year might be highly misleading when evaluating the impact of a pandemic on immunization rates (Bramer et al., 2020; Buonsenso et al., 2020; MacDonald et al., 2020).

In a first step, in Section 3.3.1, we explore the overall impact of the COVID-19 pandemic on routine child immunization by analyzing the yearly growth rate of the number of total doses per district from April 2019 to April 2020 as well as from 2019 to 2020 and from 2019 to 2021. The yearly growth rate per district from 2018 to 2019 will serve as a control to understand pre-pandemic patterns. Equation 3.1 shows how we calculate the growth rate from 2019 to 2020:

$$\sum_{i=1}^{260} \frac{\sum_{m=1}^{12} Y_{i,m,2020} - (\sum_{m=1}^{12} Y_{i,m,2019} * 1.011)}{\sum_{m=1}^{12} Y_{i,m,2019} * 1.011} \tag{3.1}$$

In a second step, in Section 3.3.2, we analyze the development of routine child immunization by month based on the following OLS regression model with month fixed effects ($Month_{i,t}$), year fixed effects ($Year_{i,m}$), district control variables ($D_{i,m,t}$), and regional COVID-19 cases ($C_{i,m,t}$). Additionally, we include the average number of vaccinations in 2018 and 2019 to control for differences in levels of vaccinations administration (T_i). In

particular, we estimate the following model:

$$Y_{i,m,t} = \beta_0 + \beta_1 Month_{i,t} + \beta_2 Year_{i,m} + \beta_3 Month_{i,t} * Year_{i,m} + \beta_4 D_{i,m,t} + \beta_5 C_{i,m,t} + \beta_6 T_i + \epsilon_i \tag{3.2}$$

We introduce the control variables with a stepwise approach to test their effect on the coefficients and we use cluster-robust standard errors on a regional level (see Table 3.1, columns 1 and 2). Moreover, to understand differences among lockdown- and non-lockdown-affected districts, we run the same model separately (see Table 3.1, columns 3 and 4). In Table 3.1, only our coefficient of interest, the interaction term ($Month_{i,t} * Year_{i,m}$) is shown to highlight the monthly effects relative to 2019. The interaction terms with the year 2018 will serve as a robustness test to demonstrate that there were no significant differences before the pandemic (see Table 3.1, rows 1-11).

Additionally, as a robustness test, we disentangle the effects in lockdown- and non-lockdown-affected districts. Therefore, we create a five-level lockdown and COVID-19 impact status variable (I_i) to indicate if the district was affected by COVID-19 cases at the beginning of the pandemic and how far the district was away from the geographically concentrated public lockdown in April 2020 (for more details, see 3.C in the Appendix). For districts very close to the lockdown-affected districts (neighbor districts), we assume that they are very similar in terms of the fear of COVID-19 exposure,[1] but different in terms of restrictions. We estimate the following OLS model for each month separately:

$$Y_{i,m,t} = \beta_0 + \beta_1 Year_{i,m} + \beta_2 I_i + \beta_3 I_i * Year_{i,m} + \beta_4 D_{i,m,t} + \beta_5 T_i + \epsilon_i \tag{3.3}$$

Our coefficient of interest is the interaction term ($I_i * Year_{i,m}$) showing how non-lockdown districts relative to lockdown districts developed over the year, controlling for district and year effects (see Table 3.A.1). The months January - March 2020 (see Table 3.A.1, columns 2-4, rows 6-9) will highlight the effects before COVID-19 occurred in Ghana, but when COVID-19 was already spreading globally. The comparison of 2019 with 2018 is again a robustness test to check if there were significant effects before the lockdown (see Table 3.A.2).

In a final step, in Section 3.3.3, we analyze the development of routine child immunization by vaccine type using again equation 3.1, but we run the analysis for each of the 15 vaccine types individually.

Additionally, we conduct a series of sensitivity analyses (results available from authors upon request). First, we run equation 3.2 for each of the 15 vaccine types individually to understand if they follow the same trend as the total number of vaccinations. Second, we run equations 3.2 and 3.3 with different specifications of (T_i), such as the average number of vaccinations from 2018, the average number of vaccinations from 2019, and the lagged number of vaccinations one period before. Lastly, we run all results for non-population growth adjusted numbers.

[1] COVID-19 cases were published only at regional level, so people in each district did not know how much their district was affected (GHS, 2020a).

3.3 Results

3.3.1 Development of routine child immunization over time and across districts

In April 2020, when a public lockdown was implemented in 40 out of 260 Ghanaian districts (Figure 3.A.3), we find that, on average, child immunizations significantly decreased by -6.4% (95% CI: -8.8 – -4.1) relative to April 2019 across the districts. However, we find a large variance: in 138 districts, the number of immunizations dropped by more than 5%, in 67 it stayed about the same (-5% – +5%), and in 55 it increased (Figure 3.1a). Comparing the total yearly number of doses administered in 2020 with 2019 (Figure 3.1b) indicates that, on average, immunizations decreased only by -1.2% (95% CI: -2.4 – +0.3) across districts. Hence, immunization rates largely recovered after the severe drop in April 2020, even when COVID-19 cases were still rising until July/August when the peak for 2020 was reached. Figure 3.2 shows that vaccination rates recovered already two months after April and were back to monthly 2019 levels from June 2020 onwards.

Figure 3.1c further shows that before the COVID-19 pandemic, the yearly number of routine child immunization doses administered increased from 2018 to 2019 by +1.9% (95% CI: +0.3 – +3.5) per district. However, even before the pandemic, we observe a range in the growth rate of vaccination administered: from -40% up to more than +60%. Hence, an analysis of the impact of a shock on immunization rates in a single district might be highly misleading, as even in non-pandemic years immunization rates vary quite substantially from one year to the other within certain districts, whereas on the country level they may remain constant or slowly increase.

Comparing the pre-pandemic level with the level in 2021 shows that, on average, the total number of doses administered between 2019 and 2021 (Figure 3.1d) increased by +4.2% (95% CI: +2.4 – +6.1) per district over the two years. Figure 3.2 further shows that the monthly numbers in 2021 again follow the overall seasonal trend of immunization over the year as in 2018 or 2019. This finding indicates that at the national level, the number of doses administered has fully recovered to the pre-pandemic growth levels even during the second and third COVID-19 wave in February 2021 and August 2021 (Figure 3.A.1). Nevertheless, 28 districts (out of 260) still show a negative development of more than -5% from 2019 to 2021, indicating that not all districts have fully recovered from the COVID-19 shock. These districts should receive particular policy focus.

All results on district level can be found in the newly created and freely available online dashboard (`https://nadel.shinyapps.io/Immunization_Dashboard`).

3.3.2 Impact of fear, COVID-19 cases, and social distancing regulations on routine child immunization

Table 3.1 analyzes the differences in number of vaccinations between 2019 and 2020 based on the OLS regression model, controlling for district characteristics and regional COVID-

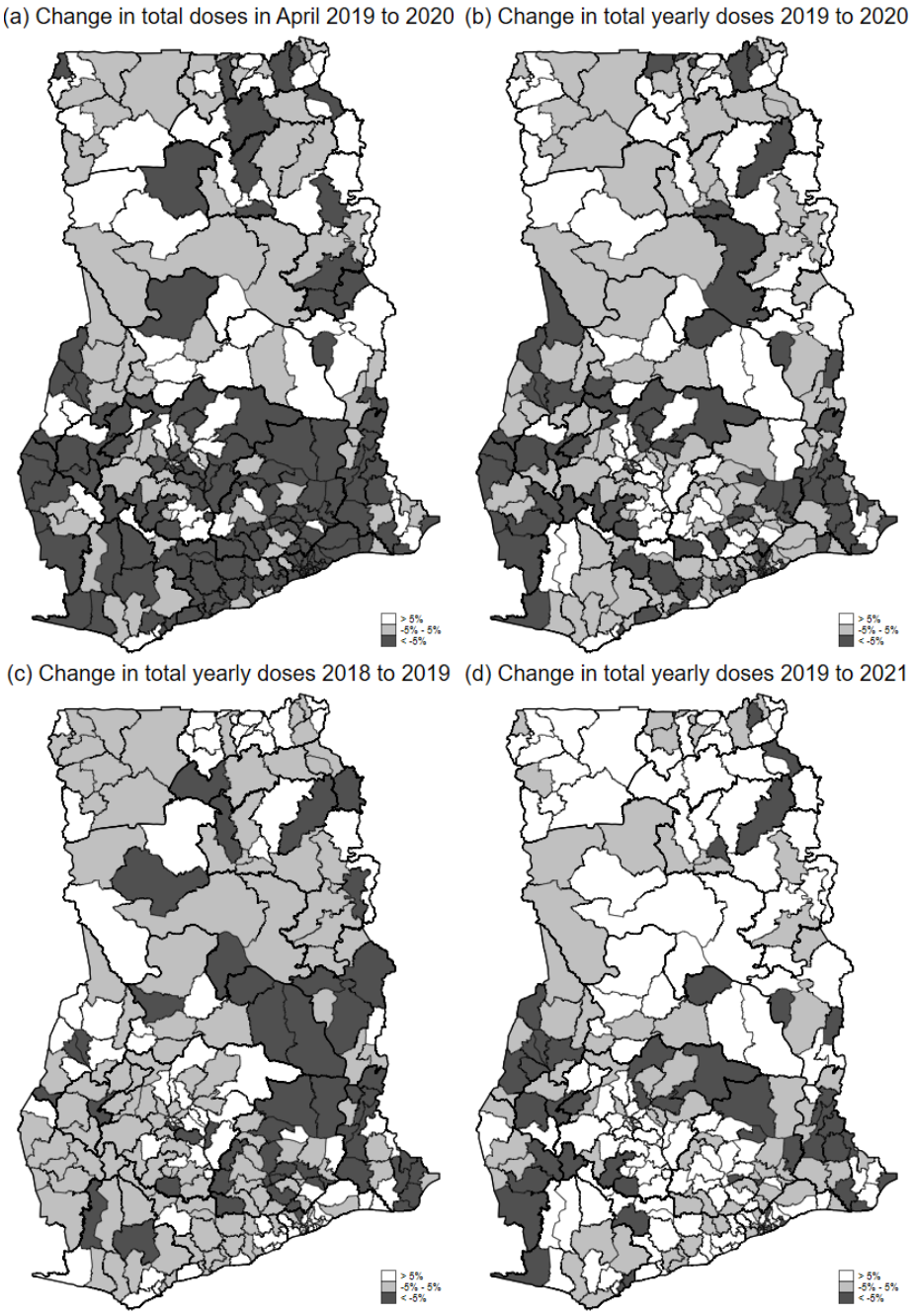

Fig. 3.1: Differences of routine child immunization total doses.
Notes: Figure (a) shows the difference of total number of administered doses of all children routine vaccines per district for April 2020 compared to April 2019. Figure (b) shows the yearly total change from the number of doses from 2019 to 2020. Figures (c) and (d) show the yearly total change from the number of doses from 2018 to 2019 and 2019 to 2021, respectively. All results are population growth adjusted. Detailed results per districts and for each immunization type can be found in the online dashboard: `https://nadel.shinyapps.io/Immunization_Dashboard/`.

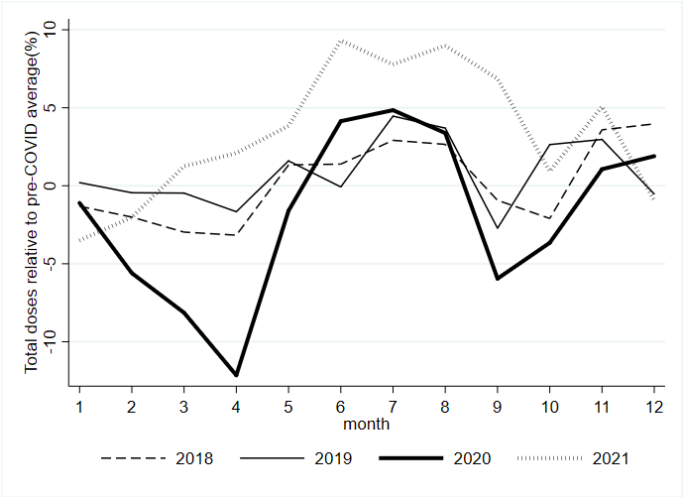

Fig. 3.2: Development of total routine child immunization doses by month.
Notes: The figure shows the monthly average development of total doses of the vaccinations for the year 2018, 2019, 2020, and 2021 relative to pre-COVID average (2018 and 2019). All results are population growth adjusted. The OLS model analyzing the monthly differences between the years can be found in Table 3.1.

19 cases (see equation 3.2). While there was a large drop in monthly vaccination rates in April 2020 (-9% or 364 doses), Table 3.1, column 2, shows that there was already a decrease in administered doses before COVID-19 first occurred in Ghana in March 2020 and before the public lockdown in April 2020, indicating that the public lockdown only partially explains the severe drop in child immunizations. In particular, we find a 4% drop (-217 doses) in February 2020 relative to February 2019 and a 7% drop (-364 doses) in March 2020 relative to March 2019 (see Table 3.1). Small statistically significant recovery effects can be found already in June (about +7%., relative to June 2019) at a time with surging COVID-19 cases. In 2021, the results show a significant recovery relative to 2019 for almost all months. The effects also do not substantially change if we control for district characteristics as well as regional COVID-19 cases (Table 3.1, column 1).

We also find a large difference in the effects between the 40 lockdown-affected districts and the districts that did not experience a public lockdown (220 districts): in lockdown-affected districts, the total doses per district from April 2019 to April 2020 decreased on average by -1,361 doses (14%) and in not-affected districts by -360 doses (8%) (see Table 3.1, columns 3 and 4). Interestingly, the decrease in administered doses in February and March occurred in lockdown- and non-lockdown-affected districts.

Table 3.A.1 in the Appendix (columns 2-5) shows that this difference is statistically significant, independent of whether districts had COVID-19 cases or not and independent of whether they were close to districts with a lockdown (neighboring districts) or not, controlling for differences over years and districts. In January 2020, when China reported the first death from COVID-19, but the pandemic had not yet spread globally, we do already find any small significant difference between lockdown-affected districts and their

neighbors (Table 3.A.1, column 2). In February 2020, when the first death from COVID-19 outside of China was reported and Italy had a major surge in cases, we already find a larger significant difference between the district types (Table 3.A.1, column 3). Similarly, in March 2020, when the first COVID-19 case occurred in Ghana and the president started with weekly updates on measures taken against the spread of COVID-19, but before the public lockdown was in place, we again find a significant difference between the district types (Table 3.A.1, column 4). Over the period of a year, the statistically significant differences between lockdown- and non-lockdown-affected districts remain (Table 3.A.1, column 1). This indicates that the 56 districts with a negative yearly development from 2019 to 2020 seem to be concentrated in lockdown and COVID-19 impacted districts. Nevertheless, in 2021 relative to 2019, lockdown- and non-lockdown-affected districts are not significantly different from each other over a one-year period.

3.3.3 Different effects across different vaccine types

Similar to the development of total doses discussed in Section 3.3.1, several of the 15 different vaccination types show a substantial drop from April 2019 to April 2020, such as -22.2% (95% CI: -37.5 – -6.8) for yellow fever, -6.1% (95% CI: -11.4 – -0.9) for OPV/ polio 2, -5.6% (95% CI: -10.8 – -0.3) for rotavirus 2, and -5.5% (95% CI: -11.0 – -0.0) for PCV 2 (Figure 3.3, upper left panel). For time-critical vaccines, such as polio 0 (OPV) and rotavirus 1, we do, however, not find statistically significant changes from April 2019 to April 2020, even though point estimates are slightly negative for most vaccinations. However, studying each of the 15 vaccination types reveals that the yearly development from 2019 to 2020 is not different from zero (Figure 3.3, upper right panel). The results highlight that the reasons for vaccination disruptions mentioned in the literature, such as closed health facilities or shortages in vaccines and personal protection equipment, seem not to be the main driver in Ghana, since polio 0, which is given at birth in health facilities, seems uninterrupted. On the contrary, delayed vaccination campaigns—as was the case for yellow fever (WHO, 2020k; Gavi, 2020)—seem to play an important role. Nevertheless, all vaccine types recovered over the course of a year.

3.4 Discussion and conclusion

This study is one of the first to investigate the long-term development of routine child immunization for a middle-income country two years into the COVID-19 pandemic. Our extensive dataset—including monthly number of doses for 15 vaccinations per district for the years 2018 to 2021 in Ghana—allowed us to compare the number of vaccines administered, while accounting for seasonal trends, and estimating the effect before, during, and after a lockdown by district. Additionally, the geographically concentrated public lockdown Ghana implemented provides a unique opportunity to compare districts that had lockdowns with other districts with more moderate social distancing regulations within one country.

Tab. 3.1: OLS regression of number of total monthly doses 2018-2021.

	Number of doses		Number of doses		Number of doses Non-lockdown-affected districts		Number of doses Lockdown-affected districts	
	(1)		(2)		(3)		(4)	
Month*Year (ref. 2019)								
Feburary # 2018	-2.324	[-131.0,126.3]	-31.86	[-171.2,107.5]	45.91	[-52.47,144.3]	-457.9	[-1749.6,833.9]
March # 2018	-53.15	[-204.0,97.74]	-89.82	[-258.5,78.83]	-82.57	[-254.5,89.33]	-113.3	[-1379.5,1153.0]
April # 2018	0.730	[-152.0,153.4]	-23.56	[-199.8,152.7]	8.801	[-169.8,187.4]	-201.1	[-1414.2,1012.0]
May # 2018	67.62	[-76.50,211.7]	57.07	[-105.8,219.9]	-35.13	[-173.5,103.3]	575.7	[-814.1,1965.5]
June # 2018	160.5	[-59.85,380.9]	158.4	[-87.67,404.5]	62.75	[-110.5,236.0]	700.5	[-595.6,1996.6]
July # 2018	-1.883	[-268.4,264.6]	-13.74	[-275.2,247.7]	-5.695	[-220.4,209.0]	-54.45	[-1307.9,1199.0]
August # 2018	25.56	[-228.4,279.5]	41.72	[-198.0,281.4]	-3.314	[-183.5,176.9]	285.4	[-1137.3,1708.0]
September # 2018	178.1	[-99.15,455.4]	168.1	[-141.6,477.9]	-5.066	[-264.7,254.5]	1135.7	[-329.2,2600.6]
October # 2018	-173.6	[-442.2,95.10]	-173.5	[-440.0,93.09]	-180.6	[-428.3,67.04]	-123.9	[-1485.1,1237.3]
November # 2018	115.0	[-212.2,442.2]	131.7	[-185.8,449.1]	23.56	[-215.2,262.4]	744.4	[-965.0,2453.7]
December # 2018	324.0**	[18.38,629.7]	328.8*	[-28.33,685.9]	115.3	[-187.0,417.7]	1465.9**	[33.14,2898.6]
Feburary # 2020	-207.2**	[-411.1,-3.388]	-217.0**	[-427.6,-6.479]	-139.3***	[-234.8,-43.74]	-642.1	[-2154.4,870.2]
March # 2020	-343.1*	[-722.5,36.18]	-364.7*	[-778.3,48.85]	-285.2***	[-485.9,-84.56]	-825.2	[-2434.4,784.1]
April # 2020	-494.7**	[-864.7,-124.7]	-493.0***	[-831.3,-154.6]	-360.2***	[-515.1,-205.3]	-1361.5*	[-2773.4,50.49]
May # 2020	-102.0	[-342.8,138.8]	-66.32	[-337.6,204.9]	-168.2**	[-331.4,-5.075]	102.5	[-1442.5,1647.4]
June # 2020	297.4***	[99.99,494.8]	379.1**	[53.33,704.9]	135.7	[-90.48,362.0]	1129.9	[-442.7,2702.4]
July # 2020	90.87	[-131.7,313.4]	238.2	[-106.3,582.8]	5.152	[-223.6,234.0]	365.3	[-1198.2,1928.8]
August # 2020	53.32	[-310.5,417.1]	118.1	[-253.3,489.6]	-20.16	[-430.7,390.4]	345.9	[-1251.9,1943.7]
September # 2020	-103.9	[-364.5,156.8]	-119.8	[-404.0,164.5]	-231.7	[-529.8,66.39]	366.7	[-1302.6,2036.1]
October # 2020	-268.9	[-719.8,182.0]	-265.3	[-747.0,216.4]	-227.7	[-537.7,82.37]	-560.9	[-2298.3,1176.6]
November # 2020	-32.56	[-272.6,207.5]	-11.17	[-290.2,267.9]	-134.3	[-394.2,125.6]	464.5	[-1365.6,2294.6]
December # 2020	201.2**	[5.755,396.6]	222.1*	[-5.866,450.1]	78.26	[-141.1,297.7]	792.2	[-1020.0,2604.3]
Feburary # 2021	114.8	[-57.13,286.8]	138.3	[-35.40,311.9]	115.3	[-77.78,308.5]	5.047	[-1563.5,1573.6]
March # 2021	292.1**	[74.33,509.8]	212.5**	[36.52,388.4]	146.5	[-57.24,350.2]	950.8	[-665.1,2566.7]
April # 20221	402.4***	[159.8,645.0]	303.0**	[48.56,557.5]	335.9**	[63.74,608.0]	748.6	[-699.2,2196.3]
May # 20221	320.6***	[108.6,532.6]	222.6**	[16.68,428.6]	203.6*	[-38.94,446.1]	981.4	[-676.6,2639.5]
June # 20221	705.9***	[395.1,1016.6]	620.6***	[392.3,849.0]	505.6***	[198.1,813.1]	1868.7**	[269.6,3467.8]
July # 20221	377.9***	[116.8,639.1]	314.4***	[115.5,513.3]	239.5*	[-0.524,479.6]	1011.7	[-519.2,2542.5]
August # 2021	484.9***	[189.7,780.1]	501.0***	[187.2,814.9]	338.3**	[19.32,657.3]	1207.6	[-393.3,2808.6]
September # 2021	715.6***	[281.9,1149.3]	667.0***	[287.8,1046.3]	533.8***	[193.2,874.4]	1706.4**	[74.43,3338.4]
October # 2021	107.4	[-74.00,288.8]	13.18	[-243.7,270.1]	136.9	[-79.94,353.8]	-81.78	[-1768.1,1604.5]
November # 2021	313.4**	[26.01,600.8]	210.9	[-50.94,472.7]	229.1*	[-49.45,507.7]	846.1	[-896.5,2588.8]
December # 2021	177.3	[-305.2,659.7]	162.4	[-382.9,707.8]	22.44	[-315.8,360.6]	915.2	[-665.1,2495.4]
Constant	5400.1***	[4473.2,6327.0]	151.3	[-641.4,944.0]	75.48	[-79.29,230.3]	283.4	[-293.8,860.5]
Month fixed effects	X		X		X		X	
Year fixed effects	X		X		X		X	
Vaccine level			X		X		X	
District control variables			X		X		X	
Regional COVID cases			X		X		X	
Observations	12480		11328		9600		1728	
R-squared	0.004		0.922		0.917		0.908	

Note: Only the month and year interaction term of equation 3.2 are shown. Robust regional clustered standard errors were used; 95% confidence interval in parenthesis; * p<0.05, ** p<0.01, *** p<0.001. All results are population growth adjusted. Vaccine level refers to the average number of doses administered in 2018 and 2019 at the district level. District control variables include: number of births, population density and poverty rate at district level. Regional COVID-19 cases refer to the monthly number of COVID-19 cases at regional level.

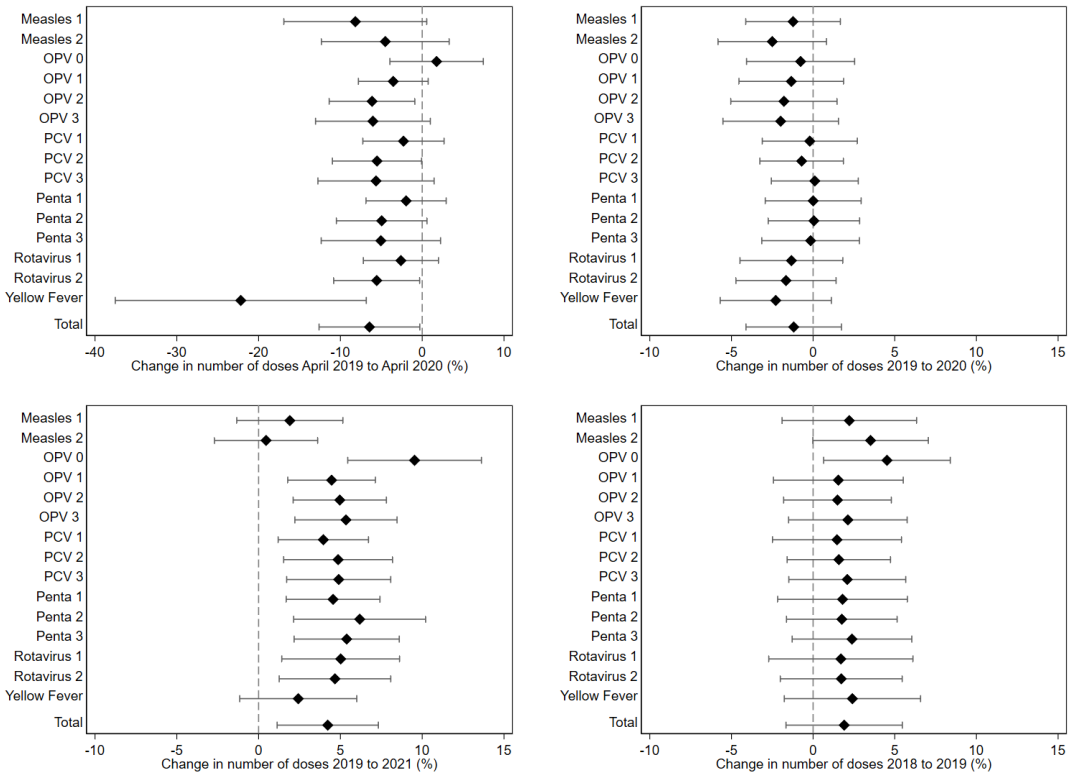

Fig. 3.3: Development of routine child vaccinations by year and type.
Notes: Point estimates (dot) and the 95%-CI (line) are shown. The upper left figure shows the decrease from April 2019 to April 2020, the upper right figure the yearly doses decrease from 2019 to 2020, the lower left figure the yearly doses from 2018 to 2019, and the lower right figure from 2019 to 2020. All results are population growth adjusted with the 95% confidence interval shown.

We show that during the public lockdown, in April 2020, the total number of child routine immunizations doses decreased significantly by -6% (compared to April 2019) across Ghana. This result is substantially lower than what other studies find which focused on selected areas of a country, for example, reductions of -80% in Karachi, Pakistan (Chandir et al., 2021) and -84% in one hospital in Sierra Leona (Buonsenso et al., 2020). However, we also find large spatial variations in the impact of COVID-19 on vaccinations during the lockdown. If we only focus on the areas with the highest reported COVID-19 cases and the highest population density districts in Ghana, we also find a very large decrease of over -80% in April 2020—but this is not consistent across all districts.

When we compare the 40 lockdown-affected district to those with more moderate social distancing regulations (but also with COVID-19 cases), we find that on average the lockdown-affected districts needed longer to recover from the COVID-19 shock and to reach a normal pre-pandemic child vaccination level. Nevertheless, some lockdown-affected areas did not show a decrease in vaccination rates even in April 2020, revealing that even within the same country and with the same restrictions the effect of a lockdown can vary a lot.

Our findings also indicate that the broader way in which COVID-19 impacted child vaccinations is more complex than anticipated. A few months after the lockdown, in June 2020, we find significant compensation and therefore a recovery over the course of 2020. Overall, the yearly number of doses administered in 2020 was similar to 2019 (only 1.2% lower, but not statistically significant). From 2019 to 2021, the number of doses even significantly increased by 4.2%, fully recovering to a pre-pandemic vaccine growth trend. This catch-up effect is substantially faster than expected by health experts (Abbas et al., 2020; Roberton et al., 2020), especially since COVID-19 cases were still increasing over the same period and the country experience additional waves of new variants of the disease. Still, 28 out of 260 districts had a negative growth rate between 2019 and 2021.

Additionally, we find that the drop in routine child vaccinations started in February and March 2020, even before the first COVID-19 case occurred in Ghana, and before the implementation of social distancing and public-lockdown measures, but when the disease was already spreading globally. Our findings indicate that uncertainty had an important impact on Ghanaian's protective health behavior. In contrast, we provide evidence that the monthly number of COVID-19 cases in Ghana does not seem to lead to lower routine child vaccination. This finding is in line with the catch-up effect we observe into 2021—similar to the study from Arsenault et al. (2022), who show on a country-level that COVID-19 incidence is not significantly correlated with health service disruptions.

Moreover, we find large variations among the 15 recommended child routine vaccines. We witnessed the largest disruption for yellow fever vaccinations, whereas for time-critical vaccinations that are given at birth (polio 0), we do not find any significant disruptions—even in lockdown-affected areas in April 2020. This is contrary to studies from other countries that found disruption in time-critical vaccinations given at birth (Arsenault et al., 2022; Rabbani, 2021; Buonsenso et al., 2020).

The within-country variation we identify in our results emphasizes the need for country-wide data, instead of analyzing only some provinces, in order to fully understand the effect of COVID-19. At the same time, the data should at least be at the district level to identify areas that are highly affected by the lockdown measures. Our district-level results give policymakers insights on where additional policies or campaigns might be required to target unvaccinated or under-vaccinated children (`https://nadel.shinyapps.io/Immunization_Dashboard`).

The findings also suggest that limited access to health facilities due to closed facilities or traveling restrictions was not a driving factor of the disruptions since time-critical vaccinations given at birth were not interrupted. Another reason for the disruptions, mentioned in the literature, is that people cannot afford the health service anymore due to the worsened economic situation (WHO, 2018a). However, we argue that this does not apply to our case, since all routine child vaccinations are given out for free in Ghana. Moreover, we do not find a country-wide shortage of vaccines causing disruptions.

Reasons more likely to drive the disruption in routine child immunizations in Ghana include greater fear of visiting a health facility, and delays in vaccination campaigns and

outreach sessions of community health workers early in the pandemic. The disruption of vaccinations in February and March 2020—which started before the first case of COVID-19 was reported in Ghana, but when the pandemic was already widely featured in Ghanaian media—indicate that people were concerned about potential infection when visiting a health facility, and postponed a visit if not absolutely necessary. Disruptions of national vaccination campaigns and of some local outreach programs in the beginning of the pandemic might have also driven short-term disruptions. In particular, the decrease in yellow fever vaccinations in April 2020 could have been due to the national yellow fever campaign that was scheduled in April 2020, but had to be postponed to November 2020 (Gavi, 2020; WHO, 2020d,k). However, due to the limited data we cannot completely disentangle the effects of these three potential sources. Nevertheless, our results indicate that the decrease in April 2020 was not caused by a generally overburdened health system, but rather a combination of fear and very strict social distancing regulations. Since the number of administered doses largely recovered after two months, even when COVID-19 cases were still rising up until July/August when the 2020 peak was reached, the fear was strongest mainly before or in the beginning of the pandemic and not linked to the actual COVID-19 cases or continuing moderate social distancing regulations.

Future studies that investigate the long-term and country-wide impact of COVID-19 on routine child immunization will show if the positive catch-up effects seen in most districts in Ghana is rather exceptional or if predictions and models have underestimated the reaction time of the healthcare system. Thus, it seems essential to further investigate the impact and understand the reasons behind the trends in order to quickly react and allocate resources to the districts that most need it.

3.A Supplementary Figures and Tables

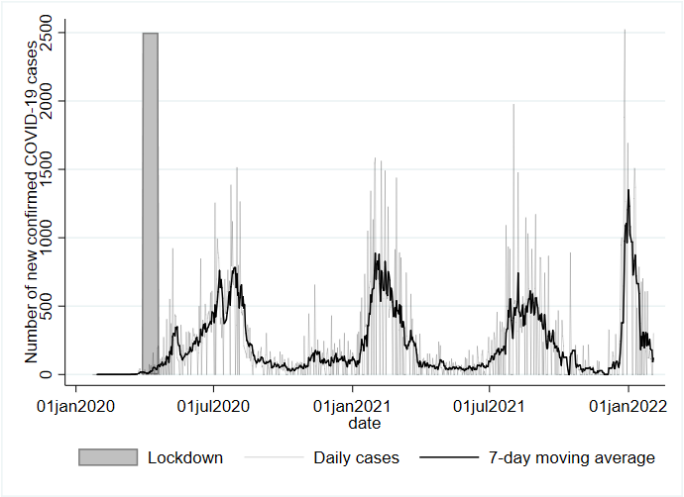

Fig. 3.A.1: Daily new confirmed COVID-19 cases in Ghana since January 1, 2020.
Notes: The seven-day moving average was calculated as the average of the daily number and the six lags. The gray shaded area indicates the period of the geographically concentrated public lockdown in Ghana (March 29 to April 19, 2020).
Source: JohnsHopkins (2022)—last updated February 8, 2022.

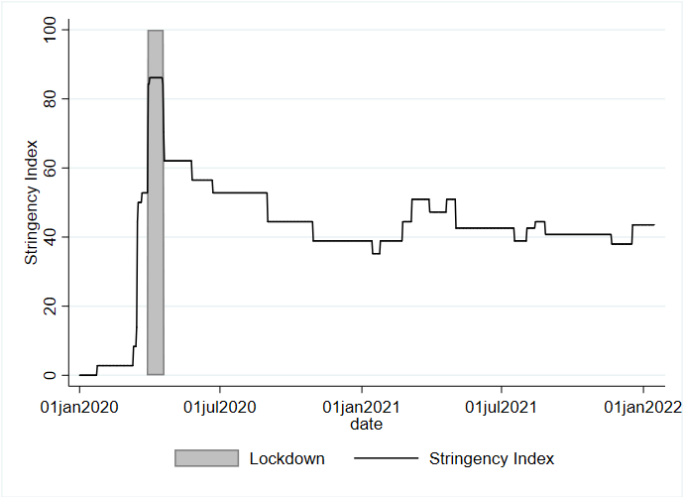

Fig. 3.A.2: Stringency index from Ghana since January 1, 2020.
Notes: The Government Response Stringency Index is a composite measure based on nine response indicators, including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest response). This index should not be interpreted as "scoring" the appropriateness or effectiveness of a country's response; it simply records the number and the strictness of government policies. The gray shaded area indicates the period of the geographically concentrated public lockdown in Ghana (March 29 to April 19, 2020).
Source: Hale et al. (2022)—last updated February 8, 2022.

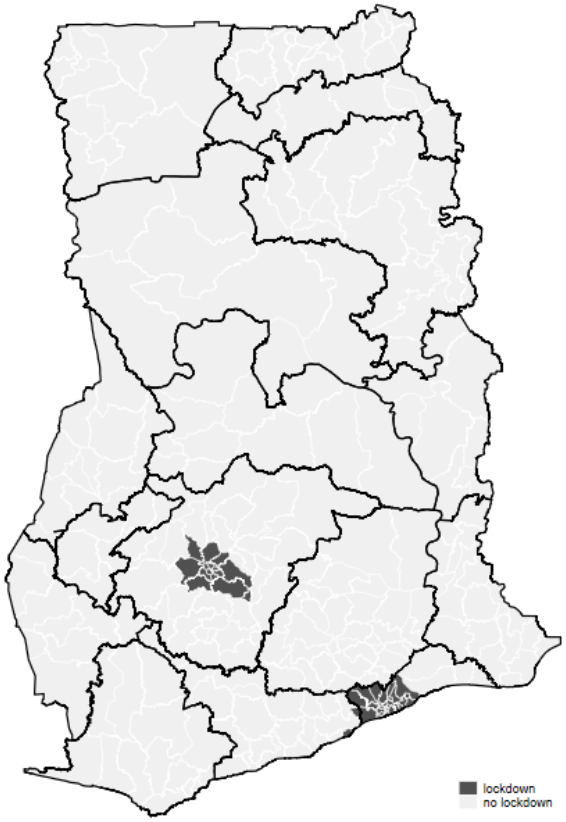

Fig. 3.A.3: Lockdown impact status of districts in Ghana.
Note: Out of the 260 districts in Ghana, 40 districts were under lockdown in April 2020 (dark gray areas) and 220 districts were not affected by the lockdown (light gray areas).

Tab. 3.A.1: OLS regression of absolute number of total monthly doses 2019-2020 by lockdown and COVID-19 impact status.

	Number of doses January - December (1)		Number of doses January (2)		Number of doses February (3)		Number of doses March (4)		Number of doses April (5)	
Year (ref. 2019)										
2020	65.60**	[14.34,116.9]	160.8**	[0.796,320.8]	-10.80	[-138.3,116.7]	-111.4	[-255.9,32.96]	-55.41	[-191.7,80.84]
Lockdown and COVID-19 impact status										
(ref. Other districts without COVID)										
Lockdown district with COVID	828.7***	[567.4,1090.0]	611.4*	[-9.432,1232.2]	753.8*	[-112.1,1619.7]	759.1*	[-94.98,1613.3]	954.3**	[179.2,1729.4]
Neighbor districts with COVID	203.5***	[116.1,291.0]	-111.5	[-408.0,184.9]	194.2**	[14.29,374.1]	263.4**	[32.32,494.4]	324.0***	[111.2,536.9]
Neighbor districts without COVID	94.70**	[17.98,171.4]	-41.32	[-283.2,200.5]	88.96	[-107.4,285.3]	88.59	[-128.0,305.2]	246.6**	[40.06,453.1]
Other districts with COVID	171.7***	[60.76,282.7]	-143.9	[-351.0,63.08]	-140.8	[-377.2,95.51]	107.4	[-282.8,497.7]	224.8*	[-37.01,486.7]
Lockdown and COVID-19 impact status *Year										
Lockdown district with COVID # 2020	-740.3***	[-1096.1,-384.5]	-703.9*	[-1542.9,135.1]	-1317.1**	[-2435.2,-198.9]	-1377.9**	[-2547.4,-208.5]	-1983.1***	[-2951.6,-1014.5]
Neighbor districts with COVID # 2020	-114.1	[-271.5,43.29]	-102.1	[-505.4,301.3]	-116.0	[-395.9,164.0]	-161.9	[-454.4,130.7]	-418.0**	[-740.8,-95.27]
Neighbor districts without COVID # 2020	-38.07	[-142.1,65.95]	-196.1	[-521.0,128.8]	-53.59	[-315.1,207.9]	-53.82	[-340.7,233.1]	-464.6***	[-807.3,-121.9]
Other districts with COVID # 2020	-160.4***	[-280.6,-40.24]	-17.95	[-316.6,280.7]	23.61	[-294.7,342.0]	-166.2	[-581.4,249.0]	-421.1**	[-785.7,-56.45]
Constant	93.68	[-156.2,343.6]	-111.7	[-568.6,345.2]	10.17	[-581.2,601.5]	350.7	[-242.8,944.2]	130.7	[-452.0,713.4]
Month fixed effects	X									
Vaccine level	X		X		X		X		X	
District control variables	X		X		X		X		X	
Observations	5664		472		472		472		472	
R-squared	0.918		0.957		0.942		0.923		0.946	

Notes: Robust standard errors were used; 95% confidence interval in parenthesis; * p<0.05, ** p<0.01, *** p<0.001. All results are population growth adjusted. Vaccine level refers to the average number of doses administered in 2018 and 2019 at the district level. District control variables include: number of births, population density and poverty rate at district level. Lockdown and COVID-19 impact status fixed effects refers to the five categories "Neighbor of lockdown-affected districts with COVID cases", "Neighbor of lockdown-affected districts without COVID cases", "Other districts with COVID cases", "Other districts without COVID cases" and "Lockdown-affected districts with COVID cases" (see Appendix 3.C).

Tab. 3.A.2: OLS regression of absolute number of total monthly doses 2018-2019 by lockdown and COVID-19 impact status.

	Number of doses January - December (1)		Number of doses January (2)		Number of doses February (3)		Number of doses March (4)		Number of doses April (5)	
Year (ref. 2019)										
2018	107.2*	[-9.445,223.8]	206.7	[-208.3,621.8]	247.2	[-143.8,638.1]	197.4	[-209.5,604.3]	194.2	[-186.5,575.0]
Lockdown and COVID-19 impact status										
(ref. Other districts without COVID)										
Lockdown district with COVID	676.7***	[206.3,1147.1]	600.8	[-802.3,2003.9]	801.0	[-688.7,2290.7]	551.5	[-711.1,1814.1]	517.8	[-1019.6,2055.1]
Neighbor districts with COVID	-325.4*	[-662.9,12.07]	-659.0	[-1765.4,447.5]	-467.3	[-1616.2,681.5]	-212.7	[-1288.4,862.9]	-417.7	[-1486.4,651.1]
Neighbor districts without COVID	-325.4*	[-662.9,12.07]	-659.0	[-1765.4,447.5]	-467.3	[-1616.2,681.5]	-212.7	[-1288.4,862.9]	-417.7	[-1486.4,651.1]
Other districts with COVID	-345.6*	[-731.0,39.82]	-546.9*	[-1164.9,71.07]	-732.8**	[-1367.8,-97.88]	-531.9	[-1243.7,180.0]	-613.3*	[-1318.4,91.84]
Lockdown and COVID-19 impact status *Year										
Lockdown district with COVID # 2018	-403.1	[-1220.5,414.2]	-562.7	[-2646.9,1521.5]	-1056.2	[-3328.1,1215.7]	-764.3	[-2740.9,1212.2]	-952.3	[-3400.5,1495.8]
Neighbor districts with COVID # 2018	-272.7	[-680.5,135.0]	-380.5	[-1836.0,1075.0]	-324.2	[-1769.3,1120.9]	-275.4	[-1624.9,1074.1]	-381.7	[-1787.5,1024.1]
Neighbor districts without COVID # 2018	-172.9	[-443.5,97.65]	-410.8	[-1474.1,652.6]	-374.7	[-1438.8,689.5]	-327.2	[-1421.7,767.2]	-496.9	[-1568.6,574.7]
Other districts with COVID # 2018	-143.0	[-372.5,86.48]	-208.7	[-952.4,534.9]	-61.28	[-821.2,698.7]	-174.1	[-979.4,631.2]	-368.8	[-1142.6,405.0]
Constant	2475.0***	[1743.2,3206.8]	1553.2***	[722.7,2383.6]	1778.5***	[926.4,2630.6]	1662.8***	[844.4,2481.2]	1770.3***	[783.0,2757.6]
Month fixed effects	X									
Vaccine level	X		X		X		X		X	
District control variables	X		X		X		X		X	
Observations	5664		472		472		472		472	
R-squared	0.623		0.732		0.707		0.735		0.672	

Notes: Robust standard errors were used; 95% confidence interval in parenthesis; * p<0.05, ** p<0.01, *** p<0.001. All results are population growth adjusted. Vaccine level refers to the average number of doses administered in 2018 and 2019 at the district level. District control variables include: number of births, population density and poverty rate at district level. Lockdown and COVID-19 impact status fixed effects refers to the five categories "Neighbor of lockdown-affected districts with COVID cases", "Neighbor of lockdown-affected districts without COVID cases", "Other districts with COVID cases", "Other districts without COVID cases" and "Lockdown-affected districts with COVID cases" (see Appendix 3.C).

3.B Routine child immunization data

As listed in Table 3.B.1, all children should be vaccinated per Ghana's recommended immunization schedule. Children with any missed doses should receive "catch-up" vaccines within the first five years of the child's life. Exceptions are the four time-critical vaccinations: OPV/polio 0, BCG and rotavirus 1 and 2. OPV/polio 0, and BCG should be given at birth or at least within the first two weeks[2], whereas the rotavirus vaccine at weeks 20 and 24. Most vaccinations require more than one dose for the development of adequate antibody response. A minimum interval of two weeks between each dose is recommended. A longer interval does not necessarily reduce the final antibody response (if the maximum age is adhered to), but it extends the time when the child is at risk of developing the disease. The numbers for the IPV and MenA vaccine will be excluded from our analysis to avoid bias due to the recent introduction of IPV in June 2018 and the anyway decreasing trend of MenA. For BCG, we only received the data until the year 2020 and therefore also excluded it from the analysis. Nevertheless, the results up to 2020 follow the same trend as other time-critical vaccinations, such as polio 0 (results available from authors upon request).

All routine child immunizations are given out for free at all points of care in Ghana, even to those not covered by the National Health Insurance Scheme (NHIS). The distribution of the vaccines is planned based on the Expanded Program on Immunization (EPI) Plan of Ghana and given out (i) in the hospital at all levels of health care, (ii) by outreach of Community-based Health Planning and Services (CHPS), and (iii) by national immunization campaigns in cooperation with the Ministry of Health and health partners. The latter includes only the following vaccine types: measles/rubella, yellow fever, polio and MenA (Gavi, 2020; WHO, 2018a,b, 2020k).

In line with the general trend of routine child vaccination coverage in Ghana, the data show that almost all vaccinations in 2020 were on a similar level of around 1,100,000 total doses administered within a year in the entire country, corresponding to a coverage rate of around 97% of the target population (WHO, 2020k). Although polio 0 has a lower absolute level (around 900,000 doses yearly), this still corresponds to a high coverage rate of up to 97% since the target population is children younger than two weeks and therefore we expect a smaller number than vaccines for children below five years old. There is a lower absolute level of total doses for measles rubella 1 and 2, rotavirus 2, and yellow fever, which is again in line with the official WHO-UNICEF coverage rates, corresponding to a coverage rate of around 80% (WHO, 2020k). Therefore, we do not assume any bias due to data quality.

[2]BCG preferable not beyond two weeks, however, at maximum within the first year.

Tab. 3.B.1: Overview of vaccine-preventable diseases targeted by Expanded Programme on Immunization (EPI) in Ghana.

Disease	Associated Vaccine used in Ghana	Min. Age	Max. Age	Indicator
Measles	Measles-Rubella vaccine	9 months	<5years	Measles Rubella 1
Rubella & Congenital				Measles Rubella 2
Rubella Syndrome				
Poliomyelitis	Oral polio vaccine (OPV)	Birth	<2weeks	OPV/Polio 0
		<6weeks	<5years	OPV/Polio 1
		<6weeks	<5years	OPV/Polio 2
		<6weeks	<5years	OPV/Polio 3
Pneumonia, mengitis,	Pneumococcal vaccine	<6weeks	<5years	PCV 1
other IPD				PCV 2
				PCV 3
Diphtheria	Component of Pentavalent (DPT-Hib-HepB) and Td vaccines	<6weeks	<5years	Penta 1
Tetanus	Component of Pentavalent (DPT-Hib-HepB) and Td vaccines			Penta 2
Pertussis or	Component of Pentavalent (DPT-Hib-			Penta 3
Whooping cough	HepB) vaccine			
Viral hepatitis	Component of Pentavalent (DPT-Hib-HepB) and HepB vaccines			
Pneumonia, mengitis,	Component of Pentavalent (DPT-Hib-			
Septicaemia etc.	HepB) vaccine			
Rotavirus diarrhea	Rotavirus vaccine	6 weeks	1st dose: 20 weeks	Rotavirus 1
Rotavirus diarrhea	Rotavirus vaccine	6 weeks	2nd dose: 24 weeks	Rotavirus 2
Yellow fever	Yellow fever vaccine	9 months	<5years	Yellow Fever
Tuberculosis (TB)	Yellow fever vaccine	9 months	<5years	Yellow Fever
BCG	Bacillus Calmette-Guérin (BCG)	Birth	textless1year	BCG
Poliomyelitis	Inactivated polio vaccine (IPV)	14 weeks	<5years	IPV
Meningococcal meningitis	Conjugate Meningococcal A (MenAfriVac)Vaccine	18 months	<5years	MenA

Note: Based on the EPI Ghana, for each vaccination the minimum and maximum age for the dose are listed as well as the corresponding indicator in our data.
Source: Gavi (2020).

3.C Lockdown and COVID-19 impact status

As stated in Section 3.2.1, the Ghanaian government introduced a geographically concentrated public lockdown in 40 of the most affected districts in the Greater Accra Metropolitan Area and Greater Kumasi Metropolitan Area from March 30 to April 19, 2020 (Figure 3.A.3, RepublicGhana, 2020a).

It is important to note that at that time, not only the lockdown-affected districts had COVID-19 cases, but also 63 additional districts all over the country (Figure 3.C.1, left panel). We do not have access to data on the intensity of COVID-19 cases per district, but we can use the binary information indicating whether a district was affected by COVID-19 in April 2020 that was published in Ghana's outbreak response management updates (GHS, 2020a).

Using a simple OLS regression to analyze which COVID-19 affected districts were put

under lockdown reveals that besides the intensity, population density and wealth were also highly correlated. Because the 220 non-lockdown-affected districts significantly differ in terms of population, socioeconomic factors, and urbanization, we also create a three-level categorical variable (Figure 3.C.1, middle panel) to indicate whether the district was affected by the geographically concentrated public lockdown in April 2020, if the district was a first- or second-order neighbor of a lockdown-affected district (with the assumption that these are very similar to lockdown-affected districts in terms of population, socioeconomic factors, and urbanization, as well as fear of COVID-19 exposure, but different in terms of restrictions), and if the district was not affected by the geographically concentrated public lockdown in April 2020 and is further away from a lockdown-affected district. Therefore, we categorize 40 districts as lockdown-affected districts, 45 districts as neighbor districts, and 175 districts as other districts.

Putting together the information on which districts were affected by COVID-19 in April 2020, as well as on which districts were closer to the lockdown hotspot, we created a five-level categorical variable (Figure 3.C.1, right panel) to indicate if a given district was affected by the geographically concentrated public lockdown in April 2020 (40 districts), if a district was a neighbor of a lockdown-affected district and also experienced COVID-19 cases in April 2020 (17 districts), if the district was an "other" district and also experienced COVID-19 cases in April 2020 (46 districts), if the district was a neighbor of a lockdown-affected district but did not experience COVID-19 cases in April 2020 (28 districts), or if the district was an "other" district but did not experience COVID-19 cases in April 2020 (129 districts).

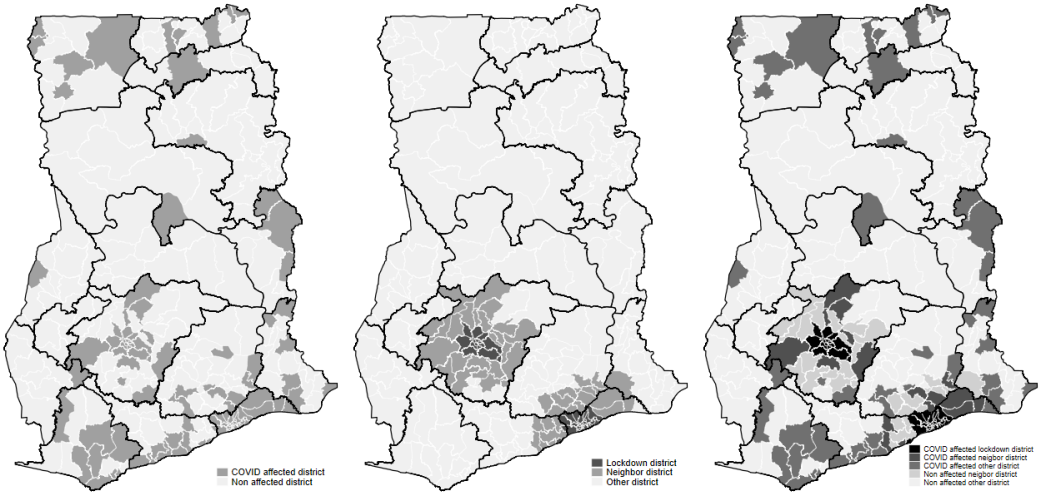

Fig. 3.C.1: Lockdown and COVID-19 affected districts in Ghana.
Notes: The left figure shows which districts had COVID-19 in April 2020. The middle figure shows in addition to Figure A.3 the neighbor districts (highlighted in light gray). The right figure shows the five-level lockdown and COVID-19 impact status variable.
Source: GHS (2020a).

Chapter 4

Indirect health effects of government interventions during COVID-19: Evidence from essential health care services in Ghana

Kathrin Durizzo*

Abstract: As previous epidemics have highlighted, disease outbreaks and the corresponding government interventions can cause indirect health effects, such as reductions in the utilization of non-outbreak related health services. Current research on the COVID-19 pandemic shows that, in high-income countries, mainly preventive and non-essential services declined, whereas in low- and middle-income countries, it was essential health services that were affected. To date, little is known about the impact of government interventions on the utilization of health care services in LMICs. I examine country-wide monthly administrative data on four essential health services aggregated by district in Ghana. I find that the maternal health services, C-sections and birth at a health facility, were not interrupted by either the COVID-19 pandemic or by government interventions to limit the spread of COVID-19 in Ghana. On the contrary, declines in road accident treatments and diarrhea disease services were both positively correlated with the stringency of policy measures, but not with the COVID-19 exposure levels. Both results highlight that the population's adherence to general hygiene and social-distancing measures and mobility restrictions led to indirect health effects. The results shed light on the trade-off between the direct benefit of government interventions to curb the spread of a disease and the potential costs and benefits of indirect health effects. For future epidemics, the results imply that the effectiveness of government interventions is highly context-specific and strongly depends on the population's adherence.

Keywords: government intervention; COVID-19 pandemic; hygiene and social distancing measures; health care utilization; administrative data; Ghana

JEL code: C3; H4; I1; I3; O2

Status: working paper

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4.1 Introduction

The COVID-19 pandemic has affected health systems worldwide. To avoid spreading the pandemic, governments implemented hygiene and social distancing measures–which varied considerably from one country to another in terms of stringency and length (Hale et al., 2022). Previous research from high-income countries (HICs) suggests that public lockdowns effectively curb spreading of the virus (e.g., for Italy: Borri et al. (2021) and DiPorto et al. (2022); and for the US: Cronin & Evans (2020) and Courtemanche et al. (2020)). The effects for low- and middle-income countries (LMICs), which generally implemented stricter policy measures early in the pandemic to avoid overrunning health systems, are unclear, often depend on the public's adherence, and are highly influenced by the population's trust in the government (e.g., Durizzo et al., 2021; Dutta & Fischer, 2021; Kohler et al., 2022).

Studies from previous epidemic outbreaks in LMICs show that the outbreak and the corresponding government interventions can cause indirect health effects. Specifically, they can cause reductions in the utilization of non-outbreak-related health services. Those indirect health effects can be intentional—for example, delays of non-urgent and planned health services to ensure sufficient capacity for urgent services—or unintentional, for example, people chose not to go to hospital when they previously would. A study from the 2014-2015 Ebola outbreak in Sierra Leone, Liberia, and Guinea, for example, shows an 80% reduction in maternal delivery care, a 75% decline in fully vaccinated children, and a 60% decrease in attendance at hospitals for diarrhea and acute respiratory infections (Elston et al., 2017). Some other studies even estimated that mortality from those indirect health effects was potentially more extensive than the direct effect of Ebola (e.g., Helleringer & Noymer, 2015).

Similarly, several researchers undertook modeling studies about the impact of indirect effects of the COVID-19 pandemic on the provision and utilization of health care (Abbas et al., 2020; Hogan et al., 2020; Roberton et al., 2020). However, simulations early in the COVID-19 pandemic seemed inaccurate due to significant uncertainties surrounding the nature of the novel disease (Press & Levin, 2020), particularly for LMICs. Surveys and studies with administrative data show that in HICs mainly preventive and non-essential services declined, whereas in LMICs also essential health services were affected (e.g., Moynihan et al., 2020). However, the effects differ considerably depending on what health service is investigated, over what period, and for which sample (e.g., Arsenault et al., 2022; Cantor et al., 2022; Chandir et al., 2021; Hategeka et al., 2021; Jain & Dupas, 2022; Kc et al., 2022; Kumari et al., 2020; Roberton et al., 2020; Siedner et al., 2020; Smith et al., 2020).

The reasons for a decline in the utilization of health care services can be a mix of supply- and demand-side factors (WHO, 2020h). On the demand side, fear of COVID-19, difficulties in traveling and inability to afford health-care services due to social distancing regulations and lockdowns, and lower disease incidences due to hygiene and social distan-

cing regulations are likely possibilities, among others. On the supply side, interruption in the supply of medicine, shifting resources to mitigate the impact of the COVID-19 pandemic, staff shortages, and the closure of health facilities are some possible driving factors. However, there is limited and mixed empirical evidence of what precisely drives the observed declines.

Two studies early in the pandemic found that besides the lockdown itself, the COVID-19 exposure level significantly worsened the disruption of preventive and elective care in the US (Cantor et al., 2022) and child immunization in Bangladesh (Rabbani, 2021). In a longer-term cross-country analysis of two HICs and eight LMICs, Arsenault et al. (2022) highlight that the stringency of policies or the COVID-19 incidence is only moderately correlated with health-service disruptions. Studies from the US, Japan, and Cameroon show that it was the fear of COVID-19 infection rather than the lockdown itself that held patients back from attending the hospital for some services (Caston et al., 2021; Kumagai, 2021; Tsafack Nanfosso & Tadadjeu, 2022). Additionally, due to the fear of getting infected, a few studies observed substitution effects of the classical health care provision with telemedicine or self-medication at pharmacies (e.g., in the US Cantor et al. (2022); Mehrotra et al. (2020); in Kenya Gómez-Pérez et al. (2022)). From a more economic side, a few studies observe that financial liquidity constraints and unemployment due to the COVID-19 pandemic impacted individuals' medical-seeking behavior (e.g., for Brazil: Belchior & Gomez (2022); for Mozambique: Krauss et al. (2021)). Lastly, a study from Kenya also finds evidence that part of the decrease in the utilization of health care services was due to a lower incidence of infectious diseases, such as respiratory and gastrointestinal diseases, because of hygiene and social distancing measures (e.g., Gómez-Pérez et al., 2022).

Since many countries continue to experience new and sometimes much stronger COVID-19 waves and since scientists predict more severe pandemics in the future (CGD, 2021), it is crucial to understand the impact of such a health shock and the corresponding government interventions. Yet so far, insights into longer-term indirect effects to understand catch-up effects, evidence for whole countries to understand the overall effects on the health system, and empirical evidence from government interventions instead of solely descriptive studies for essential health services in LMICs are all rare.

In this paper, I attempt to disentangle the indirect effects of the COVID-19 pandemic and the implemented hygiene and social distancing measures on the utilization of essential health care services in LMICs. I use monthly administrative data of administered health services from all health facilities in all 260 districts in Ghana from January 2018 to December 2021. The analysis not only focuses on the effects during the lockdown, but also explores potential catch-up effects 20 months after the lockdown was lifted. Given the variations in social-distancing regulations across districts in Ghana, it is possible to further differentiate between the impact of a lockdown, the exposure of COVID-19 cases, and the general effect of the pandemic. Additionally, due to a set of essential health care services of maternal health, gastrointestinal diseases, and emergency services, potential disruption

from different angles can be observed, which will help to disentangle the reasons behind the indirect health effects.

The contribution of the results to the current literature is threefold. First, I provide evidence for a longer time period. I analyze data from over two years before the pandemic and up to two years into the pandemic. This evidence contributes to the few studies examining longer-term effects (Arsenault et al., 2022; Cantor et al., 2022; Gómez-Pérez et al., 2022), providing evidence when many countries experience new and sometimes much stronger COVID-19 waves. Additionally, the longer-term period allows us to use the 27 pre-COVID-19 months as a robustness check and the 20 after-lockdown months to explore potential catch-up effects. Second, providing evidence for Ghana not only contributes to the limited literature on LMICs (Arsenault et al., 2022; Belchior & Gomez, 2022; Gómez-Pérez et al., 2022; Krauss et al., 2021; Rabbani, 2021; Tsafack Nanfosso & Tadadjeu, 2022), but also contributes to providing evidence for a whole country using administrative data (Arsenault et al., 2022). Therefore, the overall effects on an LMIC's health system can be examined, and the results do not only focus on small-scale results in specific regions or health facilities. Third, since Ghana introduced only a regional lockdown in April 2020 in some of the COVID-19 affected areas, Ghana provides a unique case to disentangle the reasons behind potential decreases in the utilization of health services. Therefore, this study contributes to the few papers assessing the impact of COVID-19 policies on health care utilization (Cantor et al., 2022).

4.2 Data and methodology

4.2.1 Context

On March 12, 2020, the first two COVID-19 cases were reported in Ghana (Figure 4.A.1 in the Appendix). Three days later, the Ghanaian government banned all public gatherings such as conferences, festivals, political rallies, and church activities and closed schools to curb the virus's spread (Nyabor, 2020, see Figure 4.A.2 in the Appendix). Nevertheless, the confirmed COVID-19 cases were slowly increasing, leading to 152 confirmed cases recorded in four (out of 16) regions: Greater Accra, Ashanti, Northern, and Upper West Region on March 29 (GHS, 2020a). To avoid an escalation of the cases, the government introduced a geographically concentrated lockdown of the most affected areas in the Greater Accra Metropolitan Area (including Awutu Senya East) and Greater Kumasi Metropolitan Area on March 30 (RepublicGhana, 2020a) (see Figure 4.A.3 in the Appendix). In addition to the national hygiene and social distancing measures already in place, the geographically concentrated lockdown restricted all non-essential movement and services, such as religious gatherings, hotels, bars, restaurants, entertainment venues, fitness centers, or public parks. Inter-city movement of vehicles and aircraft for private or commercial purposes was forbidden (RepublicGhana, 2020a). Essential health services were still provided, however, people in a lockdown area were not allowed to travel to other districts.

Due to fears about the worsening economic situation of the population, the government lifted the geographically concentrated lockdown three weeks later, on April 20, 2020 (Akinwotu & Asiedu, 2020). Strict hygiene and social distancing measures were still in place (RepublicGhana, 2020b; Haider et al., 2020), but were slowly lifted (Figure 4.A.2). Wearing of face masks in public places remained mandatory until March 2022, almost two years after the lockdown. Since the lifting of the geographically concentrated lockdown in April 2020, Ghana has experienced four additional and even stronger COVID-19 waves (Figure 4.A.1). However, most of the COVID-19 cases still primarily occurred in the lockdown-affected areas of Ashanti and Greater Accra Region (GHS, 2020a).

4.2.2 Data

For the analysis, the Ghana Health Service (GHS) provided District Health Information Management System (DHIMS) time-series data on the number of essential health care services provided in all health facilities in Ghana for each month from January 2018 to December 2021. The monthly numbers are available for all 16 regions and 260 districts and are aggregated at the district level. The aggregated monthly district numbers represent the number of people receiving health services within a given month and district at all levels of health care provision. Due to data limitations, the analysis is restricted to four essential health services for three broad health care needs: maternal health services, gastrointestinal diseases, and emergency services. Specifically, I analyze the number of cesarean section (C-section) deliveries, the number of births attended by skilled health personnel at the health facility, the number of children under five years old treated for diarrhea diseases, and the number of transport injuries due to road traffic accidents. Another limitation of the dataset is that only information about the administered services, but not the demand or the incidences of certain diseases, such as diarrhea, is available.

I combine the dataset with time-series data from monthly regional COVID-19 cases based on the JohnsHopkins (2022) dataset and stringency measures based on the Hale et al. (2022) dataset. Additionally, I create a dummy variable for each district under the geographically concentrated public lockdown based on Ghana's outbreak response management updates (GHS, 2020a). Although I do not have access to data on the intensity of COVID-19 cases per district, I can use the binary information indicating whether a district was affected by COVID-19 in April 2020 based on Ghana's outbreak response management updates (GHS, 2020a). In addition, I enrich the dataset with district control variables such as population density data from 2020 based on GHS (2020b) and poverty rates data from 2015 based on the Ghana Poverty Mapping Report (GHS, 2015).

4.2.3 Empirical strategy

In a first step, in Section 4.3.1, I descriptively show the overall development of the four health care services two years before and two years into the pandemic. To this end, I use the yearly unadjusted utilization changes for each health care service. The pre-COVID-

19 unadjusted changes from 2018 to 2019 will highlight pre-pandemic trends, which are essential to understand the development. I use the following equation for each health service:

$$\sum_{i=1}^{260} \frac{\sum_{m=1}^{12} Y_{i,m,t} - \sum_{m=1}^{12} Y_{i,m,t-1}}{\sum_{m=1}^{12} Y_{i,m,t-1}} \tag{4.1}$$

Where $Y_{i,m,t}$ is the total number of a health service (Y) for each of the 260 districts (i), for each of the 12 months (m), and each year (t). As a result, I obtain the yearly average changes for each health service from 2018 to 2019, 2019 to 2020, and 2020 to 2021. While the unadjusted trends highlight the overall development of the health care service utilization two years into the pandemic, it does not identify how the COVID-19 pandemic exposure, the stringency of the policy measures, and the lockdown itself have affected the health care utilization.

Thus, in a second step, in Section 4.3.2, I estimate an OLS model to analyze the effect of the COVID-19 pandemic and the corresponding government interventions on the utilization of health care services. To account for potential yearly time trends within each region and month, the monthly difference in the number of health services to the year before is analyzed ($Y_{i,m,t} - Y_{i,m,t-1}$). I estimate the following model, including the COVID-19 exposure and stringency per month (m) and region (i):

$$Y_{i,m,t} - Y_{i,m,t-1} = \beta_0 + \beta_1 Stringency_{i,m,t} + \beta_2 Cases_{i,m,t} + \epsilon_i \tag{4.2}$$

Where $Stringency_{i,m,t}$ is the Government Response Stringency Index, a composite measure based on nine response indicators rescaled to a value from 0 to 100 (100 = strictest response). This index should not be interpreted as "scoring" the appropriateness or effectiveness of a country's response; it simply records the number and the strictness of government interventions. $Cases_{i,m,t}$ refers to the number of COVID-19 cases. I include the variables in a stepwise process and use cluster-robust standard errors on a regional level.

In the last step, in Section 4.3.3, I estimate as a robustness check the effect of COVID-19 exposure and lockdown exposure on the utilization of health care services. I create a five-level lockdown and COVID-19 impact variable (I_i)[1], making use of the facts that not all COVID-19 affected districts were under lockdown (Figure 4.2.1, left panel) and the distance from the geographically concentrated public lockdown (Figure 4.2.1, middle panel)[2]. Putting together the information on which districts were affected by COVID-19 in April 2020, as well as on which districts were closer to the lockdown hotspot, the five-level categorical variable indicates if a given district was affected by the geographically concentrated public lockdown in April 2020 (40 districts), if a district was a neighbor of a lockdown-affected district and also experienced COVID-19 cases in April 2020 (17

[1]The same approach as used in chapter 3 of this dissertation.

[2]The distance will give insights into any differences between lockdown-affected districts and the first- or second-order neighboring districts, which are assumed to be similar in terms of fear of COVID-19 exposure, but different in terms of restrictions.

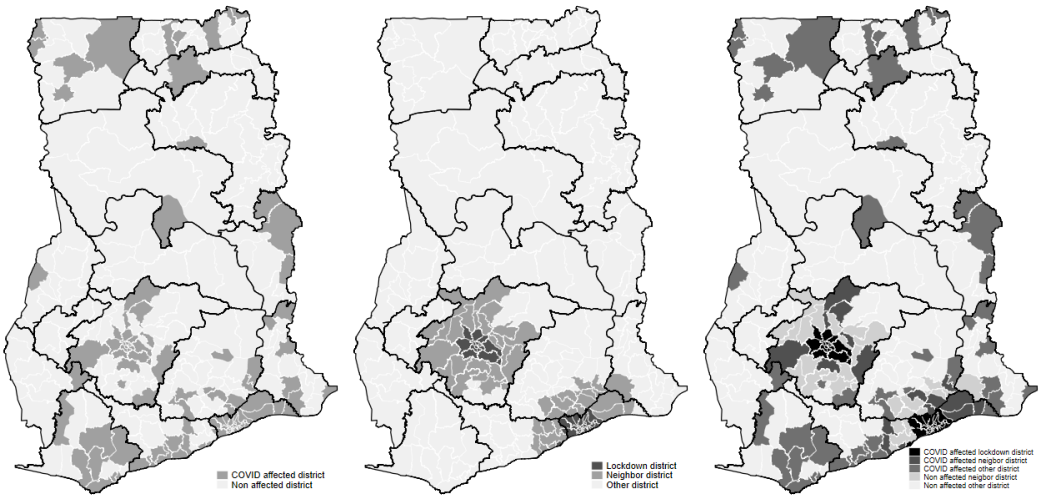

Fig. 4.2.1: Lockdown and COVID-19 impact status of districts in Ghana.
Notes: The left figure shows which districts had COVID-19 in April 2020. The middle figure shows in addition to Figure A.3 the neighbor districts (highlighted in light gray). The right figure shows the five-level lockdown and COVID-19 impact status variable (more details see 3.C).
Source: GHS (2020a).

districts), if the district was an "other" district and also experienced COVID-19 cases in April 2020 (46 districts), if the district was a neighbor of a lockdown-affected district but did not experience COVID-19 cases in April 2020 (28 districts), or if the district was an "other" district but did not experience COVID-19 cases in April 2020 (129 districts).

I estimate the following OLS model first for each month and later for one year aggregated:

$$Y_{i,m,t} = \beta_0 + \beta_1 Year_{i,m} + \beta_2 I_i + \beta_3 I_i * Year_{i,m} + \beta_4 D_{i,m,t} + \epsilon_i \tag{4.3}$$

Where $Year_{i,m}$ are year fixed effects and $D_{i,m,t}$ represents district control variables. β_3 is our coefficient of interest, measuring the effect of COVID-19 exposure and lockdown policies for each health care service, controlling for district and year effects.

As a robustness check, I run the model also for the pre-COVID years 2018 and 2019 (see Tables 4.A.2 and 4.A.4) as well as for only the three lockdown types as stated in Figure 4.2.1 middle panel, (see Tables 4.A.1 and 4.A.3).

4.3 Results

4.3.1 Unadjusted trends in health care service utilization

Figure 4.3.1 shows the yearly unadjusted trends in healthcare utilization for the four services: C-section, births in a health facility, diarrhea of children below five years, and road accidents (see equation 4.1 in Section 4.2.3). For all health services, I find that before the pandemic, the utilization increased from 2018 to 2019, emphasizing the importance of

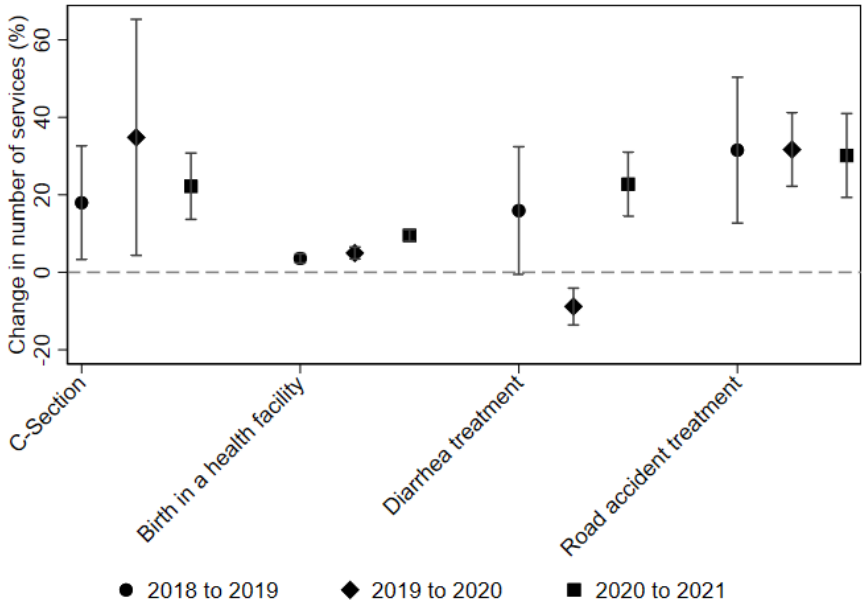

Fig. 4.3.1: Unadjusted trends in health care service utilization.
Notes: Figure shows the point estimate of the unadjusted average changes in number of services per district for each service, relative to the year before. The line represents the 95% confidence interval. Diarrhea only consist of services for children below five years.

examining pre-COVID-19 trends when analyzing the development during the COVID-19 pandemic. For the four health services, there could be a mix of reasons behind this trend, such as increasing population, improved access to health care, but also increased incidences (WHO, 2021a, 2020j). Road accidents, for example, have increased substantially over the years, potentially leading to the large yearly increase of road accident treatments of 32% per district from 2018 to 2019 (WHO, 2020j).

During the COVID-19 pandemic, from 2019 to 2020 and from 2020 to 2021, this trend remains positive and similar for road accident treatments and the two maternal health care services, C-section and birth in a health facility. Hence, contrary to many studies early in the pandemic, no interruption can be found, even when additional and more severe COVID-19 waves occurred in Ghana in 2020 and 2021. An exception is diarrhea services for children below five years; a significant decrease of -9% from 2019 to 2020 in the first year of the pandemic can be found. However, from 2020 to 2021, the trend catches up to its pre-pandemic level. Figure 4.A.4 in the Appendix highlights that the monthly unadjusted trend of the health care utilization for diarrhea was substantially interrupted from March to December 2020 compared to the same months in 2019. Nevertheless, the results do not identify how the COVID-19 pandemic exposure, the stringency of the policy measures, and the lockdown itself have affected this trend.

4.3.2 Effects of COVID-19 cases and stringency on utilization on regional level

Table 4.3.1 presents the OLS estimates of the monthly changes in the number of health care services per region from 2019 to 2020 (see equation 4.2 in Section 4.2.3). In line with the findings from Section 4.3.1, the monthly changes in maternal health services, number of C-sections and births in a health facility, do not significantly correlate with the monthly stringency levels of the policy measures or the monthly COVID-19 cases (Table 4.3.1, columns 1-6).

For diarrhea services for children below five years, the estimates in Table 4.3.1 show a significant and robust negative correlation with the monthly stringency of the policy measure (columns 7 and 9). In contrast, the monthly COVID-19 cases (column 8) are not driving the trend shown in Figure 4.3.1. Nevertheless, the results do not yet explain any mechanisms what drives this correlation. Possible explanations for this pattern could be demand-side effects, such as fewer children getting diarrhea-related diseases due to higher hygiene or fewer children having access to health facilities due to stricter (mobility) policies. Conversely, supply-side effects could also drive the decline in diarrhea treatments, such as closed health facilities.

Although Figure 4.3.1 showed no yearly drop in road accident treatments, Table 4.3.1 (columns 10-12) highlights that the monthly stringency level of policy measure is negatively correlated. This result suggests that at the beginning of the pandemic, when the stringency level was high, there might have been a decrease in the number of road accident treatments. Indeed, the development by month highlights, that in April 2020 compared to April 2019, in the time when the geographically concentrated public lockdown was in place, road accident treatments decreased substantially by -6 number of services per district, which corresponds to around 20% reduction. A possible explanation for this pattern could be that during the geographically concentrated public lockdown, where inter-district mobility was limited, also road accidents and, therefore, road accident treatments in health facilities decreased.

4.3.3 Effects of the public lockdown on utilization on district level

Table 4.3.2 analyzes the impact of COVID-19 exposure and lockdown exposure on road accident treatments, controlling for district and year effects (see equation 4.3 in Section 4.2.3). Only for April 2020 I do find a significant yearly effect (column 4), whereas for the months before and after the public lockdown, I find no significant effect, confirming the insights from Section 4.3.2. Additionally, the estimates show a significant difference between lockdown-affected districts and non-lockdown-affected districts without COVID-19 cases, controlling for district and year effects. Conversely, for non-lockdown-affected districts with COVID-19 cases, I do not find a significant difference to lockdown-affected districts–both in neighboring districts and districts further away from the lockdown. Therefore, not only the lockdown itself, but also the existence of confirmed COVID-19 cases per

Tab. 4.3.1: Effect of monthly COVID-19 cases and stringency levels on health care utilization changes.

	C-section			Birth in a health facility		
	(1)	(2)	(3)	(4)	(5)	(6)
Monthly Stringency level	-0.0537		-0.0541	-0.00127		0.00432
	(0.148)		(0.143)	(0.990)		(0.965)
Monthly COVID-19 cases		0.000145	0.000164		-0.00185	-0.00185
		(0.819)	(0.795)		(0.201)	(0.203)
Constant	6.760***	3.933***	6.723***	8.698	9.335***	9.113*
	(0.001)	(0.000)	(0.001)	(0.111)	(0.000)	(0.094)
Observations	144	144	144	144	144	144
R-squared	0.013	0.001	0.015	0.000	0.019	0.019
	Diarrhea treatment			Road accident treatment		
	(7)	(8)	(9)	(10)	(11)	(12)
Monthly Stringency level	-2.943***		-2.939***	-0.287***		-0.284***
	(0.000)		(0.000)	(0.000)		(0.000)
Monthly COVID-19 cases		-0.00231	-0.00128		-0.00110*	-0.00101
		(0.519)	(0.692)		(0.099)	(0.115)
Constant	54.05	-97.11***	54.34	20.78***	6.393***	21.01***
	(0.124)	(0.000)	(0.124)	(0.000)	(0.000)	(0.000)
Observations	144	144	144	144	144	144
R-squared	0.114	0.001	0.114	0.132	0.017	0.146

Notes: Table shows the estimates from OLS regression model (see equation 4.1 in Section 4.2.3). Robust standard errors were used; 95% confidence interval in parenthesis; * p<0.05, ** p<0.01, *** p<0.001. The outcome is the absolute change in health care utilization for each month compared to the level the year before. The unit of observation is at the year, month, and region level. Only the monthly changes since the outbreak of the pandemic are included in the model (April 2020–December 2020). Diarrhea only consist of services for children below 5 years.

district in April 2020 seem to drive the decline in road accident treatments.

Table 4.3.3 presents the same model (see equation 4.3 in Section 4.2.3), but for the essential health services: birth at a health facility, C-section, and diarrhea. In line with the findings from Sections 4.3.1 and 4.3.2 that utilization for births and C-sections has not decreased nor was substantially affected by COVID-19 pandemic exposure or the stringency of the policy measures, the estimates do not show any differences between lockdown and non-lockdown-affected districts, controlling for district and year effects (columns 1–4). On the contrary, in columns 5-6, I find that diarrhea services for children below five years significantly decreased in April 2020 and remained lower over the period of a year (row 1). Controlling for district and year effects, the results show a significant difference between lockdown-affected districts and neighboring districts (rows 6 and 7, see also Table 4.A.2), particularly neighboring districts without COVID-19 cases. However, there is no difference between lockdown-affected districts and other districts.

The estimates in Tables 4.A.2 and 4.A.2 for 2018 and 2019 highlight that the results are robust and are not affected by general differences between the lockdown and COVID impact status groups.

Tab. 4.3.2: OLS regression of number of total monthly services for road accident treatments, January to May 2019 and 2020.

	Number of Road Accidents Treatments January (1)		Number of Road Accidents Treatments February (2)		Number of Road Accidents Treatments March (3)		Number of Road Accidents Treatments April (4)		Number of Road Accidents Treatments May (5)	
Year (ref. 2019)										
2020	2.833	[-20.50,26.17]	2.333	[-17.90,22.57]	-4.556	[-27.07,17.96]	-26.22***	[-43.99,-8.457]	-8.472	[-25.52,8.572]
Lockdown and COVID-19 impact status										
(ref. lockdown district with COVID)										
Neighbor of lockdown districts with COVID cases	-30.52**	[-55.46,-5.583]	-18.94*	[-37.94,0.0508]	-15.69	[-38.68,7.304]	-21.48**	[-42.91,-0.0462]	-29.68***	[-48.25,-11.11]
Neighbor of lockdown districts without COVID cases	-20.08	[-45.28,5.111]	-24.51**	[-43.75,-5.270]	-22.27**	[-43.79,-0.749]	-25.97**	[-47.77,-4.178]	-24.14***	[-42.29,-5.987]
Other districts with COVID cases	-16.48	[-41.14,8.185]	-17.48*	[-35.92,0.973]	-19.89*	[-41.07,1.290]	-11.22	[-37.27,14.83]	-11.42	[-30.83,7.990]
Other districts without COVID cases	-17.51	[-46.99,11.98]	-16.70	[-39.83,6.436]	-25.90**	[-45.68,-6.115]	-23.91**	[-43.81,-4.012]	-25.01***	[-42.70,-7.321]
Lockdown and COVID-19 impact status *Year										
Neighbor of lockdown districts with COVID cases # 2020	3.814	[-22.71,30.34]	-0.451	[-23.75,22.84]	-5.562	[-33.71,22.58]	15.40	[-5.801,36.60]	14.94	[-5.863,35.75]
Neighbor of lockdown districts without COVID cases # 2020	-3.561	[-30.95,23.83]	4.667	[-19.79,29.13]	1.646	[-25.97,29.26]	24.99**	[2.831,47.16]	14.52	[-7.715,36.75]
Other districts with COVID cases # 2020	2.076	[-24.58,28.74]	5.530	[-17.55,28.61]	13.40	[-14.81,41.61]	23.81	[-6.204,53.83]	9.313	[-14.31,32.93]
Other districts without COVID cases # 2020	-7.893	[-35.30,19.52]	-5.889	[-29.60,17.82]	7.650	[-16.10,31.40]	25.78***	[6.689,44.87]	13.26	[-5.493,32.01]
Constant	58.13***	[34.07,82.20]	53.27***	[35.70,70.84]	58.37***	[39.49,77.26]	56.00***	[36.79,75.22]	55.23***	[38.86,71.60]
Health service level	X		X		X		X		X	
District control variables	X		X		X		X		X	
Observation	472		472		472		472		472	
R-squared	0.029		0.030		0.044		0.045		0.048	

Notes: District control variables contain of population density and poverty rates per district. Robust standard errors were used; 95% confidence interval in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Tab. 4.3.3: OLS regression of number of total monthly services for births at a health facility, C-sections and diarrhea treatments, 2019 and 2020.

	Number of Births January-December (1)		Number of Births April (2)		Number of C-sections January-December (3)		Number of C-sections April (4)		Number of Diarrhea January-December (5)		Number of Diarrhea April (6)	
Year (ref. 2019)												
2020	-4.646	[-20.15,10.86]	-9.444	[-52.15,33.26]	7.701**	[0.719,14.68]	8.722	[-7.403,24.85]	-99.71***	[-126.6,-72.85]	-198.7***	[-287.2,-110.2]
Lockdown and COVID-19 impact status												
(ref. lockdown district with COVID)												
Neighbor of lockdown districts with COVID cases	-8.132	[-18.71,2.441]	-10.64	[-41.00,19.72]	-0.306	[-4.491,3.879]	2.311	[-8.705,13.33]	21.52	[-5.207,48.25]	2.257	[-76.03,80.55]
Neighbor of lockdown districts without COVID cases	-11.96**	[-22.93,-0.996]	-15.99	[-47.77,15.80]	-2.552	[-6.913,1.810]	-0.533	[-10.62,9.553]	18.50	[-7.482,44.49]	-0.724	[-85.14,83.70]
Other districts with COVID cases	-7.780	[-17.34,1.780]	-11.33	[-36.74,14.08]	-3.055	[-6.875,0.764]	0.0243	[-10.61,10.66]	70.73***	[39.76,101.7]	-12.43	[-143.6,118.7]
Other districts without COVID cases	-10.63*	[-21.59,0.329]	-21.60	[-54.23,11.02]	-2.466	[-6.916,1.985]	-2.140	[-11.02,6.743]	54.17***	[28.93,79.41]	36.38	[-52.05,124.8]
Lockdown and COVID-19 impact status *Year												
Neighbor of lockdown districts with COVID cases # 2020	12.98	[-3.894,29.86]	27.62	[-19.70,74.94]	-5.574	[-13.20,2.049]	-2.487	[-22.00,17.03]	30.26*	[-3.804,64.32]	80.08	[-35.70,195.9]
Neighbor of lockdown districts without COVID cases # 2020	6.782	[-9.556,23.12]	3.444	[-41.14,48.03]	-5.671	[-12.96,1.622]	-7.540	[-25.07,9.993]	76.02***	[39.46,112.6]	165.4***	[56.12,274.8]
Other districts with COVID cases # 2020	7.864	[-8.824,24.55]	15.44	[-29.57,60.46]	-3.105	[-10.38,4.169]	-5.222	[-22.64,12.20]	-8.154	[-43.74,27.43]	12.24	[-113.3,137.8]
Other districts without COVID cases # 2020	13.07	[-2.581,28.72]	16.40	[-26.70,59.51]	-5.213	[-12.23,1.807]	-5.782	[-22.08,10.52]	17.60	[-14.00,49.20]	89.51	[-19.89,198.9]
Constant	-5.531	[-23.17,12.11]	31.38	[-19.99,82.76]	-0.0717	[-6.448,6.304]	5.337	[-4.162,14.84]	73.78***	[42.26,105.3]	46.24	[-59.04,151.5]
Health service level	X		X		X		X		X		X	
District control variables	X		X		X		X		X		X	
Observation	5664		472		5664		472		5664		472	
R-squared	0.931		0.964		0.891		0.940		0.618		0.708	

Notes: District control variables contain of population density and poverty rates per district. Birth refers to births in a health facility. Diarrhea only consist of services for children below 5 years. Robust standard errors were used; 95% confidence interval in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

4.4 Discussion and conclusion

The COVID-19 pandemic and the corresponding government interventions have interrupted health care service utilization worldwide. While in HICs mostly preventive and non-essential services declined, many LMICs experienced a substantial decline in essential health service utilization. Since scientists predict further and more severe pandemics (CGD, 2021), it is crucial to understand the impact of the COVID-19 pandemic and the corresponding government interventions on the utilization of health care services. Especially for LMICs, which generally implemented stricter policy measures early in the pandemic to avoid overrunning health systems.

This study is one of the few studies providing insights into the impact of a lockdown, the exposure of COVID-19 cases, and the general effect of the pandemic on essential health services in LMICs. I use country-wide monthly administrative DHIMS data of a set of four essential health services aggregated for all districts in Ghana from 2018 to 2021. Given the variations in social-distancing regulations across districts in Ghana due to a geographically concentrated lockdown in April 2020, I am able to provide evidence of the potential decline of the four essential health services. In particular, the study analyzes the number of C-sections, births in a health facility, road accident treatments, and diarrhea services for children below five years.

I find that maternal health services, C-sections, and births in a health facility were not interrupted during the COVID-19 pandemic, nor were they affected by the COVID-19 exposure or lockdown measures. This result emphasizes that in the case of Ghana, no supply-side factors, such as closed hospitals, nor demand-side factors, such as travel barriers, liquidity constraints, or fear of COVID-19 infections, led to barriers in the utilization of these two services. This result is on contrary to what was expected from studies from previous pandemics (Elston et al., 2017) or studies from other countries (e.g., in DRC Hategeka et al., 2021) but is in line with Arsenault et al. (2022), showing that interruptions of maternal health services considerably differ among countries.

Additionally, I show that the temporary decline in road accident treatments in April 2020 was affected by the limited movement restrictions in lockdown-affected districts and non-lockdown-affected districts with COVID-19 cases. As Asante & Mills (2020) discuss in their study, non-lockdown-affected districts with COVID-19 cases were also affected by the temporary closure of markets and/or special hygiene and social distancing policies for markets and traders, which both led to less economic and traffic activity. The results suggest that mobility restrictions, which limit road accident treatments, can be an effective measure to save health facility resources that are not used for road accident emergencies during a pandemic.

Finally, I find that in this set of analyzed essential health services, only diarrhea services for children below five years observed a substantial decline in utilization during the pandemic of -9% from 2019 to 2020. However, the decrease was much lower and benefitted from a faster recovery than expected by some studies (e.g., Roberton et al., 2020). I find

that the number of services had already caught up one year into the pandemic even though the country experienced further and more severe COVID-19 waves. The interruption of utilization was mainly affected by the stringency of policy measures, especially hygiene and social distancing measures. Therefore, the general adherence to the hygiene and social distancing measures probably affected health behavior in the longer term, indicating that improved hygiene and social-distancing measures led to lower incidences rather than the policy measures creating demand barriers. In particular, demand barriers, such as travel barriers, liquidity constraints, or patients preferring to go to neighboring districts to get the treatment seem not suitable due to the length of the effect and because no other essential services were interrupted. However, I cannot rule out a potential substitution effect with self-medication at the pharmacy. However, since Gómez-Pérez et al. (2022) find no effect on gastrointestinal diseases, I assume that health facility treatment for severe diarrheal diseases for children under five years might also be unlikely to be replaced with self-medication.

Overall, the results show that monthly COVID-19 cases are not correlated with the interruption of utilization. This finding is in line with other studies from HICs and LMICs (Arsenault et al., 2022); however, in contrast to the study on preventive and elective care in the US (Cantor et al., 2022) and child immunization in Bangladesh (Rabbani, 2021), which both show that COVID-19 exposure level significantly worsened the disruption of health services. For future epidemics, more evidence from countries is needed to better understand indirect health effects of government interventions.

The results have several important implications for public policy. In epidemic disease outbreaks, governments must assess the trade-off between implementing government interventions to curb the spread of the disease while minimizing their negative consequences, i.e., indirect health effects or economic declines. As Günther et al. (2022) recommend, effective short-term policy approaches in African countries are essential to avoid radical national measures. For Ghana, which implemented only a short and locally concentrated public lockdown, I indeed find no negative impact of the implemented government interventions for the analyzed health service—but a reduction in diarrhea diseases most likely due to the adherence to general hygiene and social-distancing measures and a reduction of road accident treatment most likely due to the adherence to mobility restrictions. These results highlight that the direct and indirect effects of government interventions are highly context-specific, depending on the cost-benefit trade-off of the interventions and the population's adherence to the implemented interventions.

The study has three main limitations. First, I only had access to a small set of health needs: maternal health services, gastrointestinal diseases, and emergency services. Depending on the country sample and the service types, effects can vary substantially (e.g., Arsenault et al., 2022). Therefore, the results cannot be generalized to all essential health services in Ghana or other countries with similar health services. Second, in the analysis, I cannot control for potential substitution effects of self-medication at pharmacies, as was documented in one study from Kenya (Gómez-Pérez et al., 2022). This limitation is only

relevant for one of the analyzed health services: diarrhea services for children below five years. Since Gómez-Pérez et al. (2022) only found this substitution effect for malaria and fever symptoms and not for gastrointestinal diseases, I assume gastrointestinal infections to be less likely to be compensated. Lastly, although administrative data from the DHIMS platform does not suffer from recall bias nor is it only gathered from a certain subgroup—as is the case for survey data (e.g., Tsafack Nanfosso & Tadadjeu, 2022) or claims data (e.g., Cantor et al., 2022)—it nevertheless does not capture detailed data about the patients or the services they received. Since I am analyzing the number of health services provided, I cannot draw any conclusions about the quality of the health services provided. Future research will be needed to explore the impact on the quality of care.

4.A Supplementary Figures and Tables

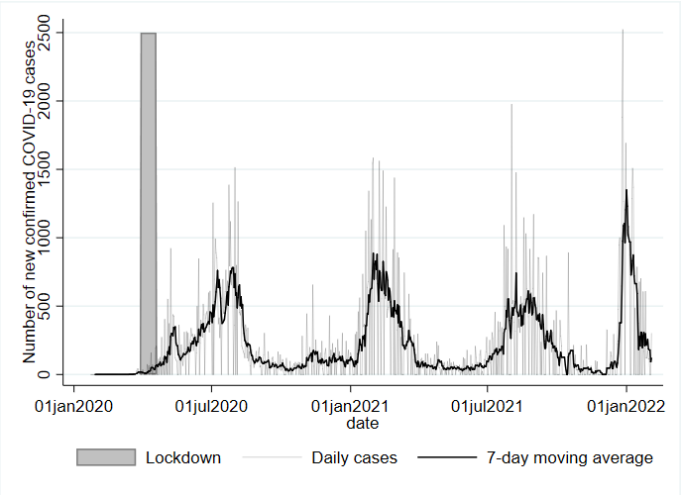

Fig. 4.A.1: Daily new confirmed COVID-19 cases in Ghana since January 1, 2020.
Notes: The seven-day moving average was calculated as the average of the daily number and the six lags. The gray shaded area indicates the period of the geographically concentrated public lockdown in Ghana (March 29 to April 19, 2020).
Source: JohnsHopkins (2022)—last updated February 8, 2022.

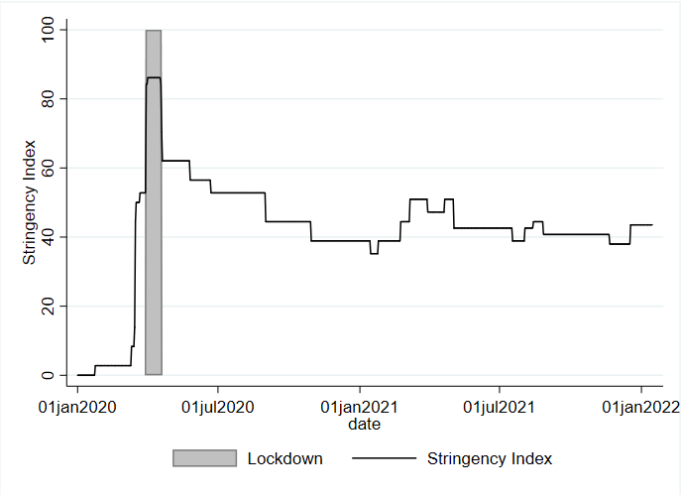

Fig. 4.A.2: Stringency index from Ghana since January 1, 2020.
Notes: The Government Response Stringency Index is a composite measure based on nine response indicators, including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest response). This index should not be interpreted as "scoring" the appropriateness or effectiveness of a country's response; it simply records the number and the strictness of government policies. The gray shaded area indicates the period of the geographically concentrated public lockdown in Ghana (March 29 to April 19, 2020).
Source: Hale et al. (2022)—last updated February 8, 2022.

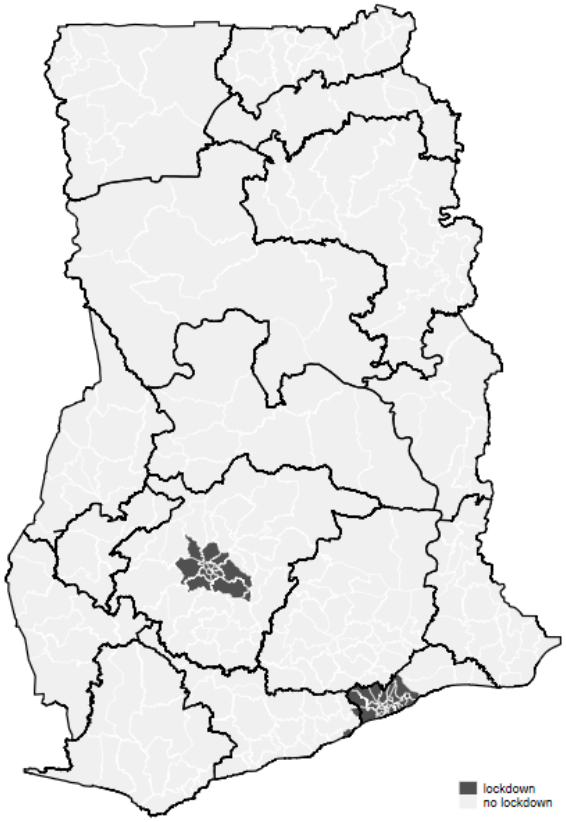

Fig. 4.A.3: Lockdown impact status of districts in Ghana.
Note: Out of the 260 districts in Ghana, 40 districts were under lockdown in April 2020 (dark gray areas) and 220 districts were not affected by the lockdown (light gray areas).

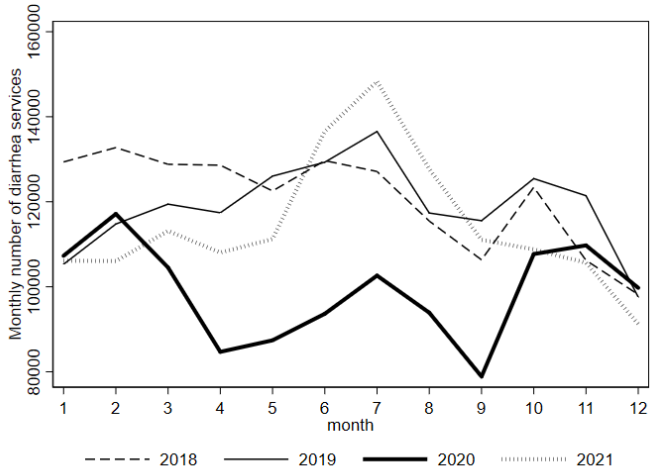

Fig. 4.A.4: Monthly number of diarrhea service utilization.
Note: Figure shows the unadjusted total number of diarrhea service utilization. Diarrhea only consist of children below 5 years.

Tab. 4.A.1: OLS regression of number of total monthly services for road accident treatments, January to May 2019 and 2020, only district type.

	Number of Road Accidents Treatments January (1)		Number of Road Accidents Treatments February (2)		Number of Accidents Treatments March (3)		Number of Road Accidents Treatments April (4)		Number of Road Accidents Treatments May (5)	
Year (ref. 2019)										
2020	2.833	[-20.41,26.07]	2.333	[-17.82,22.49]	-4.556	[-26.98,17.86]	-26.22***	[-43.92,-8.527]	-8.472	[-25.45,8.502]
District type (ref. lockdown district)										
Neighbor of lockdown district	-24.10*	[-48.23,0.0396]	-21.63**	[-39.74,-3.525]	-18.59*	[-38.89,1.714]	-22.95**	[-43.26,-2.642]	-25.50***	[-42.72,-8.285]
Other districts	-16.49	[-43.07,10.09]	-16.27	[-36.74,4.203]	-23.11**	[-42.47,-3.754]	-18.95*	[-39.21,1.306]	-19.84**	[-37.08,-2.600]
District type *Year										
Neighbor of lockdown districts # 2020	-0.346	[-25.61,24.91]	2.436	[-19.74,24.61]	-1.496	[-26.76,23.77]	20.81**	[0.939,40.69]	14.70	[-4.810,34.22]
Other districts # 2020	-5.169	[-30.88,20.55]	-2.768	[-25.03,19.50]	9.220	[-14.33,32.77]	25.24**	[5.662,44.82]	12.18	[-6.292,30.65]
Constant	57.91***	[33.94,81.87]	53.12***	[35.61,70.63]	58.10***	[39.31,76.88]	55.62***	[36.50,74.74]	54.82***	[38.54,71.11]
Health service level	X		X		X		X		X	
District control variables	X		X		X		X		X	
Observation	472		472		472		472		472	
R-squared	0.024		0.025		0.034		0.030		0.029	

Notes: District control variables contain of population density and poverty rates per district. Robust standard errors were used; 95% confidence interval in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Tab. 4.A.2: OLS regression of number of total monthly services for road accident treatments, January to May 2018 and 2019.

	Number of Road Accidents Treatments January		Number of Road Accidents Treatments February		Number of Accidents Treatments March		Number of Road Accidents Treatments April		Number of Road Accidents Treatments May	
	(1)		(2)		(3)		(4)		(5)	
Year (ref. 2019)										
2018	-1.500	[-25.09,22.09]	-5.944	[-26.09,14.20]	-7.472	[-28.70,13.75]	-9.694	[-31.32,11.93]	-3.056	[-23.61,17.50]
Lockdown and COVID-19 impact status										
(ref. lockdown district with COVID)										
Neighbor of lockdown districts with COVID cases	-21.89*	[-47.20,3.415]	-8.425	[-27.75,10.90]	-7.771	[-31.42,15.88]	-15.87	[-38.46,6.719]	-20.97**	[-41.21,-0.738]
Neighbor of lockdown districts without COVID cases	-11.20	[-36.59,14.20]	-13.81	[-33.14,5.524]	-14.19	[-36.11,7.724]	-20.15*	[-42.91,2.620]	-15.15	[-34.83,4.521]
Other districts with COVID cases	-6.770	[-31.83,18.29]	-6.286	[-25.08,12.51]	-11.37	[-33.14,10.40]	-4.664	[-31.70,22.37]	-1.544	[-22.63,19.54]
Other districts without COVID cases	-6.391	[-36.33,23.54]	-4.168	[-27.76,19.42]	-16.31	[-36.95,4.326]	-16.30	[-37.82,5.218]	-13.67	[-33.53,6.195]
Lockdown and COVID-19 impact status *Year										
Neighbor of lockdown districts with COVID cases # 2018	4.912	[-22.39,32.21]	1.062	[-23.36,25.48]	-3.292	[-32.29,25.71]	0.577	[-24.95,26.10]	10.06	[-16.68,36.80]
Neighbor of lockdown districts without COVID cases # 2018	2.409	[-26.88,31.70]	8.490	[-15.48,32.46]	8.199	[-19.16,35.56]	9.513	[-17.36,36.39]	0.101	[-23.57,23.78]
Other districts with COVID cases # 2018	20.11	[-11.97,52.20]	16.92	[-6.762,40.61]	20.65	[-5.527,46.83]	12.79	[-17.54,43.11]	7.965	[-18.02,33.95]
Other districts without COVID cases # 2018	4.312	[-26.65,35.27]	9.782	[-17.07,36.63]	17.31	[-8.282,42.90]	17.65	[-8.959,44.26]	12.94	[-13.56,39.45]
Constant	52.28***		44.75***	[26.95,62.55]	52.17***	[32.67,71.66]	52.72***	[32.08,73.35]	49.49***	[31.26,67.72]
District control variables	X		X		X		X		X	
Observation	472		472		472		472		472	
R-squared	0.021		0.016		0.025		0.020		0.021	

Notes: District control variables contain of population density and poverty rates per district. Robust standard errors were used; 95% confidence interval in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Tab. 4.A.3: OLS regression of number of total monthly services for births at a health facility, C-sections and diarrhea treatments, 2019 and 2020, only district type.

	Number of Births January-December (1)		Number of Births April (2)		Number of C-sections January-December (3)		Number of C-sections April (4)		Number of Diarrhea January-December (5)		Number of Diarrhea April (6)	
Year (ref. 2019)												
2020	-4.646	[-20.15,10.86]	-9.444	[-52.13,33.24]	7.701**	[0.721,14.68]	8.722	[-7.390,24.83]	-99.71***	[-126.6,-72.86]	-198.7***	[-286.1,-111.4]
District type (ref. lockdown district)												
Neighbor of lockdown districts	-10.26*	[-20.55,0.0366]	-12.69	[-42.48,17.09]	-1.542	[-5.624,2.539]	0.875	[-8.993,10.74]	20.13	[-4.034,44.30]	-7.058	[-84.59,70.47]
Other districts	-9.785*	[-19.86,0.285]	-17.42	[-46.57,11.73]	-2.566	[-6.665,1.534]	-1.248	[-10.48,7.981]	59.09***	[33.66,84.51]	13.97	[-81.08,109.0]
District types *Year												
Neighbor of lockdown # 2020	9.486	[-6.559,25.53]	13.98	[-30.42,58.38]	-5.629	[-12.84,1.578]	-5.338	[-22.61,11.93]	56.07***	[24.39,87.75]	128.2**	[27.85,228.6]
Other districts # 2020	11.65	[-4.023,27.32]	16.14	[-26.93,59.21]	-4.637	[-11.66,2.386]	-5.629	[-21.93,10.67]	10.56	[-19.57,40.70]	68.39	[-33.98,170.8]
Constant	-5.581	[-22.83,11.67]	30.05	[-20.18,80.29]	-0.111	[-6.383,6.161]	5.140	[-4.237,14.52]	73.59***	[42.40,104.8]	52.01	[-52.15,156.2]
Health service level	X		X		X		X		X		X	
District control variables	X		X		X		X		X		X	
Observation	5664		472		5664		472		5664		472	
R-squared	0.931		0.963		0.891		0.940		0.618		0.699	

Notes: District control variables contain of population density and poverty rates per district. Birth refers to births in a health facility. Diarrhea only consist of services for children below 5 years. Robust standard errors were used; 95% confidence interval in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Tab. 4.A.4: OLS regression of number of total monthly services for births at a health facility, C-sections and diarrhea treatments, 2018 and 2019.

	Number of Births January-December (1)		Number of Births April (2)		Number of C-sections January-December (3)		Number of C-sections April (4)		Number of Diarrhea January-December (5)		Number of Diarrhea April (6)	
Year (ref. 2019)												
2018	-9.635**	[-18.34,-0.933]	-7.496	[-40.61,25.62]	-1.839	[-4.257,0.579]	-0.974	[-9.816,7.868]	12.54	[-21.46,46.55]	50.21	[-103.7,204.1]
Lockdown and COVID-19 impact status												
(ref. lockdown district with COVID)												
Neighbor of lockdown districts with COVID cases	43.18***	[12.09,74.27]	67.22	[-41.47,175.9]	-1.490	[-11.83,8.849]	6.105	[-27.46,39.67]	-235.8***	[-279.7,-191.9]	-291.5***	[-487.3,-95.75]
Neighbor of lockdown districts without COVID cases	47.16***	[26.56,67.75]	58.10	[-20.01,136.2]	25.45***	[16.95,33.94]	27.56*	[-4.666,59.79]	-178.4***	[-215.9,-140.9]	-218.5***	[-379.6,-57.35]
Other districts with COVID cases	18.16*	[-2.182,38.50]	26.02	[-51.15,103.2]	10.61***	[3.250,17.98]	12.09	[-16.36,40.54]	-215.4***	[-248.6,-182.3]	-266.4***	[-394.1,-138.8]
Other districts without COVID cases	105.8***	[83.47,128.1]	120.7***	[36.37,205.0]	27.29***	[22.39,32.19]	30.72***	[11.99,49.46]	61.85***	[26.33,97.38]	10.37	[-136.3,157.0]
Lockdown and COVID-19 impact status *Year												
Neighbor of lockdown districts with COVID cases # 2018	23.10	[-22.51,68.70]	4.551	[-155.0,164.1]	4.260	[-11.08,19.60]	-0.637	[-47.65,46.37]	-24.07	[-87.29,39.16]	-8.241	[-283.4,266.9]
Neighbor of lockdown districts without COVID cases # 2018	-0.276	[-28.21,27.66]	-10.62	[-115.8,94.58]	-6.480	[-17.57,4.607]	-7.849	[-49.99,34.29]	-5.867	[-59.74,48.01]	-3.155	[-219.9,213.6]
Other districts with COVID cases # 2018	6.359	[-21.93,34.65]	3.496	[-106.6,113.6]	-1.165	[-10.99,8.665]	-4.435	[-42.73,33.86]	-33.74	[-81.34,13.85]	-0.668	[-178.9,177.5]
Other districts without COVID cases # 2018	1.484	[-29.59,32.56]	5.859	[-112.2,123.9]	0.0227	[-6.758,6.804]	1.679	[-24.49,27.85]	18.80	[-37.85,75.45]	0.559	[-215.3,216.4]
Constant	205.2***		244.1***	[204.9,283.2]	38.46***	[32.82,44.11]	45.65***	[34.10,57.20]	617.1***	[572.8,661.3]	705.3***	[541.8,868.8]
District control variables	X		X		X		X		X		X	
Observation	5664		472		5664		472		5664		472	
R-squared	0.166		0.166		0.256		0.263		0.073		0.062	

Notes: District control variables contain of population density and poverty rates per district. Birth refers to births in a health facility. Diarrhea only consist of services for children below 5 years. Robust standard errors were used; 95% confidence interval in parentheses; * p<0.05, ** p<0.01, *** p<0.001.

Chapter 5

Managing the COVID-19 pandemic: Evidence from urban poor in Ghana and South Africa

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Abstract: Without a vaccine, practicing social distancing and protective hygiene are the most effective measures to curb the spread of COVID-19. In order to understand how the urban poor mitigate their risk of infection, we conducted a survey with more than 1,400 poor households in two of the African cities with the most COVID-19 infections, Accra and Greater Johannesburg, early in the pandemic, during lockdowns of public life. We find that many of the urban poor already engage in the appropriate hygienic behavior and follow social distancing rules. However, despite citywide lockdowns, about 25-40% of people still report attending large gatherings, 10-20% report receiving guests at home, and 30-35% report leaving the house more than once per week. Lack of cooperation with governmental regulations seems to be more related to a lack of infrastructure or poverty rather than unwillingness to engage in behavioral change. Interestingly, even with the stricter lockdown in South Africa, people are at least equally likely to deviate from social distancing rules. Our results indicate that more South African respondents perceive their government's actions as too extreme and underestimate COVID-19 cases in their country. About half of the sample in both countries report knowing (mainly through TV) about current COVID-19 case numbers. Most participants know that coughing is a symptom, but only half mention fever and difficulty breathing, and very few people mention tiredness. Ghanaians seem to be somewhat better informed. While lack of information is an issue, misinformation appears to be limited. We conclude that a costly shutdown of public life is only effective—and might even be prevented—with a well-informed population, who perceives their government's actions as appropriate and who has access to the infrastructure required to follow WHO safety regulations.

Keywords: Covid-19, lockdown, mitigation measures, urban poor, South Africa, Ghana

JEL code: C31; I18; J18

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5.1 Introduction

Epidemics on the African continent are frequent: between 2016 and 2018, 87% of African countries experienced at least one epidemic (Talisuna et al., 2020). By February 2020, the novel Coronavirus, SARS-CoV-2, which leads to the disease COVID-19, had reached all African countries. Despite spreading at a slower speed than in other regions of the world—probably due to a mix of the early curfews instated by many African governments, a younger population, and lower connectivity in terms of air travel—COVID-19 and the measures to curb its spread will have a significant impact across the African continent, especially on the millions of poor people living in cities.

COVID-19 has already challenged many countries with well-financed healthcare systems, causing concern about what will happen in African countries. For example, the US and Switzerland have about 2.6 and 4.2 physicians per 1,000 people, respectively, compared to most African countries that have only 0.2 doctors and 1.2 hospital beds per 1,000 people. Countries like Chad have as little as 0.05 physicians per 1,000 people (WorldBank, 2021b). The deadly Ebola pandemic of 2014-2016 revealed how ill-prepared countries in West Africa were to handle such a crisis (Hoffman & Silverberg, 2018; Kapata et al., 2020).

Recognizing the limited capacity of medical services to handle a pandemic, most African governments imposed various lockdown measures to regulate public, and even elements of private, life to enforce social distancing early in the pandemic. The cost of such lockdowns, however, is highest for poor individuals, who are more likely to work in the informal economy and/or depend on a daily wage: for them, extreme physical-distancing regulations lead to an immediate loss of income. Recent studies on the impact of a shutdown of economic activities on low-income families consistently find that income and food consumption are reduced significantly (Aushian & Abuya, 2020; HSRC, 2020; Kesar et al., 2021; LeNestour et al., 2020; Malik et al., 2020; Rahman & Matin, 2020). Due to the extraordinarily high economic burden on the poor and following social unrest (Akinwotu & Asiedu, 2020; E. Egger et al., 2020; Ward, 2020) and police and military brutality (Lamb, 2020; Ngqakamba, 2020; Wemakor, 2020), African constituents have been pressuring their governments, who are relaxing restrictions (Giles & Mwai, 2020; Tih, 2020) despite rising daily case numbers.

Costly lockdowns of public life are only effective to curb the spread of a pandemic if a large percentage of the population fully cooperates with imposed regulations. Cooperation becomes even more important once lockdowns and other regulations are lifted, making a reduction of personal interactions and an increase in personal hygiene voluntary. Moreover, with widespread cooperation in place, drastic national restrictions, such as lengthy curfews, could even be avoided in the future. Until a vaccination is available for most, living with COVID-19 will require drastic behavioral changes and cooperation from a large share of the population.

In this paper, we analyze how the urban poor in Ghana and South Africa—two countries with currently some of the highest recorded COVID-19 numbers in sub-Saharan

Africa—experience and manage the COVID-19 crisis during citywide lockdowns. In particular, we study the behavior of the urban poor to mitigate their risk of infection early on in the pandemic and during national lockdowns. Moreover, we investigate people's knowledge and anxieties about COVID-19 (e.g., Lin et al., 2020; Oosterhoff & Palmer, 2020; Roy et al., 2020)[1], their trust in the government to take appropriate action to curb COVID-19 (e.g., Briscese et al., 2020; E. Egger et al., 2020; Painter & Qiu, 2020), and the costs of and/or barriers to social distancing and hygienic behavior they face (e.g., Baye, 2020; Wasdani & Prasad, 2020). These three factors should drive people's behavior during lockdowns and throughout the duration of the pandemic, in general.

We conducted structured phone surveys with people living in poor urban areas in the greater Johannesburg and Accra areas. Our study is unique in a number of important ways. Many other studies on the impact of COVID-19 and measures to contain it rely on randomly generated phone numbers (LeNestour et al., 2020) or sample using self-selection into online surveys (Fetzer et al., 2020; Oosterhoff & Palmer, 2020; Roy et al., 2020; Wise et al., 2020). The advantage of our sample is that we already knew the socio-demographic characteristics before the survey and, therefore, could specifically choose poor urban settlements where social distancing is hardest and the risk of COVID-19 spreading is highest. Indeed, by the end of May 2020, the study areas we selected were some of the most affected regions in their respective countries (Cowan, 2020; Salaudeen, 2020). In addition, the sample was randomly drawn from a representative sample within these areas.[2] Lastly, we personally interviewed the households on the phone and were, therefore, able to ask a longer set of questions, which is not feasible with online surveys and computer-assisted telephone interviewing, allowing us to cover various dimensions of people's lives.

Our major findings are that despite many similarities between the urban poor populations around Accra and Johannesburg, the impact of curfews on these societies differs significantly: most Ghanaians are affected by the loss of income and increasing food prices, while many South Africans fear getting sick and are very anxious about the future. We also find that people in Accra and Johannesburg did not follow all governmental regulations during the citywide lockdowns. Our results indicate that the challenge is more the ability (because of lack of space and infrastructure) than the willingness of the population to cooperate with behavioral change. Interestingly, the stricter lockdown measures in South Africa in comparison to Ghana do not lead to fewer social interactions or increased hygienic measures. Our results suggest that the reason might be that the urban poor in Ghana are slightly better informed about COVID-19 and consider governmental policies to be more appropriate. In Ghana, however, few people could keep a one-meter distance to others in their daily life because the majority rely on public transportation and shared toilets.

[1]For example, Lin et al. (2020) found in a study of 21 countries, that higher levels of health literacy is associated with a lower spread of COVID-19: higher searches on Google of the terms "hand washing" and "face mask" were correlated with a slower spread of virus.

[2]The only source of bias occurs due to respondent not picking up the phone and respondents not wanting to participate. However, both sources were very low in our sample.

The results of this study should support national and international organizations in fostering safer health behavior in poor and densely populated neighborhoods.

5.2 Context for Ghana and South Africa

On February 14, 2020, the first confirmed case of COVID-19 in Africa was diagnosed in Egypt. Two weeks later, the first case in a sub-Saharan African country was identified in Nigeria. Since then, the number has increased to 614,412 confirmed cases in Africa (July 13, 2020; JohnsHopkins, 2022). South Africa and Ghana, both middle-income countries, are the sub-Saharan African countries with the highest (287,796) and third-highest (24,988) number of confirmed cases, respectively (July 13, 2020; JohnsHopkins, 2022). In both countries, most of the cases occur in major cities, such as Cape Town and Johannesburg or Accra and Kumasi. Although the number of reported cases is highly influenced by testing rates, South Africa and Ghana have some of the highest testing rates in sub-Saharan Africa, with 36,312 and 10,563 tests per million people, respectively. These testing rates are still relatively low compared to rates in Europe; for example, Switzerland has tested 79,286 per million people (July 13, 2020; Worldometer, 2020).

Figure 5.2.1 shows the development of confirmed COVID-19 cases for South Africa and Ghana with the trajectories from the United States and Switzerland for comparison. In order to compare across countries, the x-axis indicates the days after the 100^{th} confirmed case, which was on March 26 in Ghana, March 19 in South Africa, March 5 in Switzerland, and March 3 in the United States. Case numbers are still rising in Ghana and South Africa, despite early strict curfews in both countries, which lasted three weeks in Ghana and more than ten weeks in South Africa.

Similar to many other countries in sub-Saharan Africa, but in contrast to Europe and the US, both Ghana and South Africa implemented several governmental regulations to reduce contact between people even before the 100^{th} confirmed case, including closing schools and universities, closing certain borders, and banning large gatherings. Thereafter, the respective governments chose different approaches. South Africa implemented a lengthy nation-wide lockdown that has been in place since March 27, 2020. Although some regulations were lifted after ten weeks, the lockdown is still ongoing at the time of writing. From March 30, 2020, Ghana opted for a lockdown around the most affected cities only (Accra and Kumasi), which was lifted three weeks later on April 20, 2020, due to fears about the worsening economic situation of the population (Akinwotu & Asiedu, 2020).

During our survey end of April and beginning of May 2020, South Africa had one of the strictest lockdowns in the world (see Figure 5.2.2). The most stringent level, "Level Five," was implemented from March 27 to April 30, 2020. During Level Five, only essential services were allowed to stay open: food production and retail, electricity generation, and medical and emergency services. In addition, all outdoor activities and the sale of alcohol and cigarettes were prohibited. On May 1, 2020, South Africa transitioned

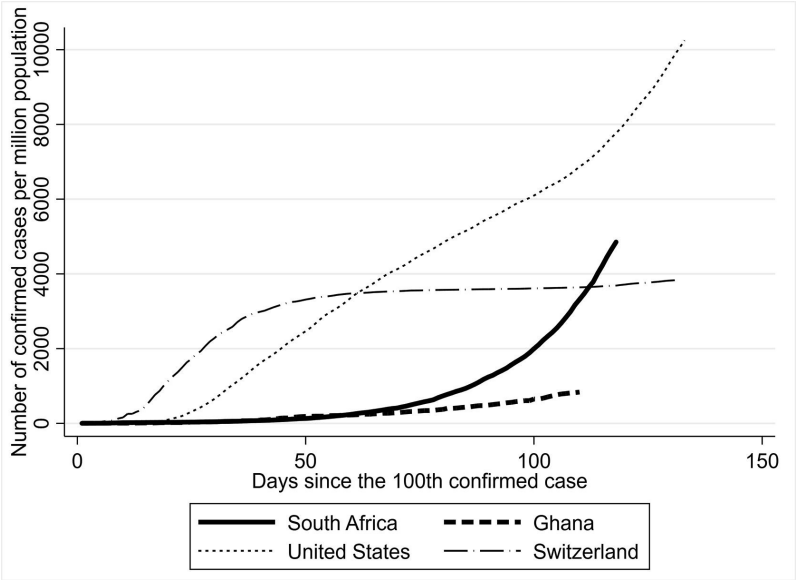

Fig. 5.2.1: Number of total confirmed COVID-19 cases in South Africa and Ghana.
Notes: First day since the 100th confirmed case is March 26 for Ghana, March 19 for South Africa, March 5 for Switzerland, and March 3 for the United States.
Source: GHS (2020c); JohnsHopkins (2022); Mervosh et al. (2020); WHO (2020i)—last update July 13, 2020.

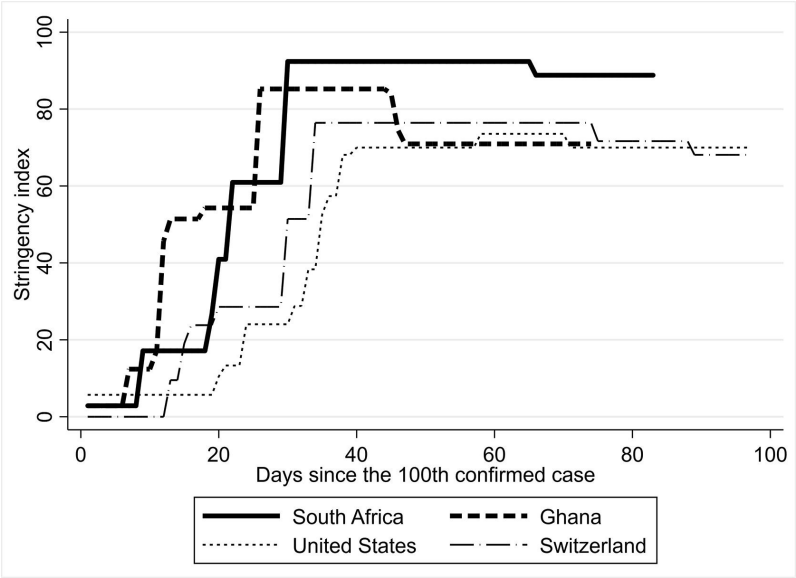

Fig. 5.2.2: Stringency index from South Africa and Ghana.
Notes: The Government Response Stringency Index is a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest response). This index should not be interpreted as "scoring" the appropriateness or effectiveness of a county's response; it simply records the number and the strictness of government policies. The 100th confirmed case was on March 26 in Ghana, March 19 in South Africa, March 5 in Switzerland, and March 3 in the United States.
Source: Hale et al. (2022)—last update July 13, 2020.

to "Level Four," in which additional services were allowed to open up, such as work in forestry, certain manufacturing sectors such as cement and automotive, certain civil engineering projects, sale of cooked food, sale of educational books, all social work, and counseling. Social gatherings were still prohibited during "Level Four". Some outdoor exercise was permitted, but only between 6:00 am and 9:00 am. Since the number of allowable activities increased during Level Four, masks were made mandatory. "Level Three" was implemented beginning June 1, 2020, which allowed some domestic travel between provinces, funerals and religious gatherings of fewer than 50 people, the opening of restaurants to sell meals not consumed on the premises, and, initially, the sale of alcohol, though this was later prohibited again (SACoronavirus, 2020).

In Ghana, between March 30 and April 20, 2020, only essential services were allowed to open in Accra and Kumasi, such as food retailers, utility (electricity and water) distributors and retailers, pharmacies, and medical services. For many informal market places, a rotational system for vendors was put in place to prevent overcrowding. After agitations over worsening economic conditions in the country, particularly for the poor, whose main economic activities are in the informal marketplaces, the government ended the lockdown. However, many public social distancing measures remained in place: schools, churches, and mosques stayed closed, bars and restaurants were encouraged to do deliveries rather than allow customers to sit at their premises, and funerals, weddings and other social gathering were limited to 25 persons. Moreover, on April 25, wearing face masks in public was made mandatory in Accra in order to prevent the spread of the virus after lifting the lockdown (GHS, 2020c). On May 10, the President of Ghana extended the ban on social gatherings until May 31 to contain the increasing number of infections. Under the directive, religious activities, festivals, schools, weddings, funerals, parties, and the country's borders remained closed. However, on the next day, the government of Ghana gave hotels, bars and restaurants permission to reopen under enhanced social distancing procedures. On June 5, restrictions on religious activities were eased, with churches and mosques allowed a maximum attendance of 100 persons.

5.3 Data and methodology

5.3.1 Sampling procedure and survey tool

We conducted a fully structured phone survey with 1,443 randomly selected households living in 18 urban settlements in the Greater Accra region in Ghana[3] and in two urban low-income settlements east of the city of Johannesburg. A map showing the location of the settlements can be found in Figures 5.A.1 and 5.A.2 in the Appendix. We obtained ethical clearance for both the South African and Ghanaian studies (available from the authors upon request). Enumerators in South Africa and Ghana were trained by one of

[3]Abeka, Ablekuma, Accra New Town, Alajo, Ashaiman, Chorkor, Gbegbeyise, Jamestown, Kokomlemle, Kotobabi, La, Maamobi, Madina, Mamprobi, Nima, Pig Farm, Sabon Zongo, Ussher Town.

the co-authors via phone.

The sample in South Africa was drawn from a database that had been aggregated as part of a 2013 study that was conducted with 3,000 randomly selected households out of about 80,000 households in two poor urban settlements, Etwatwa and Daveyton.[4] The telephone numbers of more than 2,000 households were randomly drawn from these 3,000 households, of which 1,398 were called by four enumerators during Levels Five and Four of the lockdown, from April 16 to May 9, 2020 (days 20-43 after the 100th confirmed case, as shown in Figures 5.2.1 and 5.2.2). Of the calls that were placed, 31% were directly answered, 15% of the numbers were invalid, 10% of the calls rang without answer, and 44% were answered by voicemail. Some of the unsuccessful call recipients were contacted again, of which an additional 80 calls were answered. Of the calls that were answered, 20% did not want to take part in the phone survey. In total, enumerators completed 409 surveys.[5]

In Ghana, the Ghana Statistical Service (GSS) provided us with a representative sample of the 18 low-income settlements in the Greater Accra region, which was drawn from the most recent Ghana Living Standard Survey (GLSS7) carried out in 2017. From a total of 15,679 phone numbers, 2,260 households, stratified at and proportional to the settlement-level, were randomly drawn. The phone surveys were administered by 16 enumerators who called these numbers during Accra's lockdown from April 23-29, 2020 (day 31-37 after the 100th confirmed case, as shown in Figures 5.2.1 and 5.2.2). If the respondent did not pick up the phone, enumerators called back once more at a different time of the day (either morning or afternoon). Of the 2,260 numbers, 3% were not valid, 20% were unanswered, 22% were a wrong number, 5% belonged to a respondent who did not want to participate in the survey, and 3% belonged to a respondent who had moved to another neighborhood not affected by the lockdown. One respondent was younger than 18 and two respondents did not want to complete the questionnaire, so these interviews were stopped. In total, 1,034 households answered the survey.

The survey took on average 19 minutes in Ghana and 17 minutes in South Africa and contained 84 questions in Ghana and 68 questions in South Africa. Of all the questions, 66 are identical for Ghana and South Africa, which allows for comparison across most questions. The questionnaire is available on request.

5.3.2 Sample description

In Ghana, proportionally fewer females are included in the sample (37%) because the GLSS7 includes the phone numbers of the household head, which is a man in most of the cases. In contrast, the sample from South Africa includes 75% female respondents (see Table 5.3.1), probably because women were more likely to be at home when the households were visited in person for the first time in 2013. Despite the difference in males and females

[4]If there was nobody at a specific house, fieldworkers visited their neighbours on the right and then on their left until a respondent was found.

[5]In addition, we called 509 rural households which are not included in this analysis.

Tab. 5.3.1: Household characteristics of the sample from South Africa and Ghana.

	South Africa	Ghana
Female	75%	37%
Age (average in years)	40-49 years	40-49 years
Household members	5.2	5.3
Number of rooms	4.5	2.4
Average number of rooms per person	1.0	0.6
Shared water source with other households	3%	13%
Shared toilet with other households	8%	66%
Education		
No education level completed	20%	9%
Primary education completed only	44%	9%
Secondary education completed only	29%	74%
Tertiary education completed	7%	8%
Working Status		
Unemployed	57%	4%
Self-employed	4%	44%
Employed without contract	6%	24%
Employed with contract	12%	22%
Other working status	20%	6%
Do not want to say	1%	0%
Main source of income for the household		
Salary from work	21%	23%
Own business	5%	58%
National grants	64%	5%
Support from family members	11%	20%
Other source of income	7%	9%

Notes: Number of household members were specified up to 11 people—more than 11 are counted as 12 for the average calculation. Number of rooms were specified up to 10 rooms—more than 10 are counted as 11 for the average calculation. Working status and main source of income refer to the period before the lockdown. Other working status includes Housewife/homemaker, retired person/pensioner, school pupil/full-time student, unable to work due to disability, and unemployed not looking for a job. For the household's main sources of income, the respondents could mention several sources. National grants include child support grants, old-age pensions, and disability grants.

between the two countries, results are not driven by gender, except when otherwise stated (additional sub-group analyses are available from the authors upon request).

Both urban samples are very poor (see Table 5.3.1). In South Africa, the larger municipality, Ekurhuleni, which encompasses both settlements, is one of three municipalities with the highest estimated number of people living in poverty in the country. Moreover, both settlements have an even higher percentage of people receiving no income and a higher percentage of people living in informal dwellings than the average in Ekurhuleni (StatsSA, 2020). The 18 settlements interviewed in Ghana are the poorest areas in Greater Accra according to the Ghana Statistical Service.

About 9% in Ghana and 20% in South Africa have not completed primary education (Table 5.3.1). In the South African sample, unemployment (57%) is much higher than

in Ghana (4%), however, employment in South Africa is more formalized; two-thirds of the employed respondents have a contract, compared to less than half of the employed in Ghana (Table 5.3.1). Most Ghanaians in our sample are either self-employed or work without a contract.

In South Africa, before the lockdown, the main sources of household income were child grants (49%) or pensions (21%). Income from own business activities or wage income only played a minor role. In Ghana, due to the high rate of self-employment, income from own businesses is the main income source for most households (58%), followed by salary from work (23%), and financial support from a family member (20%). Less than 5% of the respondents receive a grant from the government.

5.4 Results

5.4.1 Impact of COVID-19 pandemic on people's life

Various studies have pointed out the severe, direct economic impacts of lockdowns of public life on the global poor (Aushian & Abuya, 2020; BRAC, 2020; HSRC, 2020; Kesar et al., 2021; LeNestour et al., 2020; Malik et al., 2020; Rahman & Matin, 2020; Sumner et al., 2020). However, few studies in low-income settings analyze the impact of lockdowns on other dimensions of well-being, such as schooling of children, health concerns, and emotional stress, which can, in turn, be triggered by direct income loss, anxieties about future income, reduced social interaction, and isolation at home. Initial studies from high-income countries show that mental health is becoming a serious problem (Fetzer et al., 2020). Anxieties related to potential infection might be especially problematic in South Africa, where many people suffer from HIV/AIDS and could fear increased rates of domestic violence resulting from lockdowns (Joska et al., 2020). In addition, the trauma caused by recent Ebola outbreaks in West Africa could increase anxiety and fear about the COVID-19 pandemic in Ghana (Leach, 2020).

To better understand the impact of the pandemic on the urban poor, we first asked an open question about how the pandemic is currently affecting the respondent the most (see Figure 5.4.1). Despite many similarities—both samples studied are from poor urban neighborhoods under strict curfews in middle-income African countries—the reported experiences are quite different. In South Africa, women mention fear of getting sick (35%) and children being home (31%) most often and men mention unemployment (39%) and children being home (21%) most often.[6] In Ghana, meanwhile, no income (45%) and increased prices (41%) stand out for both men and women. The leading single source of income for the urban poor in South Africa are grants from the government (see Table 5.3.1), which have been largely unaffected by the virus. Almost all grant-receiving South African respondents say they can still collect their previous grant as usual during national lockdowns. In this regard, South Africa already has a system in place to disperse income

[6]Figure 5.4.1 shows average values.

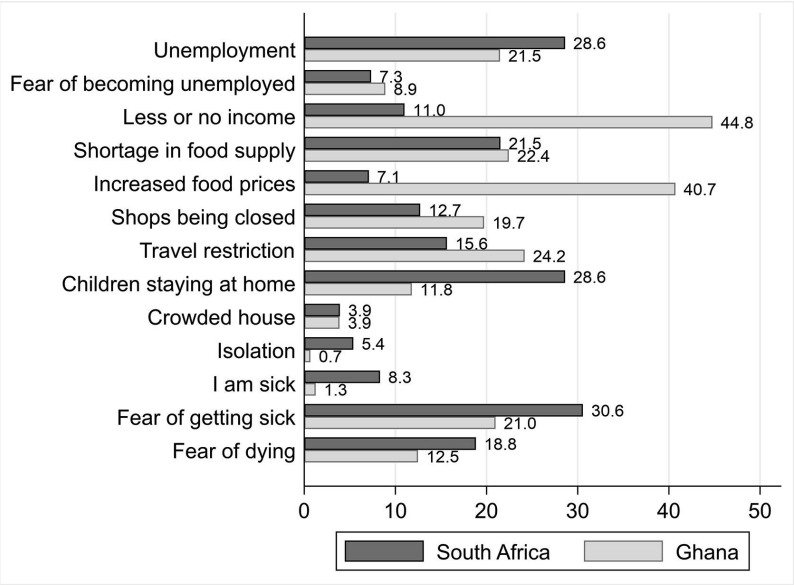

Fig. 5.4.1: Factors affecting people the most in sample from South Africa and Ghana.
Notes: Question "Name three ways how the Coronavirus crisis is affecting you personally at the moment?"

to those in need—including during a national lockdown. In contrast, 67% of self-employed workers in South Africa and 86% of self-employed workers in Ghana had to close their businesses during citywide lockdowns and did not obtain any income. Isolation is mentioned by less than 6% of people in South Africa and only 1% in Ghana, which is identified as a major health risk in various studies in high-income countries, such as the United Kingdom (Mahase, 2020; Armitage & Nellums, 2020). Of all Ghanaians, 39% report that a specific item was not affordable because of an increase in price. In particular, respondents say that they cannot afford basic foods such as beans, cassava, or jam (33%), vegetables (23%), and fruits (9%). Increased prices are less of a problem in South Africa than lack of food item (see Figure 5.4.1): of all respondents in our South African sample, 22% report that certain items, such as bread and maize porridge, were not available for purchase the last time they went shopping.

In addition, we also ask respondents directly to what extent they are anxious about the health of their families, reduced mobility, lower income, and food, and to what extent they generally feel depressed. In general, anxiety seems to be high in both countries, but higher in our South African sample. In both countries, people are more anxious about their future income than about their health and/or reduced mobility. Of the sample in South Africa, 60% worry about not getting enough food in the future, while 32% of the sample in Ghana shares this worry. Serious worries about lower incomes rank even higher, with 67% in South Africa and 48% in Ghana (Table 5.4.1). In South Africa, 51% of the sample say they worry about the health of their families, while in Ghana, 37% of the sample say they have this worry, which is similar to India where 38% of people report serious stress due to fear of infection (Roy et al., 2020). About 70% of South Africans and 35% of Ghanaians

Tab. 5.4.1: Emotional well-being in sample from South Africa and Ghana.

	South Africa Strongly	Ghana Strongly
I am worried about lower income of my household	67%	48%
I am worried about not getting enough food in the future	60%	32%
I am worried about the health of my family	51%	37%
I am worried about my health	45%	34%
I feel stressed when leaving the house	34%	24%
I am afraid of someone I am sharing my house with	8%	26%
I feel down, depressed, hopeless (somewhat and strongly)	51%	37%

Notes: Question, "To which extent do the following statements apply to you right now?" Respondents could choose from the scale "Does not apply at all", "Somewhat does not apply", "Neither apply or does not apply", "Somewhat applies", "Strongly applies", "Do not know/Do not want to say".

say they pray on a daily basis to stay healthy. Only 34% of South Africans and 24% of Ghanaians say they are stressed when they leave their homes. In South Africa, 51%, and in Ghana, 37% of the urban poor feel somewhat or strongly down and depressed. In comparison, a study in India reveals that 65% of the urban poor feel depressed (Afridi et al., 2020). Hence, the pandemic not only affects the urban poor's economic situation, but also has a severe impact on their mental well-being, which deserves more attention in future research.

Finally, children being home are mentioned in both Ghana (12%) and South Africa (29%) as one of the major impacts of COVID-19. This finding is expected, since 64% of South Africans and 52% of Ghanaians mention that they have school-age children at home, which is high compared to about 30% of households in the US and Switzerland (BFS, 2017; Kidsdata, 2020). What is even more worrying is that in South Africa 37% of the school children (age 7-15) had not been reading or studying the day before, compared to 17% in Ghana. The children who studied or read the previous day did so for only 60 minutes on average in South Africa and for 90 minutes on average in Ghana. In addition, 71% of South African children and 46% of Ghanaian children in our sample used to receive food at school, which they no longer receive since the schools closed. In South Africa, schools are slowly starting to reopen; critical grades, such as the final years of primary and secondary school, resumed classes on June 1, 2020. Many schools are open at half capacity only, with pupils divided into two groups, each group only attending school on alternating days or weeks. In Ghana, only final year students from the Senior High School (SHS) and Junior High School (JHS) resumed school in preparation for their exit examinations on June 22 and June 29, 2020, respectively. Despite the safety measures instituted by the Ministry of Education (MOE), some students have contracted the virus at school and some parents are threatening to withdraw their children from school.

Even if respondents in South Africa and Ghana have, thus far, experienced the pandemic differently, our results indicate that stringent national lockdowns have a substantial

impact on the economic lives and mental well-being of almost all study participants and threaten the future prospects of children. The question remains how effective these lockdowns are at motivating people to make the necessary behavioral changes needed to contain the spread of the virus—and how these behavioral changes can be maintained after the lockdowns are lifted. We address these questions in the following sections.

5.4.2 Behavior of the population during the lockdown

According to current medical advice and as communicated by the WHO and most national governments, the most effective measures to reduce the transmission of COVID-19 are to follow preventive hygienic measures and to keep a safe distance from other people. Hygienic measures include washing hands regularly with soap or alcoholic disinfectants, wearing a face mask, avoiding shaking hands, and not touching surfaces in public. Keeping a safe distance, the reason why drastic lockdowns were put in place, includes avoiding crowded places, such as large gatherings and public transport, keeping one-meter distance from others where possible, and staying home, if possible. To understand how many of these measures people implemented when South Africa's national lockdown and Accra's citywide lockdown were in place, we ask each participant whether he or she had practiced the following key preventative actions on a daily basis over the last seven days[7]:

Hygienic measures:

1. always washes hands with soap or alcoholic disinfectants;
2. always wears a face mask when leaving the house;
3. avoids shaking hands;
4. avoids touching surfaces in public;

Social distancing measures:

5. does not receive guests;
6. does not visit others;
7. does not leave the house more than once per week;
8. never attends large gatherings, such as churches and market places;
9. avoids public transport (only asked in Ghana);
10. tries to keep a one-meter distance between her/him and other people (only asked in Ghana)

For both countries, the most common preventative measure is always washing hands with soap (or alcoholic disinfectants), followed by avoiding private meetings at home and shaking hands—measures that households can implement at no or very low financial cost. Nevertheless, 17% of the urban poor in South Africa and 12% in Ghana report that they do not always wash their hands with soap (Figure 5.4.2). In South Africa and Ghana, 3% and 1% report that they do not even have soap at home. We also ask, in an open question, if anything was not available in the shops that they wanted to buy during the previous week: in South Africa, 3.5% of respondents mention that hand sanitizer or soap

[7]Question asked was "Which of the following statements reflects your daily behavior over the past seven days?"

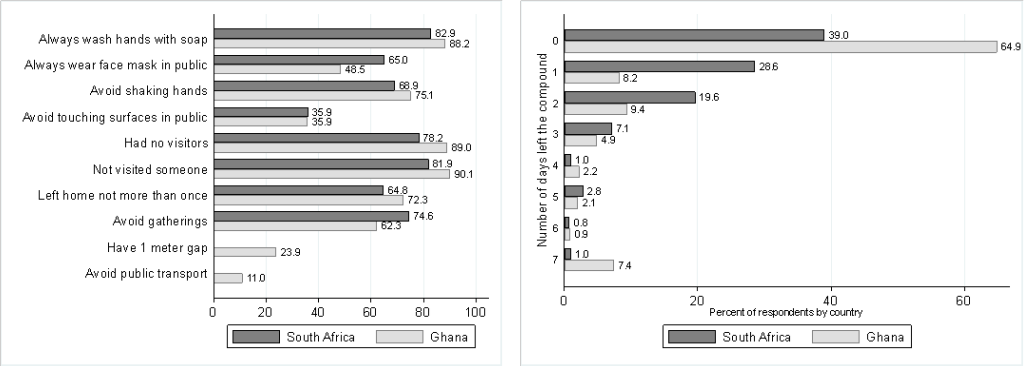

Fig. 5.4.2: Individuals' behavior in the last seven days in the sample from South Africa and Ghana.
Note: The left figure shows results from the question "Which of the following statements reflect your daily behavior over the past 7 days?" For South Africa, the two categories "one meter gap" and "avoid public transport" are not available. The right figure shows responses to the question "How many days in the last week were you outside your compound?".

were not available, compared to only four respondents (0.4%) in Ghana. Moreover, 18% of the respondents in South Africa and 44% in Ghana report that their usual water source had been disrupted at least once during the previous week. Affordability was not an issue in Ghana at the time of the survey because the Ghanaian government made piped water to residences free for three months (April-June 2020).

About 50% of the sample in Accra and Johannesburg already wore a mask in public on a daily basis even before it was made mandatory by the governments. Wearing face masks was made mandatory during the time we were conducting the survey in South Africa (all South Africans were expected to wear masks from May 1, 2020), which had a significant impact on reported usage: average reported usage increased from 56% to 72% in South Africa (Figure 5.4.2 shows the average reported usage for the entire study period). Wearing a face mask was only made mandatory in Ghana after the study period, on June 14, 2020 (Presidency, 2020a). Although only half of the Ghanaian respondents mention that they always wore a face mask in public within the last seven days, 81% state that they already own a face mask. They report that the average cost for a mask is around 3.7 GHS (0.60 US$). The main reasons why the remaining 19% of people in Ghana do not own a face mask are inconvenience (33%), inability to get one (24%), do not know (14%), or too expensive (13%). Only a few respondents mention no need (2%) or answer "do not want to say" (2%).

South African respondents are more likely than Ghanaians to have visited someone outside their house during the last week (18% vs. 10%), and more likely to have received guests at their own home (22% vs. 11%) (Figure 5.4.2). Note that visiting others and receiving guests were not allowed under the curfews put in place in both Ghana and South Africa. Moreover, even if 39% of the South Africans and 65% of the Ghanaians report that they were never outside of their compound or yard during the last week, about a third of the urban poor in our sample in Johannesburg and Accra report leaving their homes

more than once during that period (Figure 5.4.2). Households in both Johannesburg and Accra were officially only allowed to leave their compounds for essential services: food and medicine. Even more worrying, 25% of respondents in South Africa, and 38% of respondents in Ghana report that they did not avoid large gatherings during lockdowns. Only a minority report that they were able to maintain a safe distance of one meter from other people when leaving the house (24%) or avoiding public transport (11%) (data only available for Ghana). The major obstacles to following social distancing guidelines (open question later in the survey) that people report are that they need to take public transport (29%), they have shared toilet facilities with other households (23%), they cannot afford to lose income (17%), or they live in a crowded or single-room home (17%, see Table 5.3.1). Indeed, sharing toilet facilities is a major problem in poor urban neighborhoods in Ghana. Only 34% of households have their own toilet; more than 30% of the households share a toilet with more than nine other households.

Respondents follow around 2.5 out of the four hygienic measures, three out of the four social distancing measures, and 5.5 out of all eight measures in both South Africa and Ghana (Figure 5.4.3). Hence, cooperation or compliance with governmental regulations is equally high in both countries, despite much stricter governmental regulations in South Africa. However, the standard deviation of measured compliance is larger in South Africa than in Ghana. This becomes apparent in Figure 5.4.3, which shows that most Ghanaians adopt five to six protective measures, whereas the range of the total number of measures taken is wider among the urban poor in South Africa. Interestingly, a simple correlation matrix of different measures in Table 5.A.1 in the Appendix indicates that while hygienic and social distancing measures are perceived as (weak) complements in South Africa, they are perceived or executed as (weak) substitutes in Ghana. In Ghana, individual hygienic measures are weakly negatively correlated with the total number of social distancing measures taken. This result could also indicate that individuals for whom it is very difficult to comply with social distancing (for example, those working in an informal job, living in crowded housing, or sharing sanitation) engage more in preventive hygienic measures (see Table 5.4.2).

5.4.3 Knowledge of COVID-19 early into the pandemic

For an individual to take the correct actions to mitigate the risk of COVID-19 infection (see Section 5.4.2), they need access to accurate and reliable information. Given the novelty of COVID-19, there is still uncertainty in the scientific community about the pathways of infection, symptoms, and protective measures against the virus, fueling opportunities to spread misinformation (DeWitte, 2020; Wanga et al., 2020; WHO, 2020g). Therefore, organizations such as the WHO, national governments, and NGOs have tried to curb the spread of misinformation about the virus. Almost all people in Ghana (99.8%) and South Africa (96%) have heard of the Coronavirus. To get an indication about lack of information or even misinformation among the urban poor, we ask the respondents in both samples how many people in their country have tested positive for COVID-19 on

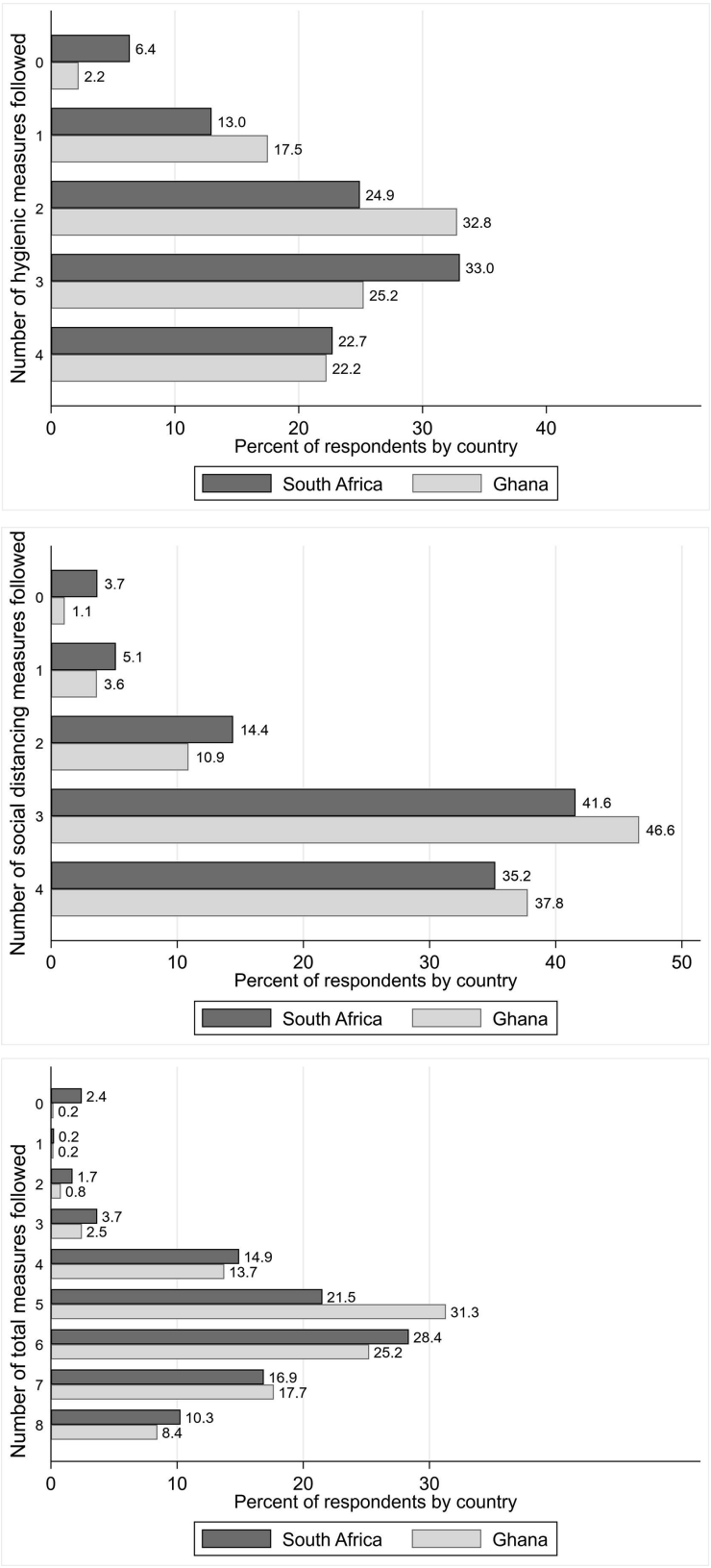

Fig. 5.4.3: Number of hygienic and social distancing measures followed.
Notes: Hygienic measures include: always wear face mask in public, always wash hands with soap, avoid shaking hands, avoid touching surfaces. Social distancing measures include: no visitors, do not visit someone, only leave home for food, avoid large gatherings.

the specific day they were interviewed. In Ghana, 48% of respondents and 41% in South Africa estimate the answer within 20% of the official number of cases recorded on the corresponding day, which was between 1,279 and 2,074 in Ghana[8] and between 2,506 and 9,420 in South Africa.[9] About 25% of the participants in both countries said they do not know the answer and are hence uninformed. The remaining 28% in Ghana and 35% in South Africa, who did not give an answer within 20% of the actual rate, can be classified as misinformed. As shown in Figure 5.4.4, people are more likely to underestimate than overestimate the number of COVID-19 cases in their country. For Ghana, we additionally ask respondents about the COVID-19 case fatality rate. Only 49% of the total sample are able to give any answer, but almost everyone (97%) that indicated they knew the answer, answers within 10% of the official number (0.8%). The other 2% extremely overestimate the likelihood of dying by estimating case fatality rates higher than 10%.

The WHO lists fever, tiredness, and dry cough as the most common symptoms and difficulty breathing as a serious symptom (WHO, 2020b). Less common symptoms include aches and pains, loss of taste or smell, nasal congestion, runny nose, sore throat, headache and diarrhea. The South African Health Department lists coughing, fever, shortness of breath and sore throat as the core symptoms (DoH, 2020). The core symptoms communicated by the official Ghana Health Service include coughing, fever, headache, sore throat, and runny nose (GHS, 2020c). We ask respondents an open question to name the symptoms of COVID-19. On average, respondents from both countries mention around three of the 10-15 symptoms recognized by the WHO. Coughing is mentioned most often (by about 4 out of 5 people), followed by fever and difficulty breathing (by about 1 in 2), and sore throat (by about 1 in 3) (Figure 5.4.5). In general, people in Accra are able to mention more common symptoms than people in Johannesburg (Figure 5.4.5). About 5% of South Africans and Ghanaians mention none of the core symptoms. The WHO recommends seeking medical attention when experiencing difficulty breathing. Although the South African Health Department communicated this as a core symptom to the public and the Ghana Health Services did not, South Africans are less likely to mention it than Ghanaians.

When asked to report what they would do if they experience symptoms, 69% in Ghana say they would go to the clinic right away (which they should not), 39% would call the toll-free hotline (as recommended by the Ghana Health Service), 13% would call a doctor, 13% would get tested, 10% would pray, and 8% would stay at home (multiple answers possible, not asked in South Africa). None of the respondents mention that they would drink alcohol in case they feel light symptoms, which is a misperception identified by the WHO (2020g). Only 0.5% of the respondents say that they would not tell anybody that they feel symptoms.

Lastly, we also ask where the urban poor get their information, in order to find ways to improve information flows from science and policy to the public (see Figure 5.4.6). In line

[8]From April 23 - 30, 2020.

[9]From April 16 to May 09, 2020.

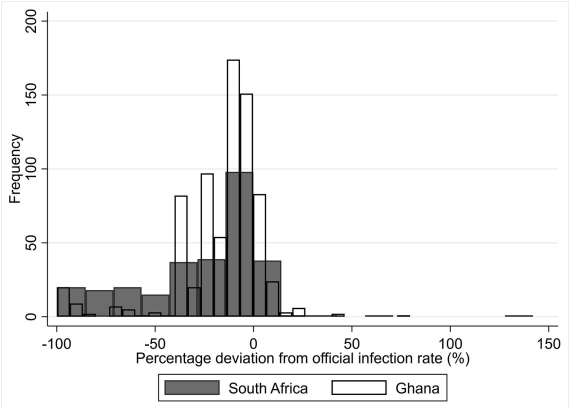

Fig. 5.4.4: Estimated infection rates of COVID-19 in Ghana and South Africa.
Note: The percentage deviation from the daily official infection rate is shown excluding outliers >150%.

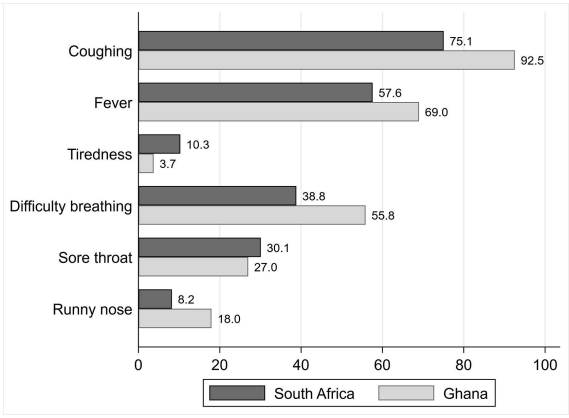

Fig. 5.4.5: Symptoms of COVID-19 in sample from South Africa and Ghana.
Note: Question, "What are the symptoms of Coronavirus?" Respondents could answer multiple symptoms.

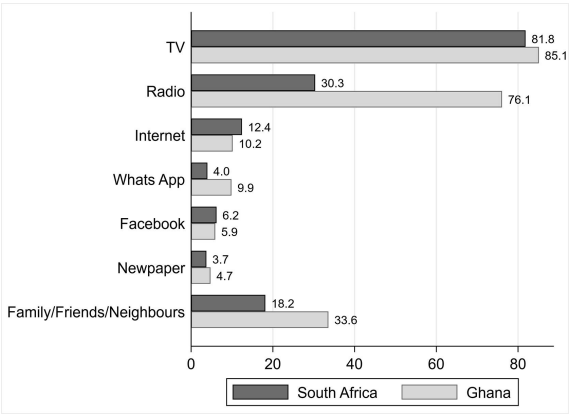

Fig. 5.4.6: Where people get their information.
Note: Question, "What kind of media have they used?" Multiple answers possible.

with research in other low-income countries, such as Kenya, Senegal, South Africa, Benin, Bangladesh (Aushian & Abuya, 2020; LeNestour et al., 2020; Elliott, 2020; BRAC, 2020), more than 80% of people in South Africa and Ghana inform themselves by watching TV. Other important information sources are radio (30% in South Africa and 76% in Ghana) and, in Ghana, social contacts from family, friends, and neighbors (around 34%). In both countries, very few people get information from social media or the newspapers.

5.4.4 Perception of the governments' actions

It is important to understand if people trust the government, if they think governmental regulations are appropriate, and if they received any mitigation measures by the government, such as free food, water, or electricity. These interactions with the government can influence the readiness of poor populations to cooperate and change their behavior during lockdowns and beyond (E. Egger et al., 2020). In South Africa, 86% of respondents and 81% of Ghanaian respondents say they trust the government somewhat or strongly to take care of its citizens (Figure 5.4.7). Despite high levels of trust in the government, 33% of South Africans say the measures implemented to stop the virus were (somewhat or much) too extreme and 28% say that the lockdown was not enforced at all in their neighborhood (Figure 5.4.7). In comparison, with similar levels of trust in the government, only 17% of Ghanaians report that their government's actions were too extreme and only 1% of Ghanaians report that the rules had not been enforced in their neighborhoods (see Figure 5.4.7).

In South Africa, the government announced only at the end of April 2020 that they would make a R500 billion stimulus package available for various expenditures, such as emergency funds for food aid, small businesses, supplementary income, water, and electricity (CNBC, 2020). In contrast, the Ghanaian government implemented many support programs already at the beginning of the lockdown in March 2020, including special life insurance and tax breaks for health personnel, three months of free water and electricity for the poor with subsidized bills for the middle class, water tank service to all vulnerable communities, and free food distribution. Only a few respondents in our survey actually report benefiting from the free food distribution (9%) and/or using the water tanks (4%). The main reason why people say they did not use the water supplied by the tanks is that it was not available in their neighborhoods (80%). Almost all respondents report receiving a free water bill and/or reduced electricity bill.

5.4.5 Drivers of social distancing and preventive hygiene

Finally, by combining Sections 5.4.1 to 5.4.4 we analyze correlates of behavioral change during the lockdowns. These correlations could indicate possible ways to foster compliance with social distancing and preventive hygiene guidelines to minimize the spread of COVID-19 and to avoid another lockdown of public life, which has immediate severe negative consequences on the lives of the urban poor (see Section 5.4.1). Table 5.4.2 presents a first

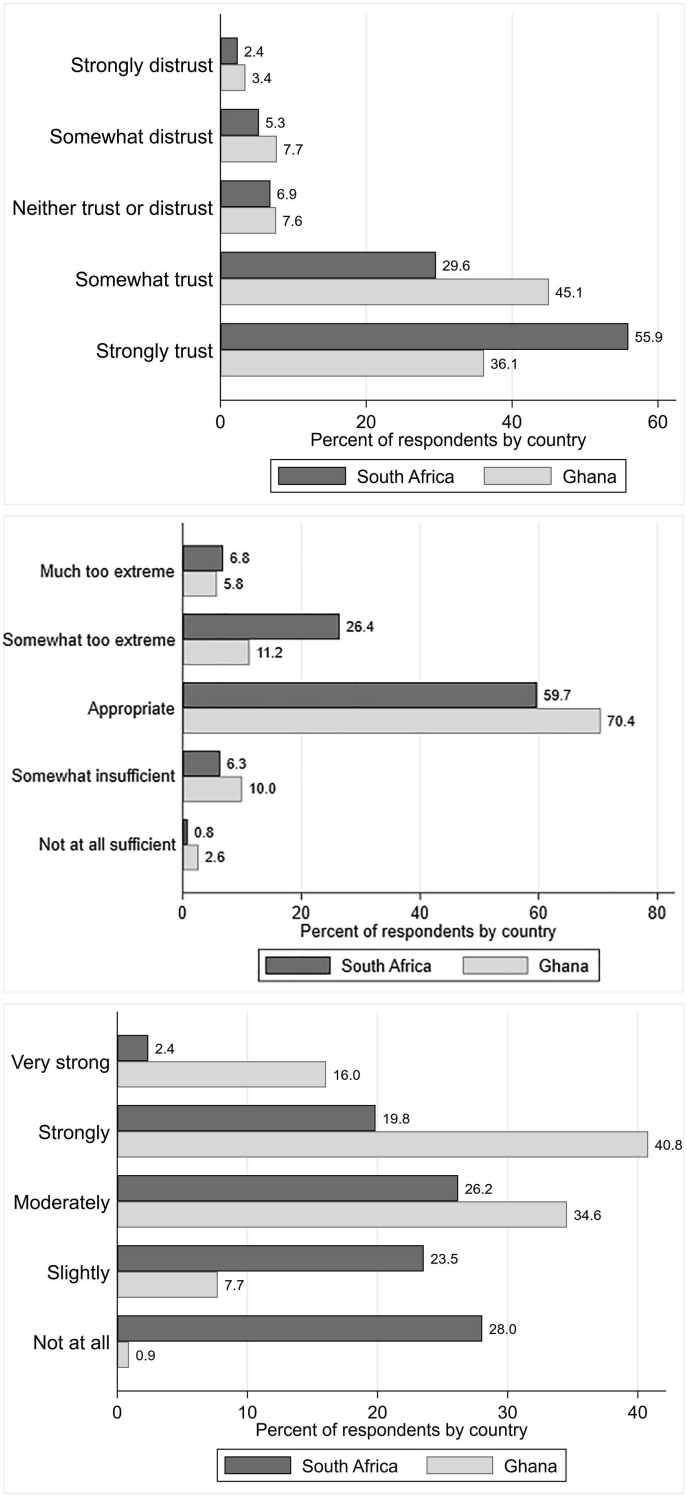

Fig. 5.4.7: Perception about government's action in the sample from South Africa and Ghana. The questions asked in the above graphs are, from top to bottom: "How much do you trust the government to take care of the people of South Africa/Ghana?"; "What do you think about the government's actions to curb Coronavirus? Is it appropriate, too extreme or not sufficient?" and "The government has announced a lockdown to combat the spread of the Coronavirus, how strongly is it enforced in your neighborhood?".

preliminary regression that shows which attributes are correlated with a higher number of reported preventative actions (as shown in Figures 5.4.2 and 5.4.3).

For Ghana, knowledge of COVID-19 case counts has a significant impact on reported mitigation measures. For the South African sample, people with higher trust in government are more likely to be engaged in behavioral change (similar to Fetzer et al., 2020). For both countries, respondents that perceive the government's measures as too extreme are more likely to report that they engage in fewer hygienic protective measures, however, they are also less likely to go outside their compounds. Anxieties about the future are not correlated with reported social distancing and/or hygienic measures. Older populations are more likely to follow social distancing regulations (but not hygienic measures) in both countries. Education and gender do not seem to play a large role in protective behavior. People in crowded houses (with children), as well as households whose income depends on a salary, are more likely to leave their compounds more often despite the curfews in both countries, but reportedly adopt more hygienic measures.

5.5 Discussion and conclusion

The global COVID-19 pandemic is manifesting differently in every country. Given each country's level of in international connectivity in terms of air travel and trade, every country initially had a different risk of an outbreak (Gilbert et al., 2020; Martinez-Alvarez et al., 2020). Due to variations in the medical capacity to handle the pandemic as well as differences in underlying health issues and demographics, the health impact of COVID-19 will not be the same in each country. What is the same for all countries is that without widespread access to a new vaccine, the most effective way to limit the spread and impact of the virus is to practice social distancing and preventive hygiene—especially in densely populated neighborhoods where the virus could spread quickly. Such measures depend on the willingness and ability of the population to cooperate and engage in behavioral change. These practices are now becoming more relevant in African countries, where many governments had to lift or ease national lockdowns of public life despite rising numbers of COVID-19 cases due to the detrimental economic effects of lockdowns on poor populations.

Various previous studies already show that, as of today, the pandemic has had a larger economic than health impact on people living in poverty (Aushian & Abuya, 2020; BRAC, 2020; HSRC, 2020; Kesar et al., 2021; LeNestour et al., 2020; Malik et al., 2020; Rahman & Matin, 2020; Sumner et al., 2020). This outcome also seems to be the case for the urban poor in Accra, where many people are dependent on their own business in the informal economy. The lockdown immediately lowered the incomes of the urban poor and, importantly, at the same time led to an increase in food prices, which has to be taken into consideration when thinking about cash-transfer programs or providing free public services as remediation measures. In contrast to Ghana and many other low- and middle-income countries, the leading single source of income for the urban poor in South Africa are grants

Tab. 5.4.2: Correlation with number of preventative actions.

	Number of hygienic measures followed (0-4)		Number of social distancing measures followed (0-4)		Number of times outside the compound (0-7)	
	South Africa	Ghana	South Africa	Ghana	South Africa	Ghana
Knowledge						
Number of estimated infected people is correct (less than 20% deviation)	-0.101	0.198***	0.114	0.0216	0.0343	0.130
	(0.305)	(0.005)	(0.294)	(0.700)	(0.812)	(0.183)
Mention at least 2 out of 3 key symptoms (Fever, Coughing, Difficulty breathing)	-0.144	0.283***	0.165	0.209**	-0.140	-0.147
	(0.154)	(0.008)	(0.117)	(0.013)	(0.327)	(0.281)
Perception government						
Government reaction too extreme	-1.28***	-0.32***	-0.156	-0.0925	-0.472***	-0.299**
	(0.000)	(0.000)	(0.157)	(0.188)	(0.004)	(0.023)
Distrusts the government	-0.482***	-0.159	-0.450**	-0.149	0.650**	-0.105
	(0.005)	(0.147)	(0.019)	(0.121)	(0.032)	(0.407)
Lockdown was strongly enforced	-0.187	0.359***	0.116	0.0124	0.205	-0.0166
	(0.208)	(0.000)	(0.385)	(0.817)	(0.303)	(0.859)
Anxieties about future						
Strongly worried about lower income of my household	0.190*	0.122	0.100	-0.0950	0.0535	0.0978
	(0.068)	(0.126)	(0.395)	(0.148)	(0.700)	(0.366)
Strongly worried about not getting enough food in the near future	0.0692	-0.005	0.101	-0.118	-0.242*	0.188
	(0.484)	(0.952)	(0.293)	(0.158)	(0.077)	(0.171)
Strongly worried about the health of my family	-0.265**	0.239***	-0.165	-0.0623	-0.160	-0.0166
	(0.016)	(0.005)	(0.105)	(0.367)	(0.254)	(0.885)
Socioeconomic and household factors						
Age 30-39 (Reference: 18-29 years)	-0.166	-0.00848	0.236	0.179	-0.499**	-0.260
	(0.230)	(0.957)	(0.134)	(0.159)	(0.035)	(0.246)
Age 40-49 (Reference: 18-29 years)	-0.0785	-0.0425	0.386**	0.315**	-0.802***	-0.408*
	(0.581)	(0.788)	(0.014)	(0.014)	(0.001)	(0.069)
Age 50-59 (Reference: 18-29 years)	-0.213	-0.185	0.197	0.266**	-0.497*	-0.466**
	(0.188)	(0.252)	(0.261)	(0.041)	(0.058)	(0.039)
Age 60-69 (Reference: 18-29 years)	-0.0999	-0.131	0.431**	0.300**	-0.720***	-0.340
	(0.633)	(0.466)	(0.020)	(0.028)	(0.009)	(0.163)
Age 70+ (Reference: 18-29 years)	-0.457	-0.328	0.560**	0.560***	-0.734**	-0.560**
	(0.128)	(0.131)	(0.037)	(0.000)	(0.023)	(0.044)
Female (Reference: Male)	-0.0438	0.0377	0.129	0.0537	-0.380**	0.0601
	(0.694)	(0.590)	(0.257)	(0.346)	(0.021)	(0.534)
Primary Educ. (Reference: no school)	0.250*	-0.133	-0.0909	-0.145	0.394**	0.0795
	(0.086)	(0.349)	(0.502)	(0.295)	(0.027)	(0.653)
Secondary Educ. (Reference: no school)	0.161	-0.0276	0.00472	-0.0224	-0.143	0.301**
	(0.351)	(0.801)	(0.977)	(0.814)	(0.488)	(0.036)
Tertiary Educ. (Reference: no school)	0.0286	0.317*	-0.304	-0.0637	0.0933	0.588**
	(0.897)	(0.056)	(0.200)	(0.642)	(0.764)	(0.009)
Have children at home (Reference: no children)	-0.0968	0.141**	-0.108	-0.156***	0.132	0.299***
	(0.354)	(0.043)	(0.344)	(0.005)	(0.407)	(0.002)
Persons per room	-0.0392	0.059***	0.108	-0.04***	-0.148	-0.0279
	(0.600)	(0.000)	(0.122)	(0.001)	(0.104)	(0.121)
Income from grants	-0.177	0.371*	0.0126	-0.146	-0.105	-0.0398
	(0.117)	(0.058)	(0.917)	(0.289)	(0.484)	(0.847)
Income from salary	0.251**	0.271***	-0.137	0.0623	0.476**	0.197
	(0.032)	(0.007)	(0.226)	(0.442)	(0.010)	(0.190)
Self-employed	0.151	0.312***	-0.368	0.00991	0.517	0.142
	(0.516)	(0.000)	(0.171)	(0.876)	(0.286)	(0.191)
Constant	2.201***	2.385***	2.807***	1.055**	1.093	3.184***
	(0.000)	(0.000)	(0.000)	(0.044)	(0.054)	(0.001)
Observations	385	993	385	993	374	915
R-squared	0.413	0.144	0.128	0.112	0.194	0.072

Note: P-values in parentheses: * p<0.10, ** p<0.05, *** p<0.01. In addition, in all regressions we controlled for the binary variable indicating if a person is stressed when leaving the house as well as the day of the interview since the 100^{th} case.

from the government, which are largely unaffected by the virus and lockdowns—at least so far. In this regard, South Africa already has a system in place to disperse income to those in need during the lockdown, from which other countries could learn. South Africans, however, are still anxious about their future economic situation: the concern might rather be the fiscal capacity of the state to sustainably finance grants given the impact of the global pandemic and the increased probability to remain or become unemployed. The somewhat smaller direct effect on poor people's income in South Africa than in Ghana might be the reason why the South African government was able to maintain a strict lockdown of public life (except for essential services) for more than 10 weeks, whereas the lockdown only lasted three weeks in Ghana.

Even if the main source of income in South Africa, grants from the government, was relatively unhindered by the pandemic, and the lockdown was only implemented for a limited time in Ghana, we find very high levels of anxiety. Most anxieties are about individuals' economic situation (48% Ghana, 67% South Africa), followed by their family's health (37% Ghana, 51% South Africa), and to a lesser extent, mobility (24% Ghana, 34% South Africa are stressed when leaving their homes). Hence, the South African sample is more worried about the impact of COVID-19, which is also reflected in 51% of South African and 37% of Ghanaian respondents saying that they feel depressed or hopeless. On a scale from zero to ten, South Africans report a general satisfaction in life of 3.6, while Ghanaians report a score of 5.7.

Last, the impact of school cancellations is a major issue in Ghana and South Africa—as in many other countries. First, more than half of the households in our sample have schoolchildren at home compared to a third of households in high-income countries. The pressure is exacerbated due to small or single-room homes and parents with a low level of education not always in the position to support their children with formal learning. The children being at home is a challenge reported by many, especially in South Africa. Moreover, there is a big concern that children are falling behind. In South Africa, 37%, and 17% in Ghana report that their school-age children did not study or read the day before the interview. In addition, 71% of South African children and 46% of Ghanaian children used to receive food at school, which they no longer receive since schools closed. It is imperative that governments focus on a safe and secure way to reopen schools, not only to reduce pressure on households, but also to ensure children do not fall behind in learning and nutrition.

Lockdowns, therefore, have had a large but different negative impact on the economic, mental, and social well-being of the urban poor in Ghana and South Africa. However have the lockdowns been effective in changing the behavior of a significant portion of the population to curb the spread of COVID-19? If yes, how can African governments, not only in South Africa and Ghana, encourage and enable people to voluntarily follow social distancing and improve personal hygiene practices in the near future?

Interestingly, whereas the impact of the lockdown was different for Ghana and South Africa, the mitigation measures taken by the population were very similar. During the

lockdowns and early into the pandemic, the most common reported way in which people mitigate their risk of infection in both countries is by frequent hand washing (80-90%), similar to studies done in urban poor areas around Nairobi (Aushian & Abuya, 2020), avoiding private gatherings (80-90%), and avoiding hand shaking (70-75%). All these measures come at a low financial cost and are relatively easy for families to implement. About 50% of the sample in both countries reports wearing a mask in public even before it was mandatory. However, about one third still attended larger gatherings of people, and/or left the home more than once per week, and 10-20% of households still received guests at home or visited others, even during strict curfews. A challenge with staying at home is both crowded housing and the need to earn an income. When leaving the house, keeping a one-meter distance in public appears to be a large challenge, mainly due to the need to use public transportation and public toilets (for the case of Ghana). In total, people already follow 2.5 (out of four) hygienic and three (out of four) social distancing measures in both countries. There is also some first (weak) indication from Ghana that hygienic measures are used as a substitute if social distancing is too costly for families. Hence, the urban poor seem to be willing to cooperate in social distancing and personal hygiene, but might not always have the infrastructure to do so—a point of intervention for governments and the international community.

Interestingly, people in South Africa are not more likely to follow social distancing rules (three out of four) despite stricter regulations, which has also been reported by the South African media, especially in densely populated informal settlements (Simelane, 2020; Ishmail, 2020). Our results indicate that the reasons are generally lower enforcement in Johannesburg's neighborhoods, as compared to Accra's, and that the South African population considers governmental policies too extreme. Moreover, people with low trust in government are also less likely to comply. Even if we cannot test this directly, a notable difference between Ghana and South Africa is that Ghana put special measures for poor populations in place at the start of the lockdown: free water and electricity, from which most of respondents in our sample benefited. Special governmental remediation only happened with a delay in South Africa. Interestingly, anxieties about future income and health do not seem to play a major role in cooperative action.

As the effectiveness of governmental regulations depends on the cooperation of the public, the South African government could reassess the future stringency of lockdown regulations, given the low levels of enforcement and the high cost to poor families' wellbeing. Instead, officials can focus on better informing the population both about COVID-19 and the reasons behind their actions, two strategies that seem to have contributed to less social interaction and/or more hygienic behavior in Ghana.

Lastly, we find that a considerable share of the population in both countries still lacks important information, the good news being that people do not currently seem to be misinformed. Similar to recent surveys in low-income countries, almost all of the respondents have heard of COVID-19 (Aushian & Abuya, 2020; Elliott, 2020; Roy et al., 2020). About 50% in both countries know how many people are infected (within 20% of the

official case numbers on a specific day). People who are misinformed tend to underestimate the number of cases. In addition, participants can identify about three of the symptoms recognized by the WHO. However, only about 50% of the sampled populations know that fever and difficulty breathing are core symptoms and only 40% say they would call the recommended toll-free number if infected (in Ghana). Most others would directly go to the hospital and/or stay at home. To increase understanding about core symptoms among the population, our results suggest that it makes sense to invest in TV information campaigns for both countries and also in radio campaigns in Ghana. Most people in South Africa and Ghana inform themselves by watching TV, which is similar to studies done in Kenya, Senegal, Nigeria and Bangladesh (Aushian & Abuya, 2020; BRAC, 2020; Elliott, 2020; LeNestour et al., 2020). Interestingly, only a few people get information on social media, much less than in countries such as Nigeria and Kenya (Elliott, 2020), which might help to reduce misinformation even if information spreads at a slower speed.

To conclude, mass cooperation is the most effective way to curb the spread of COVID-19: a large percentage of the population needs to keep a safe distance from others and maintain proper personal hygiene. Although strict lockdowns increase the amount of reported social distancing and hygiene practices, we have shown, similar to other studies, that it comes at an extraordinarily high cost to the urban poor—even if the scale of the impact varies across countries or cities, as seen in Accra and Johannesburg. Moreover, even during lockdowns, a considerable share of the urban poor does not comply with regulations. Governments might be able to mobilize cooperation by investing in both the necessary public infrastructure (such as free water or better public transportation) and information campaigns, both about COVID-19 and their policies to confront it.

5.A Supplementary Figures and Tables

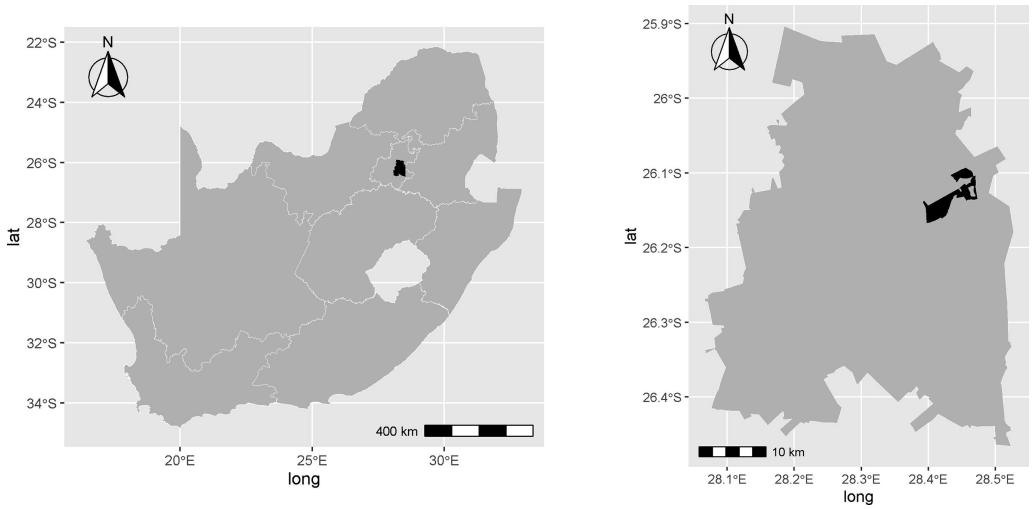

Fig. 5.A.1: Map of study area in South Africa.
Notes: The left panel in the graph above shows all nine provinces of South Africa, black highlighted the municipality of Ekurhuleni in the province Gauteng where the two neighborhoods are located. In the right panel, the two neighborhoods Etwatwa and Daveyton are highlighted in black.

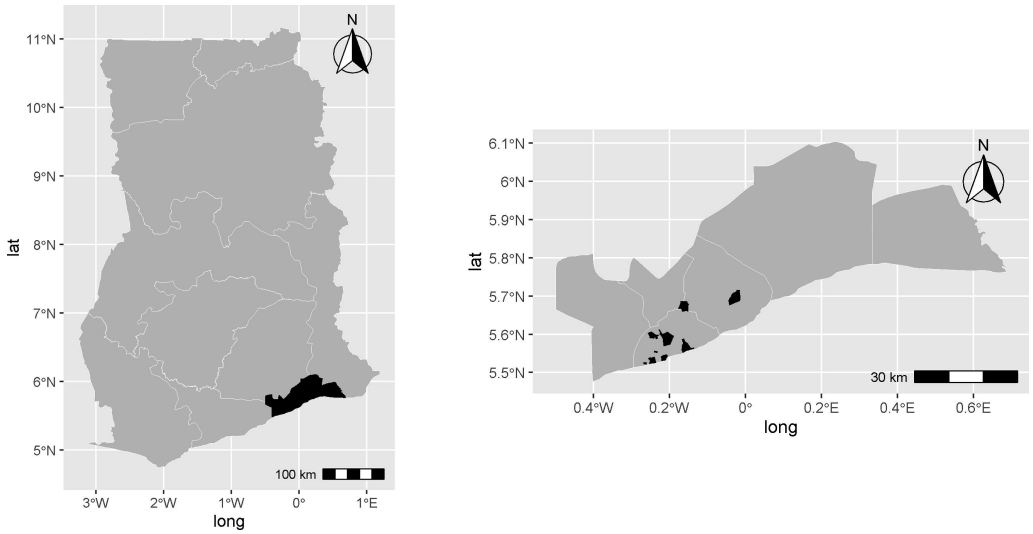

Fig. 5.A.2: Map of study area in Ghana.
Notes: The left panel in the graph above shows all ten regions of Ghana, black highlighted the region Greater Accra where the 18 neighborhoods are located. Ghana reorganized the 10 regions into 16 regions in 2019. Since the official shape files are not yet available and the boundary stayed the same for Greater Accra, the old boundaries are shown in the graph. In the right panel the region Greater Accra with the six districts are shown. In black 16 neighborhoods are highlighted. Pig Farm and Ablekuma are not yet included since the boundaries were not yet confirmed by the statistical department.

Tab. 5.A.1: Correlation Matrix of individual measures followed in South Africa and Ghana.

	Number of followed measures	Always wore face mask in public	Always wash hands with soap	Avoid shaking hands	Avoid touching surfaces	Had no visitors	Did not visit someone	Left home not more than once	Avoided gatherings
South Africa	Hygienic measures	0.271	0.377	0.45	0.196	0.051	0.039	-0.163	0.426
	Social distancing measures	0.057	0.113	0.023	0.174	0.377	0.398	0.128	0.000
Ghana	Hygienic measures	0.366	0.04	0.258	0.385	-0.113	-0.144	-0.251	0.227
	Social distancing measures	-0.065	-0.011	-0.080	-0.059	0.225	0.305	0.136	-0.126

Notes: The number of total hygienic and social distancing followed excluded for each correlation with an individual measure the specific measurs, e.g., for the correlation of hygienic measures and avoid shaking hands, the sum is maximal 3 not 4 since avoind shaking hands was excluded.

Chapter 6

Recovering from the COVID-19 pandemic: Evidence from urban poor in Ghana and South Africa

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Abstract: Ghana and South Africa proactively implemented lockdowns very early in the pandemic. We analyze a three-wave panel of households in Accra and Greater Johannesburg to study the mental and economic well-being of the urban poor between the COVID-19 lockdown and the "new normal" one year later. We find that even if economic well-being has mostly recovered, life satisfaction has only improved slightly and feelings of depression are again at lockdown levels one year into the pandemic. While economic factors are strongly correlated with mental health and explain the differences in mental health between SouthAfrica and Ghana, increasing worries about the future and limited knowledge about the pandemic (both countries) as well as deteriorating physical health (South Africa) and trust in government (Ghana) explain why mental health has not recovered. Therefore, we need broad and country-specific policies, beyond financial support, to accelerate the post-pandemic recovery of the urban poor.

Keywords: COVID-19, economic recovery, mental health, urban poor

JEL code: C33, I15, J21

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6.1 Introduction

In the early phases of the COVID-19 pandemic, many were concerned about the virus's impact in cities of low- and middle-income countries (LMICs), given poor sanitation conditions, densely populated areas, compromised immunities, and underfinanced healthcare systems. The pressure that COVID-19 outbreaks placed on countries with well-financed healthcare systems early in the pandemic raised doubts about whether medical infrastructure in LMICs would be able to manage a rapid surge of infections. Due to these concerns, many governments of LMICs, such as Ghana and South Africa, were quicker to implement public lockdown regulations than high-income countries (HICs) in Northern America and Europe. While government measures slowed the reproduction of the virus and minimized mortality rates (Flaxman et al., 2020; Hsiang et al., 2020), the policies also imposed high economic costs on LMICs because of the large share of the population working in the informal economy, low incomes, and limited social security. Studies of LMICs during lockdowns clearly indicate that earnings decreased, and unemployment and food insecurity increased (Carsi Kuhangana et al., 2020; Durizzo et al., 2021; D. Egger et al., 2021; Hamadani et al., 2020; IPA, 2020; Jain et al., 2020; Kesar et al., 2021; Mahmud & Riley, 2021; Meyer et al., 2021; Stein et al., 2020; Warren et al., 2020a,b).

A year and a half after the WHO declared COVID-19 a pandemic in March 2020, many economies showed fast macro-economic recovery. However, recovery for LMICs, especially in Africa, has been slower (IMF, 2021) and is expected to remain fragile due to the slow global distribution of vaccines (UN, 2021).

However, few longitudinal micro-economic studies focus on the economic recovery of poor populations in LMICs from early in the pandemic to after the lifting of lockdown regulations. Using phone surveys in Ghana, four months after the regional lockdowns were lifted, Schotte et al. (2021) find evidence of a national decline in income for informal and small business owners. Using financial diaries taken from October 2019 to September 2020, Rönkkö et al. (2021) find that although household income in Bangladesh recovered after economies re-opened, it was still below pre-pandemic levels four months after the lockdown was lifted. Similarly, results from ongoing high-frequency phone surveys in Burkina Faso, Ethiopia, Malawi, Mali, Nigeria, and Uganda reveal that although a substantial proportion of respondents returned to work, this has not necessarily translated to a full recovery in incomes (WorldBank, 2021a). In contrast, Innovation for Poverty Action, which conducted surveys in various countries, in May, August, and November 2020, show that employment fell substantially during the lockdown (February to May 2020), but recovered exceeding previous levels, in November 2020 (IPA, 2020). This positive trend can also be seen in hours worked, earnings, and food security, especially for the formally employed.

Given the different pace of economic recovery, further evidence is needed for LMICs to understand how economic factors have developed at the micro-level from early in the pandemic to after public lockdowns. Moreover, at least to our knowledge, no study has followed the economic well-being of households in LMICs up to one year after the start of

the pandemic, entering a "new normal" in 2021 and no study has linked this longer-term economic recovery to mental health in LMICs. Previous research on economic downturns linked to the global financial crises in 2008 has indicated that economic downturns can be associated with an increase in poor mental health and that this negative effect might remain even after the economy recovers due to job insecurity (for Germany: Avdic et al. (2020); for Australia: Black et al. (2022)).

Moreover, apart from adverse economic impacts, COVID-19 and the measures to slow the virus's reproduction has influenced many other factors that potentially have adverse mental health implications. For example, health-related anxieties, such as the fear of personal and family contamination, could worsen mental health (Banks et al., 2021; Perrin et al., 2009; Pfefferbaum & North, 2020). Limited knowledge regarding the pandemic (Bäuerle et al., 2020), reduced mobility (Burdett et al., 2021) and limited social interactions (Pancani et al., 2021) could also have a negative effect on mental health. Other concerns include a significant increase in domestic abuse and violence during strict national lockdowns (Banks et al., 2021; Peterman et al., 2020) and overburdening guardians due to school closures (Sadique et al., 2008; Shevlin et al., 2020; Pierce et al., 2020). In addition, given the significant political challenges related to managing a pandemic, political uncertainty and public distrust in the government has the potential to exacerbate stress (Bäuerle et al., 2020; Olagoke et al., 2020; Perrin et al., 2009).

The impact of the consequences of COVID-19 on mental health has, however, only been prominently analyzed and discussed for HICs. For example, using monthly online surveys from April 2020 to June 2021, Matsubayashi et al. (2022) find that adults in Japan were more likely to report symptoms related to anxiety and depression when they experienced a major change in employment or working conditions during COVID-19. Cheng et al. (2020) find that life satisfaction in Singapore declined considerably when the nationwide lockdown was introduced, especially for households that reported a decline in income. Similarly, Clark & Lepinteur (2021) find for several European countries that the policy stringency is negatively associated with life satisfaction. Zajacova et al. (2020) show that mental health in Canada decreased considerably and that it is strongly associated with economic concerns. Banks et al. (2021) find that in various countries in Europe and the United States, COVID-19 initially had a large negative impact on mental health. Despite some evidence of mental health recovery months later, not all mental health indicators have fully recovered.

The impact of COVID-19 on mental health has been less frequently analyzed in LMICs. And if so, "only" during lockdowns of public life early in the pandemic and not after most measures have been lifted. Posel et al. (2021) use longitudinal data from rapid mobile phone surveys in South Africa to show that mental health was related to job loss; those who lost their job during the lockdowns were around 5% more likely to report depressive symptoms. A longitudinal study from Uganda, with in-person surveys before the first lockdown and follow-up phone surveys during the lockdown, finds that life satisfaction significantly decreased by 25%; one of the reasons being an increase in reported intimate

partner violence (Mahmud & Riley, 2021). In Ethiopia, Meyer et al. (2021) find that 24% of women showed signs of depressive disorders when the government issued stay-at-home orders. Durizzo et al. (2021) find that 37% of the urban poor in Ghana and 51% of the urban poor in South African reported feeling down, depressed, and/or hopeless during public lockdowns in the spring of 2020. Conducting phone surveys from August to October 2020, Porter et al. (2021) finds that reported symptoms of anxiety ranged widely from 41% in Peru, 18% in Ethiopia, 11% in India, to 9% in Viet Nam. Similar results were reported by Goularte et al. (2021) for Brazil, C. Wang et al. (2021) for seven Asian countries, Shamoon et al. (2020) for Pakistan and Cénat et al. (2021) for Haiti, DRC, Rwanda, and Togo.

Since most of these studies in both LMICs and HICs are cross-sectional and were conducted when strict social distancing measures were in place, it is unclear how mental health changed throughout the pandemic, especially after strict lockdowns were lifted.

In this paper, we analyze poor urban households' mental and economic well-being as they started to re-enter public life with the global pandemic still ongoing. We interviewed about 1,000 poor urban households living in Accra, Ghana, and the Greater Johannesburg area, South Africa. We contacted respondents three times: first, early in the lockdowns in April 2020, second, about four months later in August 2020, when regulations had been substantially relaxed in Ghana and to some extent also in South Africa, and third, almost one year later in March 2021 when all social distancing regulations were lifted and only hygienic measures were still in place, and vaccine campaigns had begun in Ghana and South Africa.

In doing so, we make three important contributions to our understanding of the impact of the pandemic on the urban poor's well-being. First, the results will contribute to the small literature on the relationship between a global pandemic and mental health for LMICs. Second, we aim to identify the drivers of mental health during a global pandemic between two different countries and across time. Third, the results contribute to the few ongoing longer-term economic recovery studies after public lockdowns, but during an ongoing pandemic. This is particularly important because of the different paces of economic recovery and the varying developments in mental health discussed in the literature.

We compare South Africa with Ghana, because on the one hand these are both middle-income countries in Africa (a context that has been studied less when it comes to economic and mental health recovery), had some of the highest numbers of COVID-19 cases in Africa, experienced a similar timing of the two COVID-19 infection waves, and started COVID-19 vaccine campaigns at similar times. On the other hand, the two country contexts differ considerably in terms of the duration of strict government measures to limit social interactions at the beginning of the pandemic. Moreover, the economic situation of the urban poor in each country also differs substantially, with many South African urban poor unemployed and many Ghanaian urban poor self-employed. We focus on one of the most the vulnerable groups, the population living in low-income settlements in major cities,

where public lockdowns are expected to have more severe impacts. Our results could help design policies to assist vulnerable communities in recovery after moving out of strict lockdowns.

We find that even if economic well-being has mostly recovered after a year, life satisfaction has only improved slightly and feelings of depression are again at lockdown levels one year into the pandemic, after some improvements shortly after the first lockdown. Moreover, mental health indicators are, in general, worse among the urban poor in South Africa than in Ghana. Our results indicate that while economic factors are strongly correlated with mental health and explain the differences in mental health between South Africa and Ghana, increasing worries about future income and deteriorating knowledge about the pandemic explain why mental health has not recovered one year after the lockdown, while lack of social interactions seems to be less important. Nevertheless, key country differences exist: economic factors, trust in the government, and domestic violence seem to be more important for mental health in Ghana, whereas health factors seem to be more important in South Africa. Therefore, also for the poorest, we need to consider broader and country-specific policies beyond financial support to accelerate the post-pandemic recovery of mental health.

6.2 Context for Ghana and South Africa

At the time of writing, Africa has reported 8.65 million confirmed COVID-19 cases and 222,881 deaths (November 30, 2021; JohnsHopkins, 2022). South Africa and Ghana, both middle-income countries, have some of the highest numbers of total confirmed cases in Africa, with 2,968,052 infections and 89,843 deaths and 130,920 infections and 1,209 deaths, respectively (November 30, 2021; JohnsHopkins, 2022). Within the study duration, April 2020 until March 2021, South Africa and Ghana had two COVID-19 infection waves: the first peak was around July and August 2020 and the second in January and February 2021 (see Figure 6.2.1). Overall, South Africa was more adversely affected than Ghana, with about eight times more cases per million people during the peak. Both countries experienced third waves that exceeded the timeline of our study; lasting until around July 2021 in South Africa and August 2021 in Ghana (November 30, 2021; JohnsHopkins, 2022).

In February and March 2021, at the end of our study period, South Africa and Ghana were some of the first countries in Africa to implement COVID-19 vaccine distribution campaigns (SouthAfricanGovernment, 2021; WHO, 2021b). However, vaccination coverage remains low, mainly due to global shortages in vaccine supply. As of November 2021, 35% of South Africans and 11% of Ghanaians, respectively, received at least one dose of COVID-19 vaccines (WHO, 2021b).

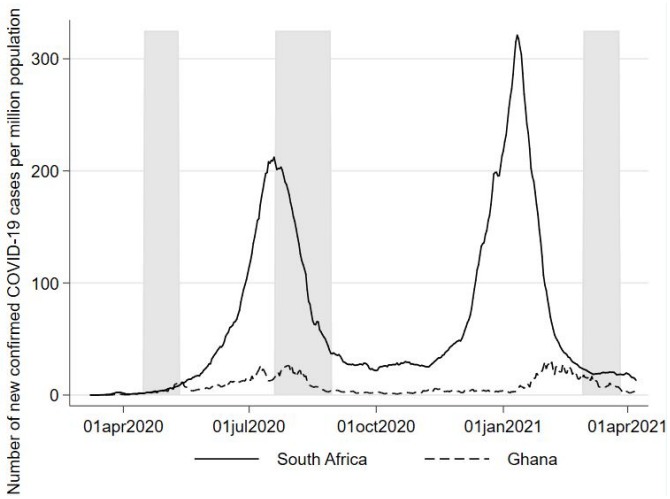

Fig. 6.2.1: Number of total confirmed COVID-19 cases per million population in South Africa and Ghana since March 1, 2020.
Notes: A 7-daymoving average was calculated to display the number of daily cases. The gray shading indicates when the survey took place for both countries.
Source: JohnsHopkins (2022)—last update April 08, 2021.

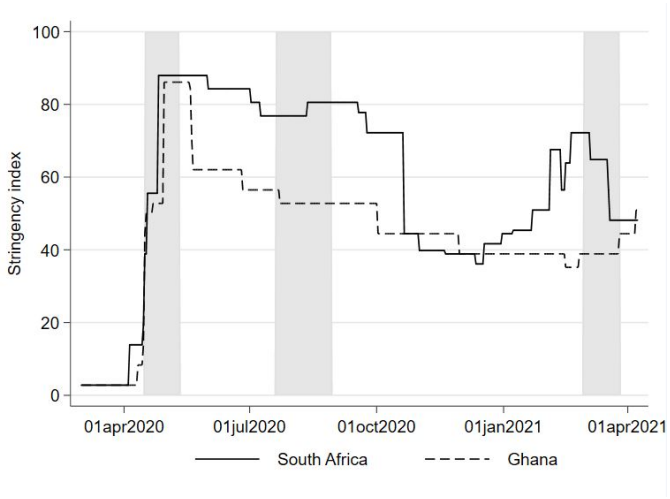

Fig. 6.2.2: Stringency index from South Africa and Ghana since March 1, 2020.
Notes: The Government Response Stringency Index is a composite measure based on nine response indicators, including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest response). This index should not be interpreted as "scoring" the appropriateness or effectiveness of a country's response; it simply records the number and the strictness of government policies. The gray shading indicates when the survey took place for both countries.
Source: Hale et al. (2021)—last updated April 8, 2021.

Although HICs, on average, reported their first wave much earlier, have experienced more waves, and have higher confirmed cases than in LMICs[1] (November 30, 2021; JohnsHopkins, 2022), HICs were slower to implement social distancing regulations and have mostly implemented less stringent measures throughout the pandemic. In contrast to many HICs, but similar to many other LMICs, both Ghana and South Africa implemented strict

[1]Note that testing rates are different between HICs and LMICs, potentially influencing the number of confirmed cases.

lockdowns of public life to limit the spread of COVID-19 even before the 100th confirmed case (see Figure 6.2.2). South Africa even implemented one of the strictest lockdowns globally and only gradually lifted the restrictions (SACoronavirus, 2020), but by October 2020, most restrictions—except a small number of regulations such as mandatory mask usage and some limitations on large gatherings—had been eased (GardaWorld, 2020). In contrast, due to fears about worsening economic conditions (Akinwotu & Asiedu, 2020), Ghana lifted the public lockdown in the most affected cities (Accra and Kumasi) after only three weeks (see Figure 6.2.2).

We contacted respondents three times between April 2020 and March 2021. First, in April 2020, when COVID-19 cases were still relatively low (see Figure 6.2.1), but when strict lockdowns were implemented in both counties (see Figure 6.2.2). In both of our sample areas, only essential services were allowed to be open, but schools were closed. Additionally, in South Africa, the sale of alcohol and tobacco products was prohibited.

The second survey was conducted in August 2020, shortly after the peak of the first wave, when most restrictions had been eased in Ghana. However, schools only re-opened for final-year university students and senior and junior high school students to allow them to write their final exams (Presidency, 2020b)—all other school levels remained closed. In contrast to Ghana, few restrictions on public life had been lifted in South Africa by the second survey round in August 2020 (see Figures 6.2.1 and 6.2.2). South Africans still had to remain at home except when going to work or school, purchasing goods, or exercising outside during the day (SACoronavirus, 2020).

The last survey round was conducted in March 2021 after the second COVID-19 wave (see Figure 6.2.1), when COVID-19 vaccine campaigns had started and when hygienic measures were the only COVID-related measures remaining in effect in both countries (see Figure 6.2.2). All businesses, including the sale of alcohol and tobacco in South Africa, were operational. All land borders and airports were open and all schools from the primary level to the university level were fully re-opened. Nevertheless, sanitary measures and mask usage were still enforced in both countries (SACoronavirus, 2020; Presidency, 2021).

As a result, respondents in both countries completed surveys at similar times regarding COVID-19 infections (before the first wave, during the first wave, and after the second wave) and when COVID-19 vaccines were introduced (shorty before the third survey round). While South Africa had a longer public lockdown, Ghana's schools were closed longer. Given these similarities and differences, it is particularly interesting to compare the economic and mental health recovery in these two countries.

6.3 Methodology and data

6.3.1 Data

We conducted three rounds of fully structured phone surveys of households living in 18 urban low-income settlements in the Greater Accra region in Ghana[2] and two municipalities in the Greater Johannesburg area[3] (see Figures 6.A.1 and 6.A.2 in the Appendix).[4] Since the first survey round was conducted during strict lockdowns of public life, phone surveys were the only possibility to reach out to low-income urban respondents. Compared to online or SMS surveys, phone surveys allowed the research team to survey vulnerable respondents who were illiterate or without internet. We obtained ethical approval for this research from universities in Ghana, South Africa and Switzerland (available from the authors upon request). While the baseline survey took place during the lockdown (April 2020), the follow-up surveys were conducted around four months (August 2020) and again approximately 11 months after the baseline survey (March 2021).

Three enumerators in South Africa and 16 enumerators in Ghana conducted the survey with the same person in the household in each of the three survey rounds. All enumerators had previous experience conducting phone surveys and were trained by one of the co-authors for this study. The questionnaire included questions on participants' age, gender, living conditions, economic situation, food consumption, stress factors, knowledge and perception of COVID-19 and vaccinations, and life satisfaction and feelings of depression. The Ghanaian questionnaire included a few additional questions and took on average 38 minutes to complete, compared to 25 minutes in South Africa (the questionnaires for both countries are available upon request).

The sample in Ghana was a representative sample provided by the Ghana Statistical Service, which was randomly drawn from the most recent Ghana Living Standard Survey (GLSS7) carried out in 2017 from the 18 poorest settlements in the capital city Accra according to GLSS (stratified at and proportional to the settlement level). From the 1,034 persons who answered the first survey round in Ghana, 8% did not want to be called again. Of the numbers we could contact again, 14% were not valid or unanswered, and 5% of respondents did not want to participate in the survey again. We excluded 15 respondents who were from the same household, but were not the same person interviewed in the first survey round. In total, 736 respondents answered all three survey rounds in Ghana.

The sample in South Africa was drawn from the database of a study conducted in 2013 that used randomly selected households in two urban settlements of Ekurhuleni of Johannesburg (NovaInstitute, 2016). A clustered sampling approach in combination with geographic sampling at the suburb level was used.[5] The two South African townships

[2]Abeka, Ablekuma, Accra New Town, Alajo, Ashaiman, Chorkor, Gbegbeyise, Jamestown, Kokomlemle, Kotobabi, La, Maamobi, Madina, Mamprobi, Nima, Pig Farm, Sabon Zongo, Ussher Town.

[3]Etwatwa and Daveyton.

[4]In both countries we had already ongoing research collaborations with universities.

[5]All suburbs where the local partner conducted their project on low-smoke stoves were selected. A

east of Johannesburg belong to a larger municipality, Ekurhuleni, one of the three municipalities with the highest estimated share of people living in poverty in the country (StatisticsSouthAfrica, 2020). In South Africa, of the 409 persons who answered the first round of the survey, 10% did not want to be called back, 37% could not be reached due to invalid phone numbers or non-responsive calls, and 18% did not want to participate when called a second time. We excluded 2% because they were not the same person surveyed in the first round. In total, 128 respondents answered all three survey rounds in South Africa.

Response rates for the second round in Ghana (83%) and South Africa (67%) are similar to follow-up phone surveys in other LMICs (IPA, 2020; WorldBank, 2021a). However, the South African response rate dropped steeply in the third round, to 30% of the baseline. A potential reason for the drop could be that spam calls had massively increased in South Africa since mid-2020 and people might have become less likely to pick up the phone if they did not recognize the phone number (Kok, 2020). In Ghana, the response rate only decreased slightly to 71% of the original sample. To address potential attrition bias, the drivers of attrition between the baseline and the second and third round samples on respondent demographics were estimated for both countries using a logistic regression model (see Table 6.A.1 in the Appendix). Testing for 22 covariates, the results show that in South Africa younger people and households with private toilets left the sample at a higher rate than the rest of the sample between the first and the third (final) survey rounds. For Ghana, we find that females and households not depending on national grants were more likely to leave the sample. To account for this potential bias in the sample, we used inverse probability weighting (IPW) for all analyses in this paper (Tables 6.4.1-6.4.3), reweighting all observations based on Table 6.A.1 in Appendix, and dropping all observations that were not interviewed in all three rounds, i.e., using a balanced reweighted sample (Wooldridge, 2020). Results do not change when IPW is not used (results available from the authors upon request).

6.3.2 Sample Description

Our sample highlights the situation experienced by urban households living in low-income settlements in the Greater Accra region in Ghana and the Greater Johannesburg area in South Africa. Both study areas are among the poorest urban settlements in the two countries. However, the Ghanaian sample has proportionally fewer females (35%) than the South African one (76%; see Table 6.A.2 in the Appendix). In the case of Ghana, telephone numbers were randomly drawn from the GLSS7, which listed information on the household heads, who are primarily male. In the South African sample, contact details were sourced from a previous research project on indoor smoke pollution (NovaInstitute, 2016). During this project, the South African partner visited a random subset of households from the areas, and women were more likely to be at home. We thus control for the respondent's

series of random coordinates were chosen per suburb. The street blocks in which each randomly chosen coordinate fell were selected and all households in these street blocks were interviewed.

gender in all our analyses (Tables 6.4.2-6.4.3) to make sure our results are not driven by gender. We also replicated all descriptive statistics (Table 6.4.1 and Figure 6.A.3 in the Appendix) and regressions (Tables 6.4.2 and 6.4.3) separately for men and women (see Appendix, Tables 6.A.4-6.A.8 and Figure 6.A.4). The described trends in Section 6.4.1 and 6.4.2 are not markedly different for men or women in either country.

More Ghanaian respondents have at least completed primary education (92% vs. 75% for South Africa), fewer Ghanaians were unemployed before the lockdown (4% vs. 58% for South Africa), and more Ghanaians were self-employed before the lockdown (39% vs. 4% for South Africa). Moreover, in South Africa, national grants constitute a major share (65%) of households' income, whereas in Ghana, income from own businesses (59%) or employment (22%) are mentioned most often (see Table 6.A.2 in the Appendix). Work in South Africa is relatively more formalized; out of the 16% of South Africans who are employed, 55% have a contract. In Ghana, of the 43% participants that are employed, 25% have a contract. Therefore, despite both samples representing poor urban populations in middle-income countries, the economic characteristics of the urban poor are quite different in the two countries, which makes for an interesting comparison.

6.3.3 Methodology

Our analysis focuses on two self-reported mental health outcomes: life satisfaction and feeling depressed. To identify respondents' subjective overall well-being, life satisfaction is measured on a scale from zero to 10 with the question "How satisfied are you with your life at the moment?" In the literature, life satisfaction is used as a first indicator to identify vulnerable groups at risk for depression (Gigantesco et al., 2019; Rissanen et al., 2011). It is shown in the literature that the evaluation of life satisfaction can change considerably depending on what areas of life the person focuses on (e.g., overall life satisfaction vs. life satisfaction in terms of health, see Cheng et al., 2020). Moreover, life satisfaction is a long-term indicator and might not change quickly. Additionally, since life satisfaction can be defined as an individual's evaluation of their life as a whole based on their personal goals and achievements, but conditional on their environment, people might adjust their goals in times of shocks and therefore report their life satisfaction based on their "new" normal (Gigantesco et al., 2019; Rissanen et al., 2011).

To include a more specific and more time-variant indicator of mental health in our analysis, we also consider a second mental health outcome: feeling down, depressed, and hopeless. Feeling depressed is measured on a five-point Likert scale ("strongly applies" to "does not apply at all"). Although this is a rudimentary indicator of depression that might be less accurate than psychological diagnostic test questions, such as the nine-point Patient Health Questionnaire (PHQ-9) or seven-point Generalized Anxiety Disorder (GAD-7; e.g., OConnor et al., 2021; Shevlin et al., 2020), it is in line with assessments of depression used in other studies (Mahmud & Riley, 2021; Witteveen & Velthorst, 2020). Moreover, such comprehensive diagnostic tests would have been difficult or even impossible to conduct using mobile phone data collection because attention span decreases much faster during

phone surveys than during in-person surveys.

The analysis is done in two steps. First, we analyze how mental health and economic factors have evolved since the start of the pandemic (Section 6.4.1) and how other factors either directly linked to the pandemic (i.e., knowledge about it) or linked to public movement restrictions during the lockdown (i.e., lower income) have evolved over time (Section 6.4.2). In a second step (Section 6.4.3), we investigate the impact of personal characteristics, such as gender, age, number of rooms per person, household with children, shared water source, shared toilet, education, and national grants as primary income before the lockdown, as well as a set of time-variant economic factors, such as job security, financial liquidity, and food security on mental health. In addition, we analyze both the impact of public lockdown stress factors (such as social interactions, trust in government, worries about future income, or food[6]) and the impact of pandemic stress factors (such as physical health, knowledge about the pandemic, or worries about the health of the family) on mental health. We are also interested in understanding which of these factors explain observed differences in mental health between countries and across time.

To explore time-variant and time-invariant effects simultaneously, we first use a pooled OLS regression. The time-invariant personal characteristics are denoted by (X_i), the time-variant economic factors as (E_i), lockdown stress factors as (L_i), and pandemic stress factors as (P_i). Survey rounds are denoted as (T_t), and country fixed effects as (C_i). We run the regression separately for both outcome variables ($Y_{i,t}$): life satisfaction (scale 0–10) and feeling down, depressed, hopeless (scale 1–5).

$$Y_{i,t} = \beta_0 + \beta_1 X_i + \beta_2 E_{i,t} + \beta_3 L_{i,t} + \beta_4 P_{i,t} + \beta_5 T_t + \beta_6 C_i + \epsilon_{i,t} \tag{6.1}$$

We introduce the independent variables with a stepwise approach (see Table 6.4.2) to test their explanatory power (R^2) and how much of the difference in mental health between countries and changes over time they explain. Moreover, we first estimate the regression for the entire sample (Table 6.4.2) and then separately for each country (Table 6.A.6 in the Appendix) to identify differences in drivers between countries. Regression coefficients indicate the association of a given variable with the person's life satisfaction or feelings of depression. A positive coefficient for life satisfaction means higher life satisfaction, whereas a positive coefficient for feelings of depression means higher feelings of depression. Therefore, we generally expect that covariates usually show the opposite sign for life satisfaction and feelings of depression.

Third (Section 6.4.3), we use the panel dimension of our sample by estimating a fixed effects model (with individual fixed effects (I_i)). The advantage of this model is that all unobserved time-invariant heterogeneities across individuals, such for example as pre-existing health risk factors that we have no data on, will be controlled for. However, this model does not allow us to analyze time-invariant personal characteristics or general

[6] As Table 6.A.3 in the Appendix shows, these worries are not highly correlated with each other. Thus, we do not assume that worries are just a representation of mental health, but that they identify specific worries in people's life.

differences across countries (see equation 6.2). Again, the following regression was first estimated for the entire sample and then separately for each country to identify differences in drivers between countries (Table 6.4.3):

$$Y_{i,t} = \beta_0 + \beta_1 X_i + \beta_2 E_{i,t} + \beta_3 L_{i,t} + \beta_4 P_{i,t} + \beta_5 T_t + \beta_6 I_i + \epsilon_{i,t} \tag{6.2}$$

Since participants stated if they felt depressed on a Likert scale, we also considered an ordered logit model for both equations 6.1 and 6.2 as a robustness check (see Appendix Tables 6.A.7 and 6.A.9). If not highlighted in the text, results do not change in comparison to the OLS regression. Moreover, we also run the two models (equations 6.1 and 6.2) controlling for a country stringency index (see Figure 6.2.2) and daily COVID-19 cases per 1,000,000 people (see Figure 6.2.1). Results are available from the authors upon request. Since both variables are highly correlated with the survey rounds and do not vary much within one survey round for each country, the results are statistically insignificant.

6.4 Results

6.4.1 Mental health crisis despite recovery in economic well-being

In our sample from poor urban South Africa, respondents' average life satisfaction improved gradually over time from a low average of 3.9 during lockdown to 4.7 in August 2020 to 5.3 in March 2021 (scale is from zero to 10, see Table 6.4.1). In contrast, in our sample of low-income settings in Greater Accra in Ghana, respondents' average life satisfaction has not changed much and even slightly decreased during the third wave, but always stayed above 5 from the lockdown in April 2020 to March 2021. Given our data, we unfortunately cannot determine if the recovery has reached pre-pandemic levels in either country. The development of feeling down, depressed or hopeless—is a short-term indicator of mental health in comparison to general life satisfaction—has changed much more over the one-year observation period. In both countries, feelings of depression dropped sharply four months after the lockdown, from 66% during the lockdown to 50% four months after the lockdown for the South African respondents and from 43% to 30% for the Ghanaian respondents (see Table 6.4.1). However, from August 2020 to March 2021, feelings of depression increased by 5 percentage points in South Africa and 6 percentage points in Ghana, respectively. In general, feelings of depression are much more prevalent in our sample from South Africa than in our sample from Ghana. Interestingly, we find the same pattern when we inspect the results by gender, except that Ghanaian women experienced a constant decrease in feeling depressed, from 50% to 38%, over time (see Table 6.A.5 in the Appendix).

Based on the literature on general economic downturns (Avdic et al., 2020; Black et al., 2022; Zajacova et al., 2020), but also specifically on the COVID-19 shock (Cheng et al., 2020; Mahmud & Riley, 2021; Posel et al., 2021), mental health is expected to be very

closely linked to economic development. Unemployment, job insecurity, a bad financial situation, or a lack of liquidity might substantially influence mental health, including life satisfaction and depression.

Figure 6.A.3 in the Appendix shows the distribution in working status for all three survey rounds in both countries as well as working status one month before the lockdown, which we elicited from participants in the first survey round (April 2020). Given that all people except essential workers were mandated to stay at home during April 2020 in both Ghana and South Africa most people did not work during the lockdown. However, a substantial share still worked, emphasizing the need for regular income in contexts where social protection schemes are low. Compared to before the lockdown in February 2020, the urban poor in Ghana and South Africa seem to have recovered to a similar working status distribution by March 2021, one year after the lockdown (see Figure 6.A.3 in the Appendix). Only the share of people not working (i.e., not looking for a job) has increased in South Africa (from 19% to 26%), whereas the share of unemployed has decreased from 57% before the lockdown in February 2020 to 45% in March 2021. Figure 6.A.3 and Table 6.4.1 also indicate that the recovery to pre-pandemic working status already happened four months after the lockdown in Ghana, whereas we see this recovery only in the third survey round for South Africa. This result is not surprising given that South Africa had a lengthier and stricter social distancing regulations (see Figure 6.2.2). Since employment status does not provide the complete picture, i.e., one could be employed, but with a lower income, we also asked respondents if their household income has changed between February 2020 (before the lockdown) and February 2021 (almost one year after the lockdown). In South Africa, 66% indicated that income has stayed the same or even increased and in Ghana, about half reported that their total household income stayed the same or even increased from 2020 to 2021.

Turning to other economic indicators (see Table 6.4.1), respondents from the South African sample rate their overall financial situation as being worse than the Ghanaian sample, are more likely to go to bed without food, and are more likely to borrow money. But in both countries, we find a substantial and continuous (from April 2020 to August 2020 to March 2021) reduction in respondents perceiving their financial situation as bad and going to bed hungry. With regard to households' financial liquidity, we find a short relaxation in both countries in August 2020, but liquidity constraints worsened again to April 2020-levels in March 2021.

To conclude, mental health factors seem to only recover slowly (life satisfaction) or even worsen again (feelings of depression) one year after the lockdown (Table 6.4.1), whereas most economic factors seem to have recovered (Table 6.4.1) with the easing of governmental restrictions (Figure 6.2.2). These results raise the question of what other factors besides economic ones could be driving mental health dynamics over time.

Tab. 6.4.1: Descriptive statistics for key indicators for South African and Ghanaian sample.

	South Africa					Ghana				
	Mean April 2020	Mean August 2020	Mean March 2021	p-value Δ April 2020 to August 2020	p-value Δ April 2020 to March 2021	Mean April 2020	Mean August 2020	Mean March 2021	p-value Δ April 2020 to August 2020	p-value Δ April 2020 to March 2021
Outcomes										
Life satisfaction (scale 0-10)	3.9	4.7	5.3	0.036**	0.000***	5.5	5.5	5.3	0.446	0.011**
Feel down, depressed, hopeless (scale 1-5)	2.9	3.4	3.0	0.025**	0.585	3.5	3.9	3.7	0.000***	0.092*
Feel down, depressed, hopeless (binary scale 0-1)	0.66	0.50	0.55	0.009***	0.247	0.43	0.30	0.36	0.001***	0.055*
Economic Factors										
Unemployed or not working (binary scale 0-1)	0.76	0.83	0.71	0.237	0.402	0.19	0.19	0.16	0.852	0.270
Bad Financial Status (binary scale 0-1)	0.73	0.66	0.59	0.292	0.032**	0.40	0.30	0.25	0.000***	0.000***
Borrowed money (binary scale 0-1)	0.29	0.17	0.31	0.028**	0.653	0.12	0.09	0.10	0.102	0.174
At least once went to bed w/out food within last 7 days (binary scale 0-1)	0.17	0.12	0.11	0.292	0.241	0.06	0.03	0.02	0.001***	0.000***
Food item not available when going grocery shopping (binary scale 0-1)	0.22	0.22	0.12	0.968	0.053*	0.14	0.05	0.04	0.000***	0.000***
Lockdown Stress Factors										
Distrust in government (binary scale 0-1)	0.09	0.42	0.37	0.000***	0.000***	0.18	0.28	0.29	0.000***	0.000***
Never went outside the compound to visit someone in last 7 days (binary scale 0-1)	0.84	0.90	0.66	0.225	0.002***	0.92	0.50	0.34	0.000***	0.000***
Worried about not getting enough food in the near future (binary scale 0-1)	0.90	0.76	0.77	0.008***	0.013**	0.62	0.40	0.46	0.000***	0.000***
Worried about lower future income of my household (binary scale 0-1)	0.96	0.77	0.83	0.000***	0.004***	0.75	0.65	0.79	0.000***	0.101
Afraid of someone at home (binary scale 0-1)	0.17	0.24	0.24	0.209	0.189	0.41	0.24	0.28	0.000***	0.000***
Pandemic Stress Factors										
Bad Health Condition (binary scale 0-1)	0.06	0.05	0.10	0.648	0.298	0.02	0.03	0.04	0.133	0.046**
Not at least mentioned two COVID-19 symptoms defined by WHO (binary scale 0-1)	0.46	0.35	0.47	0.100	0.913	0.32	0.44	0.50	0.000***	0.000***
No knowledge of COVID-19 cases (binary scale 0-1)	0.58	0.91	1.00	0.000***	0.000***	0.48	0.67	0.72	0.000***	0.000***
Worried about health of family (binary scale 0-1)	0.88	0.74	0.81	0.007***	0.159	0.62	0.52	0.66	0.000***	0.079*

Notes: Scale for outcome feel down, depressed, hopeless refers to 1 = does not apply at all to 5 = strongly applies. Detailed information about the variables can be found in Tables 6.A.4 and 6.A.5. All results are reweighted with IPW presented in Table 6.A.1. Level of p-values highlighted: * p<0.10, ** p<0.05, *** p<0.01.

6.4.2 Development of stress factors related to the global pandemic and national lockdowns

In addition to adverse economic impacts, COVID-19 cases and government measures may have influenced many other factors that have (long-term) adverse mental health implications. Concerns about personal health, political uncertainty and the related distrust in the government, limited mobility and social isolation, missing knowledge about the pandemic, domestic violence, or anxieties about future incomes might potentially negatively impact mental health, as shown in recent studies for HICs and in previous epidemics (Banks et al., 2021; Perrin et al., 2009; Peterman et al., 2020; Pfefferbaum & North, 2020).

In contrast to economic indicators, which mostly improved between April 2020 and March 2021, we find that most global pandemic stress factors increased over time in both countries (see Table 6.4.1). More people rated their personal health to be worse in March 2021 than during the lockdown in 2020. Moreover, in both countries worries about the health of the family, worsened again in March 2021. In Ghana, worries about the health of the family were even larger in March 2021 than in April 2020. Additionally, knowledge about the pandemic has decreased substantially over time in both countries—both related to the total number of COVID-19 cases in the country (within a 20% boundary) and with regard to being able to name at least two of the official WHO symptoms of the disease. Overall, this trend in the lack of knowledge could influence mental health in two different ways. On the one hand, people may no longer care about the pandemic and therefore be less afraid; on the other hand, people may be less informed and therefore more affected in their mental health due to greater uncertainty.

Interestingly, most national lockdown stress factors also worsened between April 2020 and March 2021 even after the lockdowns were gradually lifted. Trust in government and society deteriorated over time. Worries about food and lower income in the near future first decreased between April 2020 and August 2020 but then increased again in March 2021. In contrast and as expected, social isolation decreased over the year. In both countries, where going outside and gathering with other people was prohibited during the lockdown, we find that around 84% in the South African sample and 92% in the Ghanaian sample did not visit anyone outside of their compound within the last seven days in April 2020. In Ghana, this rate decreased continuously to 50% in August 2020 and 34% in March 2021. In South Africa, where strict gathering policies were still in place in August 2020, we only find a substantial decrease in people not visiting others—down to 66% in March 2021.

During the lockdown, 41% of Ghanaians said they are afraid of someone in their home, but this improved substantially to 24% in the second round. The literature supports the sudden improvement after the lockdown in Ghana, as it emphasizes that staying at home and not being able to go outside led to much higher levels of domestic violence worldwide (UN, 2020a). The level of being afraid of someone at home is higher for women than men during the lockdown (47% vs. 38%), but results in a similar level after lockdowns were lifted (see Tables 6.A.4 and 6.A.5 in the Appendix). In contrast, South African respondents

were less afraid of someone at home during the lockdown than after (an increase from 17% to 24%), which could be linked to alcohol sales that were prohibited during the lockdown (first round), but allowed during the second and third rounds. South Africa also saw a decrease in crime rates in spring 2020, especially murder and assaults, partially attributed to the alcohol ban (Burke, 2020).

To conclude, most lockdown and pandemic stress factors have increased over time, except improvements in visiting people outside of own household and fear of domestic violence (for Ghana), as expected to result from the lifting of movement and gathering restrictions.

6.4.3 Factors of COVID-19 pandemic correlated with life satisfaction and depression

In Tables 6.4.2 and 6.4.3, we bring together the various factors linked to mental health. In Table 6.4.2, we use a pooled OLS regression to explore which time-invariant personal characteristics and time-variant economic factors may be associated with life satisfaction and feelings of depression across the two cities and across time. Moreover, we compare factors directly linked to the global health crisis with factors linked to national policies restricting social interaction due to the lockdown.

First, and as indicated by Table 6.4.1, mental health is significantly worse in South Africa than in Ghana not controlling for other factors (Table 6.4.2, columns 1 and 7). Ghana has a statistically significant 0.8 scale point higher life satisfaction (scale from zero to 10) and a 0.6 scale point lower feeling of depression (scale from one to five). Moreover, and again in line with Table 6.4.1, we see that life satisfaction did not change much over the three survey rounds and only improved somewhat one year after the first lockdown, whereas feelings of depression improved from the lockdown to August 2020, but interestingly, worsened again to lockdown levels in March 2021 (Table 6.4.2, columns 1 and 7).

When only controlling for time-invariant socio-economic personal characteristics (Table 6.4.2, columns 2 and 8) these country and time effects remain. This is expected for the time effects (with time-invariant personal characteristics), but shows that observed differences in levels of mental health between South Africa and Ghana (see Table 6.4.1) do not seem to be driven by differences in individual characteristics of our samples even though some of those characteristics are indeed correlated with life satisfaction and feelings of depression. We find that tertiary education is positively correlated with life satisfaction, but also the likelihood of feeling depressed. Women are more likely to report that they feel depressed, but no differences between men and women can be found in life satisfaction. The higher reporting of depression by women seems to be linked to stress factors directly linked to health (Table 6.4.2, column 11): after controlling for those factors, the gender dummy becomes insignificant. Indicators of household poverty in the sample, i.e., fewer rooms per person and the need to share a toilet or water source, are negatively correlated with life satisfaction but not with feelings of depression. Other personal characteristics either show

no or a very weak correlation with life satisfaction or feelings of depression.

The difference in levels of mental health scores between Ghana and South Africa disappears once we control for economic factors (Table 6.4.2, columns 3 and 9), such as working conditions and financial status. Therefore, country differences in levels are fully explained by economic factors that are quite different between South Africa and Ghana, in general (see Table 6.4.1). Adding economic factors also levels off any changes in life satisfaction across time (Table 6.4.2, column 3). Hence, economic factors, which deteriorated during the lockdowns, seem to play a decisive role in reported life satisfaction between 2020 and 2021.[7] This is not the case for depression, where an improvement and subsequent deterioration in feelings of depression is observed even when controlling for economic factors (Table 6.4.2, column 9).

Therefore, the interesting question is which factors are correlated with changes in feelings of depression over time. Similar to Section 6.4.2, we first analyze factors that are directly influenced by the health crisis, such as personal health and knowledge about the pandemic, and compare them to factors that are influenced by national restrictions on public life, such as changes in visiting people outside the house or trust in government (Table 6.4.2, columns 10 and 11).

The predictive power of our model (adjusted R^2) to explain the variance in feelings of depression across individuals and time changes somewhat more if we control for factors related to the lockdown rather than factors related to the pandemic (Table 6.4.2, columns 10 and 11; 0.30 vs. 0.22). Factors related to the pandemic and the lockdown together seem to be driving changes in feelings of depression over time (Table 6.4.2, column 12). If we only control for factors related to the lockdown, i.e., distrust in government, lack of social interaction, being afraid of somebody at home, and worries about future income and food, feelings of depression even increase over time. In other words, when controlling for differences in factors induced by governmental restrictions on social interaction, feelings of depression even increased over time, which might be linked to the length of the pandemic and increasing uncertainty about it (which unfortunately we cannot test with our data).

The results of the panel specification with individual fixed effects (Table 6.4.3) are very similar to the pooled OLS regression (Table 6.4.2), highlighting that there is little unobserved time-invariant heterogeneity across individuals that we did not control for in Table 6.4.2. The downside of a panel is that we cannot analyze the effects of personal social characteristics and country fixed effects, as these are captured by the individual fixed effects. The advantage is that the panel allows us to control for time-invariant individual heterogeneity with a fixed effects model, i.e., that certain respondents might in general be more prone to mental health issues due to unobservable characteristics. There is one main difference between the panel (Table 6.4.3) and the pooled regression (Table 6.4.2). If, in additional to economic factors, we control for the various stress factors, life satisfaction actually improves over time (Table 6.4.3, column 3), and does not stay constant (Table 6.4.2, column 6). Therefore, stress factors seem to be also driving constant life satisfaction

[7] Note that we do not know whether in 2021 life satisfactions were back to pre-pandemic levels.

Tab. 6.4.2: Factors correlating with life satisfaction and feeling depressed, pooled OLS regression.

	Life satisfaction (0 - 10)						Feel down, depressed, hopeless (1-5)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Survey round (ref. April 2020)												
August 2020	0.166	0.167	0.0163	-0.103	0.0887	0.0106	-0.403***	-0.402***	-0.263***	-0.0167	-0.243***	-0.0634
	(0.215)	(0.198)	(0.895)	(0.426)	(0.478)	(0.936)	(0.000)	(0.000)	(0.001)	(0.837)	(0.002)	(0.430)
March 2021	0.216*	0.215*	-0.0265	0.0190	0.156	0.196	-0.128	-0.128	0.0603	0.216**	-0.0583	0.0897
	(0.083)	(0.076)	(0.829)	(0.891)	(0.223)	(0.174)	(0.107)	(0.105)	(0.440)	(0.012)	(0.468)	(0.303)
Country (ref. South Africa)												
Ghana	0.827***	1.109***	0.0961	-0.0552	-0.0952	-0.169	-0.613***	-0.762***	-0.125	0.0708	0.0982	0.183
	(0.000)	(0.000)	(0.669)	(0.803)	(0.666)	(0.437)	(0.000)	(0.000)	(0.329)	(0.575)	(0.436)	(0.143)
Socio-economic factors												
Female		-0.141	-0.0428	-0.00572	0.0317	0.0548		0.218***	0.161**	0.110*	0.0852	0.0536
		(0.174)	(0.666)	(0.953)	(0.749)	(0.567)		(0.003)	(0.017)	(0.087)	(0.199)	(0.403)
Age (average in years)		0.0484	0.0708*	0.0516	0.0956**	0.0701*		0.0325	0.0250	0.0322	-0.00342	0.00966
		(0.211)	(0.080)	(0.197)	(0.017)	(0.078)		(0.221)	(0.376)	(0.231)	(0.901)	(0.717)
Household with children (ref. no)		-0.0145	-0.00564	-0.00425	-0.00485	-0.0195		0.0909	0.0721	0.0562	0.0495	0.0518
		(0.887)	(0.955)	(0.964)	(0.960)	(0.836)		(0.192)	(0.274)	(0.368)	(0.443)	(0.403)
Average number of rooms per person		0.453***	0.314***	0.245**	0.290***	0.219**		-0.0898	-0.0118	0.0473	-0.00322	0.0503
		(0.000)	(0.002)	(0.016)	(0.003)	(0.027)		(0.211)	(0.862)	(0.482)	(0.961)	(0.442)
Shared water source with other households		-0.344***	-0.119	-0.201*	-0.0953	-0.174		0.00698	-0.163*	-0.0289	-0.176*	-0.0554
		(0.008)	(0.321)	(0.080)	(0.422)	(0.129)		(0.946)	(0.086)	(0.757)	(0.056)	(0.545)
Shared toilet with other households		-0.385***	-0.199**	-0.0662	-0.132	-0.0317		0.380***	0.235***	0.0899	0.134*	0.0414
		(0.000)	(0.041)	(0.487)	(0.173)	(0.737)		(0.000)	(0.001)	(0.169)	(0.052)	(0.525)
Education (ref. no education)												
Primary education completed only		-0.113	-0.0457	0.0132	-0.0800	-0.0213		0.238*	0.167	0.0777	0.152	0.0767
		(0.584)	(0.809)	(0.943)	(0.669)	(0.907)		(0.085)	(0.197)	(0.526)	(0.234)	(0.528)
Secondary education completed only		0.0334	-0.0584	-0.0701	-0.112	-0.129		0.0339	0.0821	0.0834	0.0984	0.106
		(0.853)	(0.734)	(0.676)	(0.517)	(0.442)		(0.778)	(0.477)	(0.436)	(0.384)	(0.318)
Tertiary education completed		0.832***	0.660***	0.557***	0.580***	0.440**		0.207	0.294*	0.393***	0.267*	0.390***
		(0.000)	(0.002)	(0.006)	(0.008)	(0.033)		(0.189)	(0.058)	(0.007)	(0.076)	(0.006)
Economic Factors												
Work Status (ref. Unemployed)												
Self-employed			0.814***	0.775***	0.808***	0.763***			-0.413***	-0.359***	-0.427***	-0.373***
			(0.000)	(0.000)	(0.000)	(0.000)			(0.001)	(0.004)	(0.001)	(0.003)
Employment without contract			0.0855	0.229	0.138	0.262			0.127	-0.0262	0.0679	-0.0496
			(0.685)	(0.270)	(0.508)	(0.199)			(0.392)	(0.852)	(0.639)	(0.721)
Employment with contract			1.030***	1.009***	1.019***	0.988***			-0.445***	-0.456***	-0.465***	-0.466***
			(0.000)	(0.000)	(0.000)	(0.000)			(0.001)	(0.001)	(0.000)	(0.000)
Not working			0.319	0.228	0.338	0.252			-0.128	-0.0631	-0.153	-0.101
			(0.173)	(0.319)	(0.145)	(0.268)			(0.378)	(0.655)	(0.275)	(0.467)
Bad Financial Status (ref. good)			-1.024***	-0.759***	-0.960***	-0.712***			0.744***	0.521***	0.656***	0.485***
			(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.000)	(0.000)
Borrowed money (ref. no)			-0.658***	-0.579***	-0.625***	-0.551***			0.465***	0.405***	0.448***	0.398***
			(0.000)	(0.000)	(0.000)	(0.001)			(0.000)	(0.000)	(0.000)	(0.000)
At least once went to bed w/out food			-0.503**	-0.404*	-0.482**	-0.400*			0.311*	0.187	0.247	0.152
within last 7 days			(0.024)	(0.061)	(0.029)	(0.062)			(0.050)	(0.237)	(0.109)	(0.327)
Food item not available when going			-0.132	-0.0727	-0.0709	-0.0616			0.318***	0.223*	0.185	0.152
grocery shopping									(0.009)	(0.058)	(0.122)	(0.196)
Lockdown Stress Factors												
Distrust in government (ref. trust)				-0.124		-0.0961				0.0175		-0.0146
				(0.242)		(0.359)				(0.810)		(0.838)
Never went outside the compound to				0.160		0.174				0.146**		0.128*
visit someone in last 7 days				(0.129)		(0.105)				(0.045)		(0.076)
Worried about not getting enough food				-0.548***		-0.575***				0.683***		0.600***
in the near future				(0.000)		(0.000)				(0.000)		(0.000)
Worried about lower future income of				-0.687***		-0.689***				0.414***		0.355***
my household				(0.000)		(0.000)				(0.000)		(0.000)
Afraid of someone at home				-0.373***		-0.384***				0.663***		0.627***
				(0.001)		(0.001)				(0.000)		(0.000)
Pandemic Stress Factors												
Bad Health Condition (ref. good)					-0.303	-0.305					0.657***	0.630***
					(0.111)	(0.100)					(0.000)	(0.000)
Not at least mentioned two COVID-19					-0.213**	-0.153					0.0552	0.0197
symptoms defined by WHO					(0.024)	(0.101)					(0.373)	(0.747)
No knowledge of COVID-19 cases					-0.459***	-0.531***					0.149**	0.220***
					(0.000)	(0.000)					(0.028)	(0.001)
Worried about health of family					-0.372***	-0.00130					0.770***	0.411***
					(0.000)	(0.989)					(0.000)	(0.000)
Constant	4.483***	4.003***	4.827***	5.766***	5.413***	6.149***	3.074***	2.702***	2.000***	0.862***	1.470***	0.659***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)
Observations	2480	2480	2479	2476	2470	2470	2485	2485	2484	2481	2475	2475
Adjusted R-squared	0.031	0.081	0.190	0.242	0.205	0.254	0.043	0.061	0.162	0.295	0.221	0.317

Notes: Pooled OLS regression of life satisfaction and depression. Scale for outcome feel down, depressed, hopeless refers to 1 = does not apply at all to 5 = strongly applies. Detailed information about the variables can be found in Tables 6.A.4 and 6.A.5. Results are robust with an ordered logit model and are presented in Table 6.A.7 in the Appendix. All results are reweighted with IPW presented in Table 6.A.1. P-Values in parentheses: * p<0.10, ** p<0.05, *** p<0.01. Models have fewer observations if people said they do not want to answer question about life satisfaction or depression.

over time in addition to feelings of depression.

With regard to individual stress factors, worse knowledge about the pandemic seems to be highly correlated with worse mental health (Table 6.4.3, columns 3 and 6). Therefore, being informed leads to better mental health or better mental health leads to information-seeking behavior. Moreover, worries about future income, food security and family health are also highly correlated with both mental health indicators. Trust in the government does not seem to play a role. Low mobility is only negatively correlated with life satisfaction and being afraid of somebody at home only with feelings of depression (Table 6.4.3, columns 3 and 6). In Table 6.4.3, we also run the panel regressions separately for Ghana and South Africa to analyze whether coefficients are different across the countries (the cross-sectional OLS regressions for each individual country can be found in Table 6.A.6 in the Appendix). We note the following differences between Ghana and South Africa. Life satisfaction of the urban poor in Ghana is highly correlated with economic factors such as job security, the financial situation, and food security, as well as worries about future income and trust in the government. In contrast, in our South African sample, mental health is less correlated with economic factors and not at all correlated with trust in government, but more so with poor current physical health.

6.5 Discussion and conclusion

COVID-19 has had a significant impact on the world economy, especially on those individuals who are living in poverty. As many LMICs implemented strict government measures to reduce social interaction early in the COVID-19 pandemic to slow down the spreading of the virus, many people, and especially the urban poor, were as affected by lockdown policies as by the disease itself. Although the global pandemic was and is still ongoing, most LMICs have relaxed social distancing regulations a couple of months after the first COVID-19 cases around the world were detected.

The end of public lockdowns with a global health crisis ongoing at the same time raises questions about how people's well-being has changed as they start to re-enter a new public life—especially in terms of their mental health, which has barely been studied after lockdowns in LMICs. The status of mental health recovery even after public lockdowns ended is an essential question, since experts warned that due to the changed social environment, continued high levels of uncertainty, and lasting economic downturns (Zajacova et al., 2020), we should expect a "tsunami" of mental illness post-pandemic (RCoP, 2020). To this end, we analyze how mental health in two middle-income countries with strict lockdowns has evolved from the start of the pandemic to one year after, and ask which factors are associated with changes in mental health and observed differences across countries.

In this study, we focus on one of the most vulnerable population groups: households living in the poorest settlements in major cities in LMIC countries. This group has a high share of people working in the informal economy, low incomes, poor housing conditions, and limited social security and savings. Thus, our results are not generalizable to

Tab. 6.4.3: Factors correlating with life satisfaction and feeling depressed, fixed effect panel regression.

	Life satisfaction (0 to +10)			Feel down, depressed, hopeless (1-5)		
	South Africa	Ghana	Both	South Africa	Ghana	Both
	(1)	(2)	(3)	(4)	(5)	(6)
Time Fixed Effect (ref. April 2020)						
August 2020	0.792*	-0.165*	0.156	-0.261	-0.0406	-0.168**
	(0.059)	(0.087)	(0.231)	(0.248)	(0.611)	(0.037)
March 2021	1.895***	-0.179*	0.414***	-0.224	0.157*	0.0168
	(0.000)	(0.066)	(0.003)	(0.296)	(0.073)	(0.849)
Economic Factors						
Work Status (ref. Unemployed)						
Self-employed	0.767	0.605**	0.899**	-0.288	-0.453**	-0.382*
	(0.524)	(0.014)	(0.012)	(0.627)	(0.028)	(0.054)
Employment without contract	0.231	0.584**	0.935***	0.386	-0.105	0.000409
	(0.643)	(0.029)	(0.002)	(0.265)	(0.642)	(0.998)
Employment with contract	1.576***	1.007***	1.294***	-0.425	-0.499**	-0.430**
	(0.008)	(0.000)	(0.000)	(0.244)	(0.018)	(0.033)
Not working	-0.392	0.0804	0.278	0.386	-0.0341	0.184
	(0.539)	(0.778)	(0.472)	(0.301)	(0.890)	(0.427)
Bad Financial Status (ref. good)	-0.920**	-0.840***	-0.779***	0.244	0.490***	0.431***
	(0.017)	(0.000)	(0.000)	(0.337)	(0.000)	(0.000)
Borrowed money (ref. no)	-1.528***	0.0777	-0.564***	0.702***	0.168	0.415***
	(0.000)	(0.617)	(0.004)	(0.002)	(0.143)	(0.000)
At least once went to bed w/out food within last 7 days	-0.394	-0.272	-0.532*	0.0159	0.237	0.157
	(0.440)	(0.198)	(0.071)	(0.956)	(0.154)	(0.338)
Food item not available when going grocery shopping	0.947***	-0.488***	0.172	-0.353	0.462***	0.0590
	(0.010)	(0.006)	(0.404)	(0.141)	(0.002)	(0.668)
Lockdown Stress Factors						
Distrust in government (ref. trust)	0.408	-0.277***	-0.0100	-0.156	0.141*	0.0505
	(0.292)	(0.007)	(0.940)	(0.529)	(0.079)	(0.578)
Never went outside the compound to visit someone in last 7 days	-0.0925	0.209**	0.402***	-0.0707	0.125	0.0637
	(0.793)	(0.026)	(0.001)	(0.758)	(0.115)	(0.405)
Worried about not getting enough food in the near future	-1.528***	-0.311***	-0.450***	0.219	0.503***	0.440***
	(0.000)	(0.004)	(0.000)	(0.397)	(0.000)	(0.000)
Worried about lower future income of my household	-0.0618	-0.598***	-0.575***	0.488	0.336***	0.410***
	(0.887)	(0.000)	(0.000)	(0.134)	(0.000)	(0.000)
Afraid of someone at home	-0.406	-0.0532	-0.0710	0.119	0.485***	0.380***
	(0.234)	(0.595)	(0.585)	(0.616)	(0.000)	(0.000)
Pandemic Stress Factor						
Bad Health Condition (ref. good)	-1.436***	-0.148	-0.562**	0.855**	0.567***	0.691***
	(0.002)	(0.570)	(0.017)	(0.041)	(0.003)	(0.000)
Not at least mentioned two COVID-19 symptoms defined by WHO	-0.0864	-0.0742	-0.128	-0.139	-0.0332	-0.0325
	(0.775)	(0.380)	(0.235)	(0.453)	(0.631)	(0.642)
No knowledge of COVID-19 cases	-1.778***	-0.566***	-0.728***	0.513	0.180**	0.217***
	(0.000)	(0.000)	(0.000)	(0.108)	(0.013)	(0.007)
Worried about health of family	-0.369	-0.307***	-0.373***	0.637**	0.104	0.238**
	(0.350)	(0.003)	(0.002)	(0.022)	(0.205)	(0.012)
Constant	7.748***	6.386***	6.012***	1.254**	1.424***	1.372***
	(0.000)	(0.000)	(0.000)	(0.033)	(0.000)	(0.000)
Observations	363	2107	2470	361	2114	2475
Adjusted R-squared	0.341	0.218	0.195	0.146	0.235	0.195

Notes: Fixed effect panel regression of life satisfaction and depression. Scale for outcome feel down, depressed, hopeless refers to 1 = does not apply at all to 5 = strongly applies. Detailed information about the variables can be found in Tables 6.A.4 and 6.A.5. Results are robust with an ordered logit model and are presented in Table 6.A.9 in the Appendix. All results are reweighted with IPW presented in Table 6.A.1. P-Values in parentheses: * p<0.10, ** p<0.05, *** p<0.01. Models have fewer number of observations if people said they do not want to answer question about life satisfaction or depression.

the entire country, however, they contribute to the few studies focusing on recovery in poor communities (Bishi et al., 2020; IPA, 2020; Porter et al., 2021; Rönkkö et al., 2021; WorldBank, 2021a). Our results could help policymakers assist vulnerable communities transition out of severe public movement and social interaction restrictions, knowledge that may also be needed for future pandemics.

The longitudinal study analyzes over 1,000 poor urban households living in Greater Johannesburg area, South Africa, and Greater Accra area, Ghana, over the span of one year. The two LMICs countries had some of the highest COVID-19 case numbers in Africa, a similar timing of peaks in cases, and a similar start to their COVID-19 vaccine campaigns, but had different governmental measures in place with regard to stringency and length. Moreover, the economic situation of their urban poor also differs substantially, with many South African urban poor unemployed and many Ghanaian urban poor self-employed.

As most government regulations were relaxed one year into the pandemic, the economic indicators that dropped considerably during lockdown mostly recovered one year after the lockdown both in urban Ghana and South Africa. Therefore, the lockdown and pandemic seemed to have little long-term economic effects on the urban poor. Ghana has recovered faster, which is expected, given that Ghana only implemented a short lockdown.

Since economic downturns have previously been shown to be strongly associated with a deterioration in mental health, one might assume that mental health factors also fell during the lockdown and should have recovered faster in Ghana than in South Africa over one year. Analyzing self-reported life satisfaction and the feeling of being depressed, we find that respondents' life satisfaction in South Africa was relatively low at the beginning of the lockdown, but improved slightly though gradually over the subsequent year, whereas in Ghana, life satisfaction stayed constant (but at a higher level than in South Africa). On the contrary, for feeling depressed, urban poor households in Johannesburg and Accra both reported a short-term recovery in August 2020, but experienced increasing feelings of depression again in March 2021. Most previous studies on mental health in LMICs are cross-sectional and were conducted only when strict social distancing measures were in place (Cénat et al., 2021; Goularte et al., 2021; Shamoon et al., 2020; C. Wang et al., 2021). Therefore, at least to our knowledge, we are the first to analyze mental health dynamics in LMICs up to one year after the start of the pandemic. Moreover, these results indicate that the correlation between economic and mental well-being recovery might be lower than expected.

In addition to economic impacts, COVID-19 and the measures to slow the virus's reproduction have also influenced many other factors that might have adverse mental health implications. We find that most stress factors related to a global pandemic and national lockdowns (such as physical health, worries about the health of family members, trust in government, and knowledge about the pandemic, worries about future income) have actually increased over time, except visiting people outside of one's own household and the fear of domestic violence (for Ghana), which was expected due to lifted movement and gathering policies.

This study is also one of the first in LMICs to extensively analyze the correlation of two mental health outcomes with economic factors as well as factors directly linked to a global health crisis and factors linked to public movement restrictions. The results contribute to the longitudinal studies of (Banks et al., 2021; Cheng et al., 2020; Matsubayashi et al., 2022; Zajacova et al., 2020) for HICs. Our results indicate that differences in economic factors explain the differences in mental health between South Africa and Ghana and are indeed highly correlated with mental health outcomes. The ongoing mental health crisis (despite substantial improvements in economic indicators) is, according to our results, mainly linked to stress factors related to both the global pandemic and national lockdowns. In particular, differences in mental health are correlated with varying knowledge about the pandemic, physical health, and worries about the future rather than lack of mobility. Nevertheless, important country differences exist: economic factors and trust in the government seem to be more important in Ghana, whereas health factors seem to be more important in South Africa.

This study has a number of limitations. First, we do not have any pre-pandemic indicators except working status, which we obtained during the first round in April 2020 for February 2020. Moreover, the sampling strategy was different for the two countries. However, we show that differences in individual characteristics across the two samples does not seem to drive our results. Third, having to rely on a phone survey during the pandemic resulted in high attrition rates, in particular for the South African sample, which we addressed by inverse probability weighting and limiting our observations to a balanced sample.

Our results indicate that we need to consider a broader range of needs when designing policies to accelerate post-pandemic recovery in the well-being of the urban poor—and that these factors might vary across countries. Moreover, supportive mental health policies could be offered, especially to poor households, as mental health is not only linked to economic factors, but anxieties linked to the pandemic and the associated governmental measures. Additionally, the government should try to increase knowledge about the pandemic among the population.

6.A Supplementary Figures and Tables

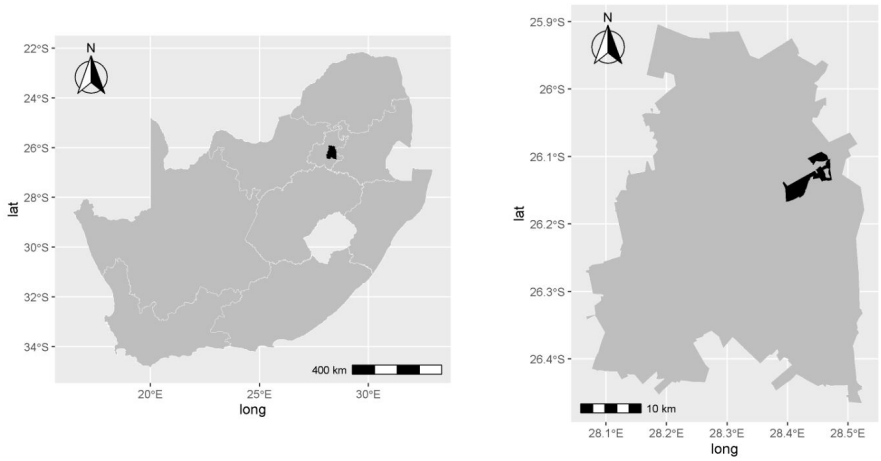

Fig. 6.A.1: Map of study area in South Africa.
Notes: The left panel in the graph above shows all nine provinces of South Africa, black highlighted the municipality of Ekurhuleni in the province Gauteng where the two neighborhoods are located. In the right panel, the two neighborhoods of Ekurhuleni, Etwatwa and Daveyton, are highlighted in black.

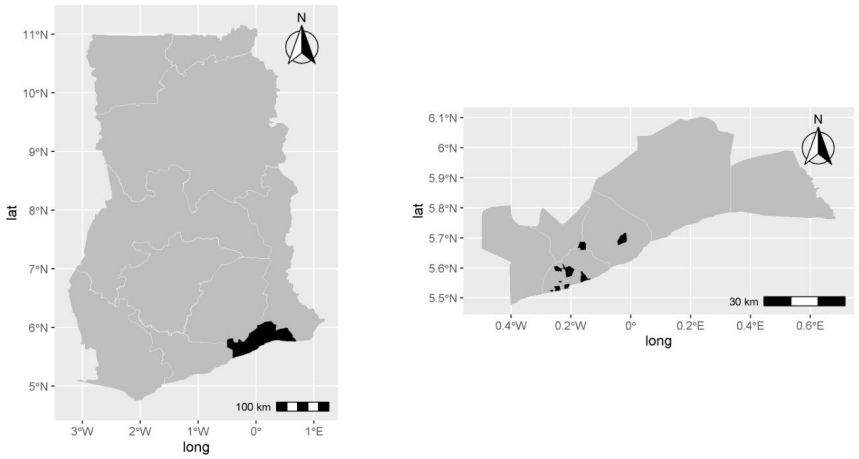

Fig. 6.A.2: Map of study area in Ghana.
Notes: The left panel in the graph above shows all ten regions of Ghana, black highlighted the region Greater Accra where the 18 neighborhoods are located. Ghana reorganized the 10 regions into 16 regions in 2019. Since the official shape files are not yet available and the boundary stayed the same for Greater Accra, the old boundaries are shown in the graph. In the right panel the region Greater Accra with the six districts are shown. In black 16 neighborhoods are highlighted. Pig Farm and Ablekuma are not yet included since the boundaries were not yet confirmed by the statistical department.

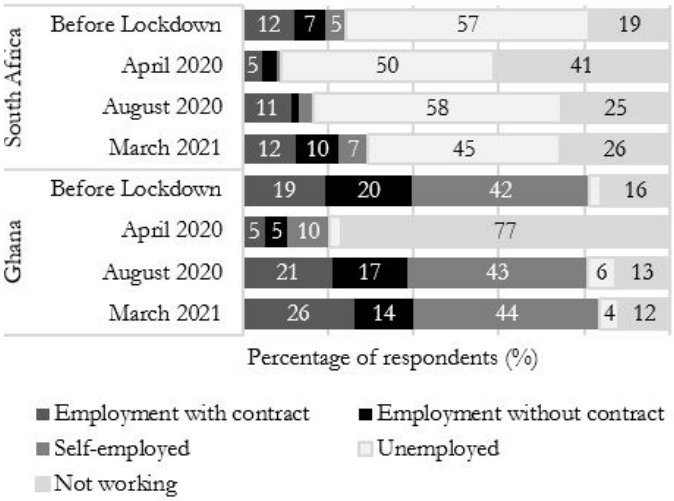

Fig. 6.A.3: Working status in South Africa and Ghana.
Notes: Based on question "What is your main working status?" The category "Not working" refers to the categories: Unable to work due to disability, not looking for a job, student, retired person, and homemaker/housewife. During the lockdown, in April 2020, all respondents who reported that they cannot work/business is closed due to the lockdown were additionally categorized as "Not working." Results are reweighted with IPW presented in Table 6.A.1

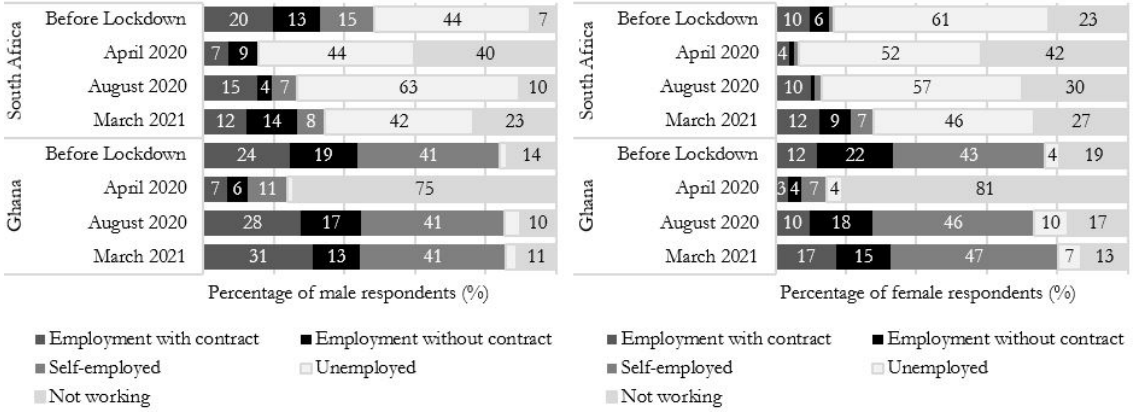

Fig. 6.A.4: Working status in South Africa and Ghana, by gender.
Notes: Based on question "What is your main working status?" The category "Not working" refers to the categories: Unable to work due to disability, not looking for a job, student, retired person, and homemaker /housewife. During the lockdown, in April 2020, all respondents were additionally categorized as "Not working" who reported that they cannot work/ business is closed due to the lockdown. Results are reweighted with IPW presented in Table 6.A.1.

Tab. 6.A.1: Attrition in South Africa and Ghana.

	South Africa		Ghana	
	Attrition 1st to 2nd survey round	Attrition 1st to 3rd survey round	Attrition 1st to 2nd survey round	Attrition 1st to 3rd survey round
Female	1.007	0.960	1.341	1.507***
	(0.982)	(0.891)	(0.123)	(0.009)
Age (average in years)	0.744**	0.809*	1.048	1.061
	(0.010)	(0.064)	(0.545)	(0.360)
Household members	0.934	0.877	0.962	0.974
	(0.446)	(0.108)	(0.363)	(0.440)
Number of rooms	1.069	1.064	1.007	0.946
	(0.525)	(0.536)	(0.925)	(0.381)
Average number of rooms per person	0.809	0.657	1.126	1.532*
	(0.519)	(0.146)	(0.671)	(0.064)
Shared water source with other households	2.891*	2.680	0.838	1.119
	(0.053)	(0.144)	(0.526)	(0.596)
Shared toilet with other households	0.998	0.379**	0.831	1.050
	(0.997)	(0.039)	(0.364)	(0.773)
Education (ref. no education)				
Primary education completed only-	1.351	1.031	1.393	1.021
	(0.400)	(0.923)	(0.464)	(0.954)
Secondary education completed only	1.894	1.292	1.586	1.187
	(0.119)	(0.512)	(0.200)	(0.531)
Tertiary education completed	1.908	1.640	1.417	1.469
	(0.258)	(0.425)	(0.440)	(0.268)
Working Status before lockdown (ref. unemployed)				
Self-employed	0.410	0.940	0.508	1.006
	(0.227)	(0.926)	(0.215)	(0.989)
Employed without contract	1.129	0.787	0.389*	0.637
	(0.813)	(0.630)	(0.100)	(0.349)
Employed with contract	0.918	1.178	1.233	1.088
	(0.856)	(0.743)	(0.743)	(0.876)
Not working	2.903***	1.216	1.348	1.368
	(0.004)	(0.594)	(0.573)	(0.497)
Main source of income for the household (before lockdown)				
Salary from work	1.230	1.194	0.494	0.813
	(0.606)	(0.669)	(0.133)	(0.579)
Own business	1.846	1.335	1.325	1.052
	(0.350)	(0.651)	(0.337)	(0.832)
National grants	1.316	0.965	0.135***	0.447*
	(0.367)	(0.908)	(0.003)	(0.063)
Support from family members	1.009	1.054	0.865	0.859
	(0.983)	(0.897)	(0.572)	(0.463)
Other source of income	0.906	0.688	0.448**	0.705
	(0.861)	(0.474)	(0.043)	(0.224)
Constant	0.609	3.289	0.175	0.272
	(0.569)	(0.150)	(0.015)	(0.027)
Observation	394	394	998	998
R-squared	0.062	0.042	0.044	0.031

Notes: Logit regression of the binary variable if person left between 1st and 2nd, 1st and 3rd survey round, respectively. Odds ratios are shown with p-values in parentheses: * p<0.10, ** p<0.05, *** p<0.01. To account for the attrition of the 1st to the 3rd waves, Inverse Probability Weighting (IPW) was applied to the results.

Tab. 6.A.2: Descriptive statistics of key characteristics of South Africa and Ghana sample over the three survey rounds.

	South Africa			Ghana		
	1st round	2nd round	3rd round	1st round	2nd round	3rd round
	n=409	n=274	n=128	n=1,034	n=863	n=736
Female	75%	74%	76%	37%	36%	35%
Age (average in years)	40-49	40-49	40-49	40-49	40-49	40-49
Household members	5.2	5.2	5.2	5.3	5.4	5.5
Number of rooms	4.5	4.4	4.5	2.4	2.3	2.4
Average number of rooms per person	1.0	1.0	1.1	0.6	0.6	0.6
Shared water source with other households	6%	3%	2%	13%	14%	13%
Shared toilet with other households	8%	6%	9%	66%	67%	67%
Education						
No education level completed	20%	23%	25%	8%	9%	8%
Primary education completed only	44%	46%	47%	9%	9%	9%
Secondary education completed only	30%	25%	23%	68%	68%	69%
Tertiary education completed	7%	6%	5%	15%	15%	14%
Working Status (before lockdown)						
Unemployed	57%	59%	58%	4%	4%	4%
Self-employed	4%	5%	4%	40%	40%	39%
Employed without contract	6%	6%	7%	21%	22%	23%
Employed with contract	12%	12%	9%	20%	20%	20%
Not working	21%	18%	23%	15%	14%	14%
Main sources of income for the household (before lockdown)						
Salary from work	22%	20%	17%	23%	23%	22%
Own business	5%	6%	5%	58%	58%	59%
National grants	64%	62%	65%	5%	5%	5%
Support from family members	11%	11%	11%	20%	20%	20%
Other source of income	7%	7%	8%	9%	9%	9%

Notes: Number of household members were specified up to 11 people—more than 11 are counted as 12 for the average calculation. Number of rooms were specified up to 10 rooms—more than 10 are counted as 11 for the average calculation. Working status and main income source refers to the baseline response to understand if there was a systematic attrition. Not working status includes housewife/homemaker, retired person/pensioner, school pupil/full-time student, unable to work due to disability, and unemployed not looking for a job. For the household's main sources of income, the respondents could mention several sources. National grants include child support grants, old-age pensions, and disability grants.

Tab. 6.A.3: Correlation matrix of mental health factors and anxieties indicators in South Africa and Ghana.

Number of followed measures	Life Satisfaction	Feeling down, depressed, hopeless	Worried about health family	Worried no food	Worried no income
South Africa					
Life Satisfaction	1.0000				
Feeling down, depressed, hopeless	-0.3620	1.0000			
Worried about health family	-0.1790	0.2132	1.0000		
Worried no food	-0.2874	0.2960	0.3195	1.0000	
Worried no income	-0.1639	0.2322	0.2186	0.4871	1.0000
Ghana					
Life Satisfaction (0-10)	1.0000				
Feeling down, depressed, hopeless	-0.3708	1.0000			
Worried about health family	-0.1217	0.3544	1.0000		
Worried no food	-0.3325	0.5141	0.4559	1.0000	
Worried no income	-0.4003	0.4415	0.3559	0.5209	1.0000

Notes: The variables feeling down, depressed, hopeless; Worried about health of family; Worried about no food; Worried about no income were asked on a five-scale from strongly agree to strongly disagree. Results are reweighted with IPW presented in Table 6.A.1.

Tab. 6.A.4: Descriptive statistics for key indicators for South African and Ghanaian sample, male.

	South Africa					Ghana				
	Mean April 2020	Mean August 2020	Mean March 2021	p-value Δ April 2020 to August 2020	p-value Δ April 2020 to March 2021	Mean April 2020	Mean August 2020	Mean March 2021	p-value Δ April 2020 to August 2020	p-value Δ April 2020 to March 2021
Outcomes										
Life satisfaction (scale 0-10)	3.7	4.6	5.2	0.199	0.031	5.8	5.7	5.3	0.610	0.001
Feel down, depressed, hopeless (scale 1-5)	2.7	3.5	3.0	0.064	0.559	3.7	4.1	3.7	0.000	0.699
Feel down, depressed, hopeless (binary scale 0-1)	0.64	0.46	0.52	0.111	0.578	0.39	0.26	0.34	0.002	0.432
Economic Factors										
Unemployed or not working (binary scale 0-1)	0.52	0.71	0.66	0.140	0.286	0.15	0.14	0.14	0.820	0.729
Bad Financial Status (binary scale 0-1)	0.63	0.65	0.59	0.894	0.724	0.38	0.26	0.24	0.000	0.000
Borrowed money (binary scale 0-1)	0.23	0.28	0.37	0.666	0.263	0.12	0.09	0.11	0.128	0.573
At least once went to bed w/out food within last 7 days (binary scale 0-1)	0.15	0.26	0.13	0.275	0.864	0.05	0.02	0.02	0.004	0.009
Food item not available when going grocery shopping (binary scale 0-1)	0.31	0.11	0.25	0.077	0.647	0.13	0.04	0.04	0.000	0.000
Lockdown Stress Factors										
Distrust in government (binary scale 0-1)	0.12	0.38	0.47	0.033	0.005	0.18	0.29	0.30	0.000	0.000
Never went outside the compound to visit someone in last 7 days (binary scale 0-1)	0.91	0.85	0.47	0.527	0.000	0.92	0.48	0.35	0.000	0.000
Worried about not getting enough food in the near future (binary scale 0-1)	0.89	0.67	0.74	0.045	0.147	0.57	0.39	0.46	0.000	0.001
Worried about lower future income of my household (binary scale 0-1)	0.96	0.83	0.81	0.092	0.077	0.70	0.63	0.77	0.018	0.011
Afraid of someone at home (binary scale 0-1)	0.21	0.29	0.14	0.435	0.505	0.38	0.23	0.27	0.000	0.000
Pandemic Stress Factors										
Bad Health Condition (binary scale 0-1)	0.05	0.02	0.12	0.528	0.309	0.01	0.02	0.03	0.152	0.009
Not at least mentioned two COVID-19 symptoms defined by WHO (binary scale 0-1)	0.52	0.44	0.37	0.521	0.251	0.33	0.42	0.47	0.004	0.000
No knowledge of COVID-19 cases (binary scale 0-1)	0.55	0.89	1.00	0.003	0.000	0.41	0.60	0.68	0.000	0.000
Worried about health of family (binary scale 0-1)	0.80	0.73	0.83	0.529	0.786	0.59	0.48	0.64	0.001	0.090

Notes: Based on questions "On a scale from 0 to 10, if 0 is not at all satisfied and 10 is completely satisfied. How satisfied are you with your life at the moment?", "Can you tell me how much this statement applies to you? I feel down, depressed, hopeless" (1= does not apply at all to 5 = strongly applies), "What is your main working status?" (displayed as binary if unemployed or not working, April 2020 refres to before lockdown, a detailed figure can be found in Appendix 6.A.3), "How would you rate the overall financial condition of your household today?" (displayed as binary if bad or very bad), "Did you borrow money last week?" (displayed as binary if yes), "How many days did you go to bed without food during the last week?" (displayed as binary if at least once), "The last time you went shopping, were there any items you wanted to buy but were not available?" (displayed as binary if yes), "How much do you trust the government to take care of the people?" (displayed as binary if strongly distrust or somewhat distrust), "How many people have you visited outside of your house in the last 7 days?" (displayed as binary if never), "I am worried about not getting enough food in the near future" (displayed as binary if does strongly apply or somewhat apply), "I am worried about lower future income of my household in the future" (displayed as binary if does strongly apply or somewhat apply), "I am afraid of someone I am sharing the house with" (displayed as binary if does strongly apply or somewhat apply), "How would you consider your health?" (displayed as binary if terrible or bad), "What are the symptoms of Coronavirus?" (displayed as binary if not more than two officially WHO symptoms are mentioned), "How many people do you think have been infected by the Coronavirus?" (displayed as binary if number not within 20% boundary of correct cases), "I am worried about the health of my family (displayed as binary if does strongly apply or somewhat apply). Results are reweighted with IPW presented in Table 6.A.1.

Tab. 6.A.5: Descriptive statistics for key indicators for South African and Ghanaian sample, female.

	South Africa					Ghana				
	Mean April 2020	Mean August 2020	Mean March 2021	p-value Δ April 2020 to August 2020	p-value Δ April 2020 to March 2021	Mean April 2020	Mean August 2020	Mean March 2021	p-value Δ April 2020 to August 2020	p-value Δ April 2020 to March 2021
Outcomes										
Life satisfaction (scale 0-10)	3.9	4.7	5.3	0.091	0.001	5.2	5.1	5.2	0.547	0.792
Feel down, depressed, hopeless (scale 1-5)	3.0	3.3	3.0	0.138	0.778	3.3	3.6	3.6	0.031	0.029
Feel down, depressed, hopeless (binary scale 0-1)	0.67	0.52	0.56	0.038	0.312	0.50	0.38	0.38	0.134	0.040
Economic Factors										
Unemployed or not working (binary scale 0-1)	0.84	0.86	0.72	0.655	0.093	0.25	0.27	0.20	0.625	0.218
Bad Financial Status (binary scale 0-1)	0.76	0.66	0.59	0.197	0.024	0.43	0.36	0.29	0.124	0.001
Borrowed money (binary scale 0-1)	0.31	0.13	0.30	0.005	0.905	0.13	0.11	0.09	0.462	0.141
At least once went to bed w/out food within last 7 days (binary scale 0-1)	0.17	0.07	0.11	0.041	0.214	0.08	0.04	0.02	0.076	0.001
Food item not available when going grocery shopping (binary scale 0-1)	0.19	0.25	0.08	0.361	0.039	0.16	0.06	0.03	0.000	0.000
Lockdown Stress Factors										
Distrust in government (binary scale 0-1)	0.08	0.44	0.33	0.000	0.000	0.18	0.28	0.27	0.009	0.020
Never went outside the compound to visit someone in last 7 days (binary scale 0-1)	0.82	0.91	0.72	0.084	0.149	0.93	0.54	0.33	0.000	0.000
Worried about not getting enough food in the near future (binary scale 0-1)	0.90	0.79	0.78	0.062	0.044	0.69	0.42	0.47	0.000	0.000
Worried about lower future income of my household (binary scale 0-1)	0.95	0.75	0.84	0.000	0.022	0.83	0.69	0.81	0.000	0.468
Afraid of someone at home (binary scale 0-1)	0.16	0.22	0.27	0.323	0.069	0.47	0.26	0.29	0.000	0.000
Pandemic Stress Factors										
Bad Health Condition (binary scale 0-1)	0.06	0.06	0.09	0.818	0.552	0.04	0.06	0.06	0.359	0.578
Not at least mentioned two COVID-19 symptoms defined by WHO (binary scale 0-1)	0.44	0.33	0.50	0.126	0.451	0.31	0.47	0.57	0.000	0.000
No knowledge of COVID-19 cases (binary scale 0-1)	0.58	0.91	1.00	0.000	0.000	0.60	0.80	0.79	0.000	0.000
Worried about health of family (binary scale 0-1)	0.91	0.74	0.81	0.006	0.068	0.67	0.58	0.70	0.047	0.493

Notes: Based on questions "On a scale from 0 to 10, if 0 is not at all satisfied and 10 is completely satisfied. How satisfied are you with your life at the moment?", "Can you tell me how much this statement applies to you? I feel down, depressed, hopeless" (1= does not apply at all to 5 = strongly applies), "What is your main working status?" (displayed as binary if unemployed or not working, April 2020 refres to before lockdown, a detailed figure can be found in Appendix 6.A.3), "How would you rate the overall financial condition of your household today?" (displayed as binary if bad or very bad), "Did you borrow money last week?" (displayed as binary if yes), "How many days did you go to bed without food during the last week?" (displayed as binary if at least once), "The last time you went shopping, were there any items you wanted to buy but were not available?" (displayed as binary if yes), "How much do you trust the government to take care of the people?" (displayed as binary if strongly distrust or somewhat distrust), "How many people have you visited outside of your house in the last 7 days?" (displayed as binary if never), "I am worried about not getting enough food in the near future" (displayed as binary if does strongly apply or somewhat apply), "I am worried about lower future income of my household in the future" (displayed as binary if does strongly apply or somewhat apply), "I am afraid of someone I am sharing the house with" (displayed as binary if does strongly apply or somewhat apply), "How would you consider your health?" (displayed as binary if terrible or bad), "What are the symptoms of Coronavirus?" (displayed as binary if not more than two officially WHO symptoms are mentioned), "How many people do you think have been infected by the Coronavirus?" (displayed as binary if number not within 20% boundary of correct cases), "I am worried about the health of my family (displayed as binary if does strongly apply or somewhat apply). Results are reweighted with IPW presented in Table 6.A.1.

Tab. 6.A.6: Factors correlating with life satisfaction and feeling depressed, by gender and pooled OLS regression.

	Life satisfaction (0 - 10)					Feel down, depressed, hopeless (1-5)				
	South Africa	Ghana	Borth	Both Male	Both Female	South Africa	Ghana	Borth	Both Male	Both Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Survey round (ref. April 2020)										
August 2020	0.689*	-0.244**	0.0106	-0.0917	0.0388	-0.273	0.0685	-0.0634	-0.121	0.0132
	(0.089)	(0.019)	(0.936)	(0.526)	(0.855)	(0.238)	(0.367)	(0.430)	(0.236)	(0.916)
March 2021	1.534***	-0.317***	0.196	-0.230	0.597**	-0.103	0.195**	0.0897	0.148	0.0357
	(0.000)	(0.003)	(0.174)	(0.131)	(0.011)	(0.639)	(0.021)	(0.303)	(0.176)	(0.788)
Country (ref. South Africa)										
Ghana			-0.169	0.0981	-0.378			0.183	0.0316	0.233
			(0.437)	(0.773)	(0.167)			(0.143)	(0.886)	(0.151)
Socio-economic factors										
Female	0.441	-0.0447	0.0548			-0.00875	0.0476	0.0536		
	(0.133)	(0.556)	(0.567)			(0.965)	(0.414)	(0.403)		
Age (average in years)	0.165	0.0591*	0.0701*	0.0777*	0.0649	-0.0776	0.0341	0.00966	-0.00533	0.0267
	(0.185)	(0.063)	(0.078)	(0.080)	(0.300)	(0.330)	(0.156)	(0.717)	(0.874)	(0.516)
Household with children (ref. no)	0.237	0.146	0.219**	0.112	0.522***	0.175	-0.0629	0.0503	0.0133	0.0243
	(0.224)	(0.131)	(0.027)	(0.329)	(0.003)	(0.174)	(0.321)	(0.442)	(0.868)	(0.838)
Average number of rooms per person	-0.0165	-0.0771	-0.0195	-0.0918	0.0495	0.0882	0.0895	0.0518	0.102	0.0130
	(0.952)	(0.312)	(0.836)	(0.385)	(0.746)	(0.644)	(0.112)	(0.403)	(0.157)	(0.899)
Shared water source with other households	-0.149	-0.229**	-0.174	-0.337**	-0.0201	-0.459	-0.0184	-0.0554	-0.0720	-0.0328
	(0.769)	(0.029)	(0.129)	(0.019)	(0.911)	(0.311)	(0.827)	(0.545)	(0.485)	(0.847)
Shared toilet with other households	0.702	-0.182**	-0.0317	-0.139	0.176	-0.0379	-0.00247	0.0414	0.0325	0.0594
	(0.146)	(0.034)	(0.737)	(0.216)	(0.289)	(0.900)	(0.969)	(0.525)	(0.680)	(0.602)
Education (ref. no education)										
Primary education completed only	0.101	-0.211	-0.0213	0.190	-0.0930	-0.0671	0.0492	0.0767	0.188	0.103
	(0.769)	(0.204)	(0.907)	(0.618)	(0.662)	(0.751)	(0.715)	(0.528)	(0.378)	(0.493)
Secondary education completed only	-0.560	-0.0937	-0.129	0.0109	-0.169	0.0480	-0.0104	0.106	0.316*	0.0514
	(0.234)	(0.513)	(0.442)	(0.972)	(0.409)	(0.855)	(0.925)	(0.318)	(0.064)	(0.709)
Tertiary education completed	0.712	0.195	0.440**	0.386	0.653*	0.756*	0.195	0.390***	0.480**	0.715***
	(0.202)	(0.284)	(0.033)	(0.252)	(0.067)	(0.094)	(0.147)	(0.006)	(0.012)	(0.007)
Economic Factors										
Work Status (ref. Unemployed)										
Self-employed	0.550	0.867***	0.763***	0.900***	0.871***	-0.136	-0.385***	-0.373***	-0.597***	-0.227
	(0.414)	(0.000)	(0.000)	(0.002)	(0.001)	(0.669)	(0.010)	(0.003)	(0.002)	(0.154)
Employment without contract	-0.0790	0.350*	0.262	0.444	0.236	0.577	-0.180	-0.0496	-0.215	0.00406
	(0.861)	(0.064)	(0.199)	(0.126)	(0.364)	(0.130)	(0.248)	(0.721)	(0.301)	(0.983)
Employment with contract	1.112**	1.132***	0.988***	1.265***	0.796**	-0.398	-0.455***	-0.466***	-0.629***	-0.435**
	(0.040)	(0.000)	(0.000)	(0.000)	(0.044)	(0.126)	(0.003)	(0.000)	(0.002)	(0.019)
Not working	-0.166	0.404**	0.252	0.486	0.159	-0.147	-0.0175	-0.101	-0.353	0.00104
	(0.669)	(0.050)	(0.268)	(0.160)	(0.565)	(0.513)	(0.916)	(0.467)	(0.109)	(0.995)
Bad Financial Status (ref. good)	-0.681**	-0.820***	-0.712***	-0.900***	-0.562***	0.571***	0.473***	0.485***	0.538***	0.449***
	(0.034)	(0.000)	(0.000)	(0.000)	(0.003)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Borrowed money (ref. no)	-1.401***	0.0486	-0.551***	0.116	-1.105***	0.633***	0.254**	0.398***	0.198	0.579***
	(0.000)	(0.720)	(0.001)	(0.546)	(0.000)	(0.001)	(0.017)	(0.000)	(0.146)	(0.000)
At least once went to bed w/out food	-0.299	-0.160	-0.400*	-0.427	-0.288	0.196	0.272	0.152	0.228	0.0891
within last 7 days	(0.427)	(0.443)	(0.062)	(0.146)	(0.343)	(0.428)	(0.108)	(0.327)	(0.301)	(0.672)
Food item not available when going	0.266	-0.369**	-0.0616	-0.324	0.187	-0.370	0.507***	0.152	0.367**	-0.0347
grocery shopping	(0.415)	(0.014)	(0.713)	(0.144)	(0.418)	(0.105)	(0.000)	(0.196)	(0.010)	(0.842)
Lockdown Stress Factors										
Distrust in government (ref. trust)	0.449	-0.296***	-0.0961	-0.200*	0.0185	0.168	-0.0470	-0.0146	-0.0786	0.0596
	(0.189)	(0.000)	(0.359)	(0.097)	(0.916)	(0.408)	(0.478)	(0.838)	(0.356)	(0.603)
Never went outside the compound to	-0.621*	0.124	0.174	0.0575	0.299*	0.322	0.121*	0.128*	0.121	0.119
visit someone in last 7 days	(0.065)	(0.170)	(0.105)	(0.623)	(0.093)	(0.155)	(0.077)	(0.076)	(0.171)	(0.307)
Worried about not getting enough food	-1.012**	-0.559***	-0.575***	-0.559***	-0.540***	0.401	0.636***	0.600***	0.523***	0.663***
in the near future	(0.010)	(0.000)	(0.000)	(0.000)	(0.006)	(0.106)	(0.000)	(0.000)	(0.000)	(0.000)
Worried about lower future income of	-0.505	-0.643***	-0.689***	-0.626***	-0.697***	0.264	0.344***	0.355***	0.330***	0.385***
my household	(0.193)	(0.000)	(0.000)	(0.000)	(0.001)	(0.307)	(0.000)	(0.000)	(0.000)	(0.004)
Afraid of someone at home	-0.764**	-0.303***	-0.384***	-0.516***	-0.218	0.284	0.737***	0.627***	0.706***	0.510***
	(0.025)	(0.001)	(0.001)	(0.000)	(0.237)	(0.157)	(0.000)	(0.000)	(0.000)	(0.000)
Pandemic Stress Factors										
Bad Health Condition (ref. good)	-0.940**	-0.000456	-0.305	-0.368	-0.233	0.552*	0.628***	0.630***	0.734***	0.551***
	(0.011)	(0.998)	(0.100)	(0.268)	(0.319)	(0.078)	(0.001)	(0.000)	(0.006)	(0.009)
Not at least mentioned two COVID-19	0.204	-0.221***	-0.153	-0.227**	-0.0828	-0.0547	0.0141	0.0197	0.0352	-0.00913
symptoms defined by WHO	(0.453)	(0.002)	(0.101)	(0.027)	(0.585)	(0.738)	(0.803)	(0.747)	(0.632)	(0.926)
No knowledge of COVID-19 cases	-1.167***	-0.438***	-0.531***	-0.353***	-0.715***	0.236	0.228***	0.220***	0.163**	0.286**
	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.373)	(0.000)	(0.001)	(0.021)	(0.022)
Worried about health of family	-0.215	0.126	-0.00130	0.128	-0.219	0.470**	0.364***	0.411***	0.316***	0.559***
	(0.530)	(0.109)	(0.989)	(0.192)	(0.231)	(0.033)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	6.499***	6.296***	6.149***	5.914***	5.927***	1.042	0.859***	0.659***	0.977***	0.413
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.110)	(0.000)	(0.004)	(0.005)	(0.205)
Observations	363	2107	2470	1470	1000	361	2114	2475	1476	999
Adjusted R-squared	0.247	0.295	0.254	0.294	0.222	0.143	0.364	0.317	0.334	0.281

Notes: OLS regression of life satisfaction and depression by country and gender and pooled. Scale for outcome feeling down, depressed, hopeless refers to 1 = does not apply at all to 5 = strongly applies. Detailed information about the variables can be found in Tables 6.A.4 and 6.A.5. All results are reweighted with IPW presented in Table 6.A.1. P-values in parentheses: * p<0.10, ** p<0.05, *** p<0.01. Models have fewer observations if people said they do not want to answer question about life satisfaction or depression.

Tab. 6.A.7: Factors correlating with the feeling depressed, pooled ordered logit regression.

	Feel down, depressed, hopeless (1 - 5)			
	(1)	(2)	(3)	(4)
Survey round (ref. April 2020)				
August 2020	0.610***	0.605***	0.710***	0.962
	(0.000)	(0.000)	(0.003)	(0.762)
March 2021	0.998	0.996	1.309***	1.414***
	(0.983)	(0.967)	(0.008)	(0.007)
Country (ref. South Africa)				
Ghana	0.493***	0.406***	0.903	1.469**
	(0.000)	(0.000)	(0.526)	(0.031)
Socio-economic factors				
Female		1.330***	1.318***	1.185*
		(0.001)	(0.002)	(0.087)
Age (average in years)		1.047	1.050	1.036
		(0.168)	(0.198)	(0.402)
Average number of rooms per person		0.915	0.993	1.112
		(0.329)	(0.936)	(0.311)
Household with children (ref. no)		1.124	1.136	1.113
		(0.176)	(0.151)	(0.273)
Shared water source with other households		1.011	0.807*	0.896
		(0.929)	(0.099)	(0.426)
Shared toilet with other households		1.641***	1.386***	1.084
		(0.000)	(0.001)	(0.440)
Education (ref. no education)				
Primary education completed only		1.380*	1.303	1.171
		(0.050)	(0.109)	(0.363)
Secondary education completed only		1.054	1.139	1.225
		(0.719)	(0.386)	(0.195)
Tertiary education completed		1.325	1.555**	2.067***
		(0.147)	(0.030)	(0.001)
Economic Factors				
Work Status (ref. Unemployed)			0.591***	0.573***
Self-employed			(0.001)	(0.001)
			1.238	0.973
Employment without contract			(0.238)	(0.885)
			0.578***	0.498***
Employment with contract			(0.001)	(0.000)
			0.846	0.887
Not working			(0.354)	(0.541)
			2.681***	2.057***
Bad Financial Status (ref. good)			(0.000)	(0.000)
			1.757***	1.700***
Borrowed money (ref. no)			(0.000)	(0.000)
			1.526**	1.289
At least once went to bed w/out food within last 7 days			(0.034)	(0.248)
			1.606***	1.315
Food item not available when going grocery shopping			(0.003)	(0.118)
			0.591***	0.573***
Lockdown Stress Factors				
Distrust in government (ref. trust)				1.019
				(0.869)
Never went outside the compound to visit someone in last 7 days				1.373***
				(0.004)
Worried about not getting enough food in the near future				2.465***
				(0.000)
Worried about lower future income of my household				2.146***
				(0.000)
Afraid of someone at home				2.396***
				(0.000)
Pandemic Stress Factors				
Bad Health Condition (ref. good)				2.425***
				(0.000)
Not at least mentioned two COVID-19 symptoms defined by WHO				1.037
				(0.699)
No knowledge of COVID-19 cases				1.399***
				(0.001)
Worried about health of family				2.155***
				(0.000)
Observations	2485	2485	2484	2475
Pseudo R-squared	0.016	0.024	0.064	0.141

Notes: Ordered logit model of depression. Odds ratios larger than 1 mean an increased feeling of down, depressed, hopeless. Scale for outcome feel down, depressed, hopeless refers to 1 = does not apply at all to 5 = strongly applies. Detailed information about the variables can be found in Tables 6.A.4 and 6.A.5. All results are reweighted with IPW presented in Table 6.A.1. P-values in parentheses: * p<0.10, ** p<0.05, *** p<0.01. Models have a smaller number of observations if people said they do not want to answer question about life satisfaction or depression.

Tab. 6.A.8: Factors correlating with life satisfaction and feeling depressed, fixed effect panel regression by gender.

	Life satisfaction (0 to +10)			Feel down, depressed, hopeless (1-5)		
	Male	Female	Both	Male	Female	Both
	(1)	(2)	(3)	(4)	(5)	(6)
Time Fixed Effect (ref. April 2020)						
August 2020	0.120	0.0681	0.156	-0.238**	-0.0473	-0.168**
	(0.408)	(0.736)	(0.231)	(0.040)	(0.673)	(0.037)
March 2021	0.0722	0.652***	0.414***	0.0824	-0.0391	0.0168
	(0.643)	(0.002)	(0.003)	(0.474)	(0.775)	(0.849)
Economic Factors						
Work Status (ref. Unemployed)						
Self-employed	0.566	1.309***	0.899**	-0.767**	-0.204	-0.382*
	(0.360)	(0.001)	(0.012)	(0.011)	(0.411)	(0.054)
Employment without contract	0.780	1.094***	0.935***	-0.279	0.0877	0.000409
	(0.168)	(0.002)	(0.002)	(0.311)	(0.748)	(0.998)
Employment with contract	1.112**	1.586***	1.294***	-0.771***	-0.246	-0.430**
	(0.046)	(0.000)	(0.000)	(0.007)	(0.419)	(0.033)
Not working	0.844	-0.0505	0.278	-0.187	0.301	0.184
	(0.228)	(0.912)	(0.472)	(0.562)	(0.284)	(0.427)
Bad Financial Status (ref. good)	-0.728***	-0.784***	-0.779***	0.579***	0.287*	0.431***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.053)	(0.000)
Borrowed money (ref. no)	0.149	-1.209***	-0.564***	0.204	0.583***	0.415***
	(0.526)	(0.000)	(0.004)	(0.145)	(0.000)	(0.000)
At least once went to bed w/out food within last 7 days	-0.271	-0.753*	-0.532*	0.148	0.182	0.157
	(0.417)	(0.084)	(0.071)	(0.518)	(0.412)	(0.338)
Food item not available when going grocery shopping	-0.354	0.540*	0.172	0.314**	-0.0912	0.0590
	(0.160)	(0.055)	(0.404)	(0.042)	(0.659)	(0.668)
Lockdown Stress Factors						
Distrust in government (ref. trust)	-0.164	0.220	-0.0100	0.115	-0.0380	0.0505
	(0.281)	(0.299)	(0.940)	(0.323)	(0.778)	(0.578)
Never went outside the compound to visit someone in last 7 days	0.279*	0.537***	0.402***	0.0575	0.0176	0.0637
	(0.054)	(0.004)	(0.001)	(0.577)	(0.881)	(0.405)
Worried about not getting enough food in the near future	-0.316**	-0.556***	-0.450***	0.302**	0.575***	0.440***
	(0.022)	(0.008)	(0.000)	(0.010)	(0.000)	(0.000)
Worried about lower future income of my household	-0.557***	-0.551**	-0.575***	0.278***	0.610***	0.410***
	(0.000)	(0.013)	(0.000)	(0.009)	(0.000)	(0.000)
Afraid of someone at home	-0.190	-0.0233	-0.0710	0.412***	0.347***	0.380***
	(0.208)	(0.905)	(0.585)	(0.000)	(0.008)	(0.000)
Pandemic Stress Factor						
Bad Health Condition (ref. good)	-0.519	-0.520*	-0.562**	0.716**	0.689***	0.691***
	(0.274)	(0.067)	(0.017)	(0.016)	(0.005)	(0.000)
Not at least mentioned two COVID-19 symptoms defined by WHO	-0.174	-0.0432	-0.128	0.0136	-0.0723	-0.0325
	(0.145)	(0.804)	(0.235)	(0.881)	(0.514)	(0.642)
No knowledge of COVID-19 cases	-0.542***	-0.964***	-0.728***	0.0741	0.377***	0.217***
	(0.000)	(0.000)	(0.000)	(0.423)	(0.008)	(0.007)
Worried about health of family	-0.230*	-0.533**	-0.373***	0.235**	0.266	0.238**
	(0.083)	(0.021)	(0.002)	(0.026)	(0.113)	(0.012)
Constant	5.974***	6.215***	6.012***	1.866***	0.979***	1.372***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Observations	1470	1000	2470	1476	999	2475
Adjusted R-squared	0.167	0.269	0.195	0.205	0.199	0.195

Notes: Fixed effect panel regression of life satisfaction and depression. Scale for outcome feel down, depressed, hopeless refers to 1 = does not apply at all to 5 = strongly applies. Detailed information about the variables can be found in Tables 6.A.4 and 6.A.5. All results are reweighted with IPW presented in Table 6.A.1. P-values in parentheses: * p<0.10, ** p<0.05, *** p<0.01. Models have fewer number of observations if people said they do not want to answer question about life satisfaction or depression.

Tab. 6.A.9: Factors correlating with feeling depressed, fixed effect ordered logit.

	Feel down, depressed, hopeless (1-5)		
	South Africa	Ghana	Both
	(1)	(2)	(3)
Time Fixed Effect (ref. April 2020)			
August 2020	0.619	0.933	0.729**
	(0.161)	(0.668)	(0.024)
March 2021	0.665	1.277	0.975
	(0.206)	(0.149)	(0.864)
Economic Factors			
Work Status (ref. Unemployed)			
Self-employed	0.800	0.397**	0.517*
	(0.776)	(0.020)	(0.053)
Employment without contract	1.750	0.807	0.984
	(0.312)	(0.610)	(0.959)
Employment with contract	0.519	0.423**	0.487**
	(0.241)	(0.035)	(0.039)
Not working	1.857	1.283	1.716
	(0.230)	(0.579)	(0.166)
Bad Financial Status (ref. good)	1.390	2.323***	1.945***
	(0.340)	(0.000)	(0.000)
Borrowed money (ref. no)	3.175***	1.421*	2.215***
	(0.000)	(0.092)	(0.000)
At least once went to bed w/out food within last 7 days	0.941	1.387	1.138
	(0.888)	(0.232)	(0.625)
Food item not available when going grocery shopping	0.558	1.889**	1.013
	(0.118)	(0.012)	(0.951)
Lockdown Stress Factors			
Distrust in government (ref. trust)	0.815	1.324*	1.091
	(0.575)	(0.089)	(0.596)
Never went outside the compound to visit someone in last 7 days	0.773	1.301*	1.125
	(0.493)	(0.099)	(0.411)
Worried about not getting enough food in the near future	1.792	2.340***	2.108***
	(0.121)	(0.000)	(0.000)
Worried about lower future income of my household	1.903	1.970***	2.230***
	(0.206)	(0.002)	(0.000)
Afraid of someone at home	1.360	1.911***	1.678***
	(0.413)	(0.000)	(0.001)
Pandemic Stress Factor			
Bad Health Condition (ref. good)	2.948*	5.499***	3.855***
	(0.070)	(0.000)	(0.000)
Not at least mentioned two COVID-19 symptoms defined by WHO	0.731	0.956	0.909
	(0.303)	(0.745)	(0.458)
No knowledge of COVID-19 cases	2.164	1.299*	1.439**
	(0.107)	(0.070)	(0.013)
Worried about health of family	2.333**	1.438*	1.661***
	(0.026)	(0.051)	(0.004)
Observations	323	1591	1914
Pseudo R-squared	0.214	0.288	0.242

Notes: Fixed effect ordered logit model of depression. Odds ratios larger than 1mean an increased feeling of down, depressed, hopeless. Scale for outcome feel down, depressed, hopeless refers to 1 = does not apply at all to 5 = strongly applies. Detailed information about the variables can be found in Tables 6.A.4 and 6.A.5. All results are reweighted with IPW presented in Table 6.A.1. P-values in parentheses: * p<0.10, ** p<0.05, *** p<0.01. Models have a smaller number of observations if people said they do not want to answer question about life satisfaction or depression.

Chapter 7

Conclusion

This dissertation demonstrates that Universal Health Coverage (UHC) demands strengthening health systems with inclusive protection schemes, sustainable financing structures, and resilient governance to leave no one behind. As the current COVID-19 pandemic threatens decades of global health achievements and has halted the progress of UHC, it has become even more clear that health systems need to be resilient and improve their emergency preparedness so that everyone, also the most vulnerable populations, can access health care at any time without financial hardship.

In this Section, I will summarize the main findings of the five papers (chapters 2-6), point out the limitations of this work, explain the key lessons for public policy, and discuss the broader academic contributions of this dissertation. I will close with some reflections on where future research might go from here.

7.1 Review of main findings

This dissertation examines three aspects of UHC (see Figure 1.1), focusing on SSA countries, where the most vulnerable population groups are located, and where health care resources are particularly limited. In the first part of the dissertation (chapter 2), I addressed the service and cost aspects of UHC to better understand the structure and the functioning of a mandatory health insurance scheme in a sub-Saharan African (SSA) country. In the second part (chapters 3 and 4), I analyzed how COVID-19 and the corresponding government interventions affected the health system, in particular, the continuous provision of essential health services, to better understand the health system's resilience. In the third part (chapters 5 and 6), I focus on how people's lives were affected by the COVID-19 pandemic and how the most vulnerable people, the urban poor, cope with the situation to better understand the people's resilience.

7.1.1 Service and cost structure of a health protection scheme

Analyzing the service structure of a mandatory health insurance scheme in an SSA country, namely the National Health Insurance Fund (NHIF) for public employees in Tanzania, my co-authors and I find that only half of the beneficiaries made at least one claim during a year (chapter 2). Since this is the first comprehensive analysis of a large-scale mandatory health insurance database for any African country, we cannot directly compare the number to other low- and middle-income countries (LMICs); however, the comparison with

high-income countries (HICs) shows that this rate is rather low (EDI, 2020). Our results show that especially men and children, the elderly, and the poorest and richest policyholders who are covered by health insurance take up services less often. Besides possible explanations for fewer recorded take-ups, such as having enough money to visit private non-accredited health facilities, and/or being in better health (e.g., highest-salary group, Fichera & Savage, 2015; EDI, 2020; Dieleman et al., 2020), this finding also highlights that vulnerable groups seem to still face barriers to access health care even if a health insurance scheme covers them. This finding contributes to the literature, indicating that being enrolled in a health insurance scheme does not necessarily improve access to health care (e.g., Alhassan et al., 2015; Duku et al., 2018; Aikins et al., 2019; Macha et al., 2014).

Analyzing the NHIF in Tanzania also allows us to better understand where services were offered (chapter 2). We find that only about two-thirds of all eligible health facilities treated at least one NHIF patient within a year. Again, since this analysis is the first of its kind for an African country we cannot compare it, but the number seems rather low compared to HICs. Our results show that especially lower care levels (dispensaries and pharmacies), rural and poorer regions, and private health facilities were less likely to treat NHIF patients. Besides possible explanations for fewer recorded take-ups, such as having fewer NHIF patients, this finding contributes to the current literature that qualitatively discusses that treating insured patients is less financially profitable for health facilities due to issues in the insurance scheme (e.g., Aikins et al., 2019; Ashigbie et al., 2016; Macha et al., 2014). The findings indicate that extending UHC by expanding the number of accredited health facilities does not necessarily improve access to health care if health facilities face barriers to providing services to insured patients. However, we could not quantitatively evaluate this effect due to data limitations.

Analyzing who received what type of service at which health facility provides a unique insight into financial protection and the costs of disease. In the analysis of the NHIF in Tanzania (chapter 2), we find that painkillers, antibiotics and anti-malaria drugs, together with diagnostics (stool, urine and blood, and malaria blood smears) are most frequently provided. Especially treatments for diseases such as malaria and diarrhea, which could at least partly be prevented through better infrastructure and hygiene, place a relatively high burden on the insurance scheme. On the other hand, non-communicable diseases (NCDs), such as cancer, cardiovascular diseases, and diabetes, which are increasing globally, are not (yet) causing most claims in Tanzania, but those claims are the most expensive ones. Therefore, only 10% of the policyholders account for 80% of the health care expenditure, which is more skewed compared to HICs (e.g., Vuffray, 2018). Since many NCDs are related to lifestyle factors and can be easily treated at an early stage of detection, it will be essential to improve access to care, diagnostic capabilities as well as promote healthier lifestyles (e.g., Lyimo et al., 2020). The results highlight the importance of investments in preventive services for malaria, hygiene-related infections, and NCDs to implement cost-effective interventions.

Finally, in our analysis of the NHIF in Tanzania, we are the first comprehensive study

to analyze the implications of expanding a health insurance scheme to the entire population to improve UHC (chapter 2). On average, the insurance incurs costs in the magnitude of about 60% of the yearly insurance fee for a single policyholder and that person's family. Thus, the health insurance makes a substantial surplus of 40%. This rate is rather high compared to some HICs (EDI, 2020; Dieleman et al., 2020; AOK-Bundesverband, 2019). The results highlight the need to run a rather high surplus based on insuring those who are formally employed in order to subsidize poor informal and rural populations to achieve UHC (Lee et al., 2019). This insight is especially important in countries with a large informal sector, where expanding social health insurance schemes to vulnerable groups is particularly difficult. We conclude that given the current costs and revenues in NHIF, an extension of the NHIF scheme to the entire Tanzanian population is currently not financially sustainable. Therefore, the government must either increase revenues (e.g., by increased insurance premiums, extended contribution groups, more tax-based revenues, or international funds) and/or decrease costs (e.g., reducing the health services covered, improving preventative behavior, or increase efficiency) to sustainably achieve UHC.

7.1.2 Essential health service provision during the COVID-19 pandemic

In our analysis of country-wide monthly administrative data of a set of essential health services aggregated by districts in Ghana (chapters 3 and 4), we find much less interruption and faster recovery from COVID-19 and the corresponding government interventions than expected by some other studies (e.g., Roberton et al., 2020; Hogan et al., 2020; Abbas et al., 2020). However, the effects differ considerably between health services. For child immunization, we find an average decrease of around 9% during April 2020, however, with large variation among vaccine types. Yellow fever witnessed a drop of around 22% in April 2020, whereas time-critical vaccines, such as polio 0, experienced no interruption. Similarly, maternal health services, such as C-sections and birth in a health facility, showed no interruption, whereas diarrhea diseases for children below five and road accident treatments decreased substantially. Nevertheless, all services that experienced a decline recovered over the period of a year, even though the country experienced additional and more severe COVID-19 waves during this time. These findings highlight the importance of country-wide and long-term data to fully understand the effects of COVID-19. However, the results also show that we cannot generalize the insights from one health service to another health service.

Surprisingly, when we focused only on child routine immunization (chapter 3) the results further show that the decline had already started in February 2020 before the first case of COVID-19 was reported in Ghana, but when the pandemic was already spreading globally and widely featured in Ghanaian media. This timing indicates that fear of COVID-19 pandemic early in the pandemic might have driven a short-term disruption. Additionally, we know that the national yellow fever campaign scheduled for April 2020 had to be postponed, potentially explaining the substantially larger drop in yellow fever vaccines compared to other vaccine types. Thus, in the case of child routine vaccines in

Ghana (chapter 3), the results provide evidence that no supply-side factors, such as closed health facilities and staff shortages, or demand-side factors, such as travel barriers and liquidity constraints, caused negative interruptions, but fear of COVID-19 early in the pandemic, a short public lockdown, and delayed vaccination outreach campaigns did.

The analysis of the two health services—the number of children treated for diarrhea disease and the number of road accident treatments due to road traffic—indicates that some health services were not interrupted due to less provision, but due to less demand (chapter 4). The results show that both services are correlated with the stringency measures in place rather than with COVID-19 cases. In the case of diarrhea diseases, the results indicate that hygiene and social distancing measures in place during the pandemic led to lower incidences. In the case of road accident treatments, the results show that mobility restrictions in lockdown-affected districts as well as mobility reduction in non-lockdown-districts with COVID-19 cases led to lower incidences due to less traffic. These findings are in line with other studies from HICs and LMICs showing that there were lower incidences of certain diseases or treatments due to the government interventions and the population's adherence to them (e.g., Gómez-Pérez et al., 2022). Therefore, the results highlight that besides adverse indirect effects, there were also positive health effects in response to government interventions against COVID-19.

7.1.3 Coping with the COVID-19 pandemic

Since the pandemic and the corresponding government interventions affect not only health systems and health care provision, but also people's socioeconomic situation and the economy, in general, we aimed to better understand how the lives of the most vulnerable people were affected in LMICs. Based on a self-collected three-wave panel in two of the African cities with the most COVID-19 infections, Accra and Greater Johannesburg, we provide both short-term evidence, one month into the pandemic and during the lockdown in April 2020 (chapter 5), as well as longer-term evidence, almost one year later in March 2021 (chapter 6). The comparison of both countries is particularly interesting because—as in many other LMICs—both Ghana and South Africa implemented strict lockdowns of public life to limit the spread of COVID-19 even before the 100^{th} confirmed case. However, South Africa implemented one of the strictest lockdowns globally and only gradually lifted the restrictions, whereas Ghana implemented the public lockdown only in the most affected cities (Accra and Kumasi) and lifted it after only three weeks due to fears about worsening economic conditions (Hale et al., 2022).

In the short term, we find a large but different impact on socioeconomic and economic factors in Ghana and South Africa (chapter 5). In Ghana, the urban poor were most affected by the loss of income and increased food prices, whereas in South Africa, fear of getting sick and children staying home due to school closures, rather than economic factors, were the largest problems. In our sample, South Africans did not experience loss of income as a major issue, most likely due to the fact that many of the urban poor receive various grants from the government, which constitute their main source of income and

which were not affected by COVID-19. We find that a substantial share of self-employed respondents in both countries still worked during the lockdown, emphasizing the need for regular income despite mandates to stay at home. These results highlight the importance of social security systems in place to disperse income to those in need—especially in times of a pandemic.

In the longer term, one year into the pandemic, most factors influencing the economic situation among the urban poor in South Africa and Ghana recovered to a similar level as it was before the lockdown (chapter 6). Interestingly, we find that this recovery already happened shortly after the lockdown was lifted in Ghana, whereas the recovery took longer in South Africa. However, this pattern is expected due to the length and stringency of the South African government interventions. The economic recovery we observe is also in line with a few longer-term longitudinal studies from other countries in LMICs (e.g., WorldBank, 2021a).

Economic downturns have previously been shown to be strongly associated with worsening mental health (Avdic et al., 2020; Black et al., 2022). Thus, we expect mental health has also deteriorated during the lockdown and should have recovered faster in Ghana than in South Africa over one year (Avdic et al., 2020; Black et al., 2022). However, our analysis of the three-wave panel survey of poor, urban Ghanaians and South Africans shows that feeling depressed recovered in the short term in August 2020, but increased again in March 2021 (chapter 6). Since we are the first study analyzing mental health dynamics in LMICs up to one year into the pandemic, we cannot compare these results with other studies. Nevertheless, the results indicate that the correlation between economic and mental health recovery might be lower than expected and that other factors drive the development.

The analysis of the impact of COVID-19 and the government interventions that could potentially influence mental health reveals that the ongoing mental health crisis is linked to stress factors related to both the global pandemic and the national lockdown (chapter 6). In particular, increased worries about the future and limited knowledge about the pandemic were highly correlated with worse mental health in both countries. Additionally, country-specific, deteriorating physical health played a role in South Africa, and trust in the government in Ghana explained why mental health has not recovered. Those findings emphasize the need for broad and country-specific policies, beyond financial support, to accelerate the post-pandemic recovery among the urban poor.

Since our results indicate that stringent national lockdowns have had a substantial impact on the economic situation, mental health, and social factors, the next question is whether these costly measures even effectively influence people to make the necessary behavioral changes to contain the spread of the pandemic. Our study of the urban poor in Ghana and South Africa during the lockdown in April 2020 highlights that although the government interventions were different in terms of length and stringency across the two countries, people's mitigation measures were similar (chapter 5). We find that most people adhered to low cost and easily implementable measures, such as washing hands, avoiding public gatherings, and avoiding shaking hands. However, staying at home is challenging

due to the crowded homes and lost income. For example, in the case of Ghana, keeping a one-meter distance in public is a major issue because many depend on public transport or public toilets. We find some weak first indications that social distancing measures are substituted by hygienic measures if social distancing is too costly for the families. This finding highlights that adherence to government interventions may be limited due to restricted infrastructure, contributing to the overall discussion on inadequate infrastructure to follow government interventions during the pandemic (e.g., Günther et al., 2022).

Our results of the survey during the lockdown in Ghana and South Africa also show that adherence to government interventions is larger if people perceive the government measures as appropriate, they trust the government, and they are well informed about the pandemic (chapter 5). The results highlight that instead of strict lockdown interventions, with low enforcement and high costs for the urban poor, providing better information to the population about COVID-19 and the reasons behind the restrictions might already improve adherence to lower-cost interventions. This recommendation is especially important since governments had to relax their interventions despite still rising COVID-19 cases.

Lastly, we find that a considerable share of the surveyed urban poor in both countries are not well informed about infection, symptoms, and recommended treatment (chapter 5). However, we find no evidence that misinformation, as it was spreading in other countries, is a major issue in Ghana and South Africa (WHO, 2020g; Wanga et al., 2020; DeWitte, 2020). A potential explanation could be that we see that most of the urban poor inform themselves by watching TV and less by social media, which might help to reduce misinformation since information spreads at a slower pace and the content is less controlled. However, due to limited data, we cannot identify any causal relationship.

7.2 Limitations

As already discussed in each of the five dissertation papers (chapters 2-6), a few limitations should be considered in interpreting the results of this dissertation. I will discuss here the two main limitations: external validity and limited data availability.

External validity

The external validity of this research—or to what extent the findings can be generalized to a broader context—is limited in particular in the dimensions: countries, population groups, and timing.

To better understand the service and cost structure of a mandatory health insurance scheme in an SSA country, I use the case of the National Health Insurance Fund covering public employees in Tanzania (chapter 2). Since this is the first comprehensive large-scale analysis of a mandatory health insurance database for any African country, I cannot directly generalize the findings to other mandatory health insurance schemes in Africa, such as in Ghana or Rwanda, nor to voluntary health insurance schemes in LMICs that are scaling up coverage to achieve UHC. However, as the literature emphasizes, the overall

challenges faced in the process of achieving UHC are similar to other countries (e.g., Afriyie et al., 2022; Aikins et al., 2019; Ankrah et al., 2018; Lyimo et al., 2020; Macha et al., 2014; Meremo et al., 2017; Salari et al., 2019; Verguet et al., 2021). Another limitation, as discussed in chapter 2, is that the sub-population of public employees and their families in Tanzania differ from the overall population in the country in terms of socioeconomic factors and possibly also their utilization behavior. Nevertheless, the estimates provide the first unbiased insight into a mandatory scheme in an LMIC by avoiding possible biases due to adverse selection of self-selected high-risk beneficiaries. Lastly, one could argue that the claims data from 2016 is outdated, however, as most studies and reports show, coverage rates and the scheme have not changed considerably during the last six years (see footnote 1 in chapter 2). Thus, the results are still relevant to the current situation.

In order to understand how the pandemic affected the ability of the health system to provide ongoing health services, data from the entire population in Ghana is analyzed in chapters 3 and 4. As cross-country studies show, the magnitude and pattern of the effects can substantially vary across countries (e.g., Arsenault et al., 2022) and can, therefore, not be generalized to other countries. However, in comparison to the literature on other countries, the results are not unusual: some health services were also interrupted at the beginning of the COVID-19 pandemic and experienced a small recovery trend (e.g., Arsenault et al., 2022), some health services also decreased due to the positive effects of the hygienic and social distancing measures (e.g., Gómez-Pérez et al., 2022), and for some health services the overall COVID-19 pandemic and not only the strict lockdown measures caused the interruptions

To better understand the impact of the pandemic on people's lives, I use the case of the urban poor in two cities in Ghana and South Africa (chapters 5 and 6). When selecting the sample for the phone survey, we as a research team focused on two of the African countries most affected by COVID-19 and on the population group within those countries that was most vulnerable to the disease as well as the corresponding lockdown measures to counter it—the urban poor. That said, due to this focus on a particular subgroup, the finding cannot be generalized to the total populations of South Africa and Ghana, nor to the urban poor from other African countries. The sample, therefore, complements insights of studies from other African countries and from studies with a total population sample (e.g., IPA, 2020). Additionally, much of the data used in the literature represents a single moment in time and cannot be generalized to the overall development during a pandemic. Chapters 5 and 6 are able to detect developments over time since a three-wave panel survey was collected, following the same people over three points in time for more than a year. Nevertheless, I cannot determine the exact timing of some changes, e.g., the recovery of the economic factors or the recurrent decrease in mental health factors.

Data availability

Data availability limitations occurred in all types of data sources: health insurance claims data, administrative data, and survey data.

Since the health insurance claims data from the NHIF in Tanzania (chapter 2) only include the basic administrative information of insured people who made a claim, I cannot disentangle the detailed mechanisms of why some population groups (e.g., the poorest) and why some health facilities (e.g., private accredited health facilities) have a lower take-up even if they are enrolled into or accredited to the scheme. Nevertheless, in line with the literature, the results highlight that patients and health facilities still face barriers (e.g., Macha et al., 2014; Fichera & Savage, 2015), emphasizing the need for further research.

I used administrative data to better understand the impact of the pandemic on the provision of ongoing health services (chapters 3 and 4), however, I only had access to a subset of health services. Thus, I cannot conclude that the findings are valid for all essential health services in Ghana. Additionally, while the administrative data from the District Health Information Management System (DHIMS) has the advantage that it is representative and does not suffer from patient recall bias (e.g., Tsafack Nanfosso & Tadadjeu, 2022; Cantor et al., 2022); it has the disadvantage that I cannot draw any conclusion about the quality of health services or what population group suffered the most from negative effects.

Lastly, to better understand the impact of the pandemic on people's lives (chapters 5 and 6, we as a research team collected a three-wave phone survey of poor urban households in the two cities, Accra and Johannesburg. The survey started during the strictest phase of the respective lockdowns, so it was only possible to use phone surveys to reach out to the urban poor. Since the phone numbers were collected before the pandemic, they were gathered using two different sampling strategies in each country. Additionally, the phone survey led to relatively high attrition in the South African sample—most likely due to the increased spam calls during the pandemic (Kok, 2020). However, I can show that differences in the sample selection and attrition did not drive the estimates. Additionally, due to the attention span of the participants during a phone survey, we also had to stick to rudimentary mental health indicators instead of more accurate psychological diagnostic test questions, such as the nine-point Patient Health Questionnaire. Nevertheless, the used approach is in line with many other studies using simplified indicators (e.g., Witteveen & Velthorst, 2020; Mahmud & Riley, 2021). Lastly, because the study collected no pre-pandemic indicators except for working status, the conclusion about how socioeconomic or mental health factors have recovered compared to before the pandemic is limited.

7.3 Public policy lessons

The dissertation highlighted some policy-relevant insights based on the main findings and conclusions discussed above. Below I explain the key lessons for public policy and make policy recommendations targeted broadly at international development organizations and local governments.

7.3.1 The need for inclusion to achieve UHC

I find that a relatively small share of beneficiaries insured by the mandatory health insurance scheme in Tanzania actually benefits from the scheme. Also, many accredited health facilities did not treat any insured patients at all within a given year. Both results highlight that access to health care is not necessarily guaranteed even if there is health insurance coverage—especially for the most vulnerable population groups (chapter 2). Besides expanding health issuance coverage, existing barriers for the insured population and the health facilities should be removed. I, therefore, recommend to further investigate existing barriers for these patients, such as lack of health personnel, distance to health facilities, or financial burdens, as well as for the health facilities, such as delayed reimbursement of claim costs or lack of infrastructure (e.g., Aikins et al., 2019; Macha et al., 2014).

Additionally, despite striving for universal coverage, I recommend improving the overall social security system. As the case of the urban poor in South Africa and Ghana during the pandemic showed, the most vulnerable in the South African sample were more resilient to financial losses during COVID-19 due to the social protection scheme in place (chapters 5 and 6). Therefore, an established social security system will help to protect the most vulnerable from shocks. Alternatively, as I find in the case of Ghana during COVID-19, governments can also provide free public services as a form of protection against shocks. However, identifying and targeting the most vulnerable is challenging, often leaving some population groups behind.

Since identifying and targeting the population most in need of additional support demands improvement, I recommend investing in information systems to be better able to identify excluded population groups. This can be in the context of health insurance claim data, where more information about the diagnosis and the service quality could improve the understanding of undertreated patients. This information is especially important in the context of rising NCDs, where preventative measures and early detection is crucial (e.g., HbA1c test to diagnose prediabetes and diabetes). As shown in studies during the COVID-19 pandemic, more health information about the patients from the health insurance data could also make using nudges more effective at instigating behavioral change toward preventative health measures (e.g., Rogge et al., 2022, used personalized messages to nudge protective behavior). Besides improving the technical infrastructure for the information systems also capacity building of health staff, organizations, and governments needs to be improved to be able to quickly respond.

7.3.2 The need for financial sustainability to achieve UHC

I show in the case of the Tanzania NHIF that expanding UHC by scaling up health insurance comes with many trade-offs (chapter 2). Each country's scheme needs to define its mix of revenue and cost sources. Due to the limited data in LMICs, I first recommend that studies from other countries are evaluated and made publicly available. Thus, more

can be learned about utilization and costs in LMICs.

Second, I recommend improving the mix of revenues and costs in a sustainable way. Besides the possible pathways discussed in chapter 2, I want to emphasize the need to reduce incidences and costs for bacterial-related diseases and malaria by raising awareness, preventing behavior, and improving infrastructure. Our findings from the impact of COVID-19 on essential health services in Ghana (chapter 4) as well as other studies (Gómez-Pérez et al., 2022; Karinja et al., 2020) highlighted that indeed more preventative behavior, such as increased hygienic practices or social distancing, can decrease incidences of bacterial- and/or virus-related diseases. Moreover, studies during COVID-19 highlighted that infrastructure such as water and sanitation is still lacking in many LMICs countries (Günther et al., 2022). Therefore, I recommend to invest in raising awareness, preventative behavior and infrastructure to sustainably achieve resilient UHC.

7.3.3 The need for resilience to achieve UHC

As the results from the dissertation highlight and other studies show, the poorest households were disproportionately affected by the COVID-19 pandemic, and pre-existing disparities were magnified (chapters 5 and 6). There is a trade-off between the benefit of government interventions to curb the spreading and the indirect costs of the interventions for vulnerable households. I recommend considering a broad range of needs when designing policies for a post-pandemic recovery and to increase emergency preparedness.

First, as chapter 3 about the impact of the COVID-19 pandemic on routine child immunization in Ghana shows, some districts had substantial interruptions that have not yet recovered. Identifying children with missed vaccines and allocating extra resources to those districts is essential. Therefore, I recommend investing in high-frequency information systems for governments to identify the most vulnerable groups and strengthen the response capacity of health staff. Additionally, since delayed vaccination and outreach programs at the beginning of the pandemic most likely led to the largest interruption, I recommend countries improve their emergency preparedness and ensure the continuous supply of health services—especially at the primary health care level—for future health shocks.

Second, as already mentioned before, besides the health systems, overall social security and infrastructure need to be improved to avoid the most vulnerable groups being worse off. This includes, for example, investing in water, electricity, and public transportation, as well as in digitization, such as internet access, information systems or remote learning possibilities.

Third, as chapter 6 about the impact of the COVID-19 pandemic on mental health in Ghana and South Africa highlighted, the recovery of urban poor households' well-being was overall linked to stress factors from the global pandemic and the national lockdown. Therefore, it is necessary to raise awareness of mental health issues and have the resources and infrastructure to address them. I recommend offering—especially during global pandemics—supportive mental health policies. Additionally, since stress factors might vary

from one country to another, as it has been shown for Ghana and South Africa, I recommend investing in a monitoring system as well as, depending on the triggering stress factors, supporting, for example, policies to improve government trust and knowledge about the pandemic.

Fourth, government trust and people's knowledge about the pandemic are not only relevant correlates of stress factors delaying mental health recovery, but they are also crucial for the population to adhere to government interventions as shown in chapter 5. Additionally, most people adhered to low cost and easily implementable measures (chapter 5). Therefore, I recommend to only implement costly interventions with a well-informed population that has trust in the government's actions and has access to the appropriate infrastructure to follow the interventions.

Lastly, I recommend building government trust to ensure that people will adhere to government interventions in future pandemics. Rebuilding trust in government is challenging; it will be crucial to increase the populations' perceptions of the trustworthiness and the government's capabilities to deliver services. Additionally, the better the population is informed the more awareness they have about what the most protective behavior is and the more they understand government's actions. Thus, I recommend strengthening outreach to the population—especially in times of large uncertainty and an "infodemic". Therefore, choosing the proper communication channels and making the message accessible and understandable to all population groups seems crucial.

7.4 Broader academic contribution

Beyond the contributions mentioned in each of the papers (chapters 2 - 6), this dissertation also makes three broader contributions to the academic area, which I will discuss in this Section.

7.4.1 Barriers to leaving no one behind

As highlighted in chapter 2 as well as other studies from Ghana, treating patients covered by the health insurance might be less financially profitable for the health facility than treating those who are not insured (e.g., due to delays in the reimbursement payments, low tariffs). Studies have shown that this can lead to poor quality health service provision (e.g., Alhassan et al., 2015; Duku et al., 2018), unauthorized charges for service provision (e.g., Aikins et al., 2019; Macha et al., 2014), and/or patients that pay out-of-pocket receiving preference (e.g., Duku et al., 2018). All consequences lead to the most vulnerable not having access to health care and being financially unprotected. This situation likely arises partly because of the higher costs of service provision due to inefficiencies in the health insurance scheme (e.g., delays in the reimbursement payments, low tariffs) or because of inefficiencies in the health facilities (e.g., infrastructure, stock management, claim management system) (e.g., Abekah-Nkrumah et al., 2022; Ubindam, 2019; Andoh-Adjei et al., 2018; Sodzi-Tettey et al., 2012). The literature highlights the need to find ways to

set up health insurance schemes in a financially sustainable way. Chapter 2, therefore, provides important insights into this challenge. Nevertheless, more research is needed to overcome the current barriers to achieving UHC.

On the patient side, in addition to financial barriers, other major barriers to UHC discussed in the literature—mostly for Ghana—are a poor understanding of what insured patients are entitled to as clients, lack of trust in the scheme, and distance to the health facilities (e.g., Macha et al., 2014; Fenny et al., 2018; Karra et al., 2017). Chapter 5 adds to this literature, showing that during the COVID-19 pandemic, vulnerable groups were also more affected by limited information, low trust in government, and barriers due to lack of infrastructure. Therefore, it is essential to understand and remove barriers to information provision, trust in government, and infrastructure provision to the most vulnerable—especially in times of pandemics—to leave no one behind.

7.4.2 Barriers to reducing cost escalation

The results from chapter 2 highlight that cost escalations are threatening the financial sustainability of health insurance schemes and, therefore, threatening UHC (e.g., Lyimo et al., 2020). Additionally, the results from chapters 3-6 show that the COVID-19 pandemic put an enormous financial burden on the health system. Health cost escalations due to reduced disease prevention, e.g., immunization or NCD screenings, and higher incidences of diseases, e.g., mental health issues, are expected. On the other hand, revenues are expected to decrease due to loss in income among insured people and lower government budgets. As a few studies point out, some LMICs have reallocated their funds for preventable diseases, such as malaria, to COVID-19 support (e.g., Rinke de Wit et al., 2022; Diptyanusa & Zablon, 2020). As a result, COVID-19 drastically increased inequalities, leaving a disproportionately higher cost burden on the most vulnerable population groups. Our results, therefore, contribute to several different research areas in the context of cost escalation.

One important field I want to highlight is the cost escalation caused by mental health issues. Mental health has been a neglected area in health care in many LMICs for many decades (e.g., Read & Doku, 2012). Yet, studies show that mental health issues are leading disease burdens globally and disproportionately affect LMICs and poorer people because of higher risk and limited access to care (e.g., Renwick et al., 2022; Wykes et al., 2015). Our results from chapters 5 and 6 provide important insights into this research area, generating evidence on how COVID-19 has impacted mental health and what factors drive those developments. It is important to address mental health issues in health system strategies directly. However, the results also highlight that triggering stress factors, such as financial worries, little knowledge about the pandemic, and low trust in government, might be avoidable in future pandemics. Additionally, building upon the discussion about the impact of COVID-19 and the corresponding government interventions in LMICs in chapters 3 and 4, the findings contribute to the broad literature about cost-effectiveness of government measures in response to COVID-19 (e.g., Fink et al., 2022; D. Egger et

al., 2021; Singha et al., 2020), emphasizing that mental health consequences due to the government interventions might have been underestimated.

7.4.3 Barriers to resilient governance

The results of this dissertation contribute to the broader academic literature that public trust and access to information are essential for providing good and resilient governance, comprising different aspects.

First, as discussed in chapters 3-6, it is vital for governments to respond effectively to health shocks, such as the COVID-19 pandemic, so that people adhere to the policy measures in place. In times of uncertainty, it is especially important that the population trust the government to make the best decision for the public interest. In chapter 5, I conclude that costly interventions are only effective with a well-informed population that has trust in the government's actions and has access to the appropriate infrastructure to follow the interventions. Therefore, our results contribute to the broader literature about government trust and trustworthy information sources (e.g., Devine et al., 2020; Gozgor, 2021), as well as provide important insights into the broader literature on vaccine hesitancy, which shows that trust and knowledge are essential to COVID-19 vaccine take-up (El-Elimat et al., 2021). Lastly, as discussed in chapter 6, public trust and knowledge are not only correlated with adherence, but also with mental health recovery, contributing to the large literature about mental health factors (e.g., Bäuerle et al., 2020; Olagoke et al., 2020; Perrin et al., 2009).

Second, as discussed in chapter 2, major barriers for patients to take-up of health services is potentially a poor understanding of their entitlements and trust in the scheme (e.g., Macha et al., 2014). The results contribute to the growing research field of health literacy, which studies the capacity of people to effectively improve their knowledge and use of information (e.g., Jansen et al., 2021; Meherali et al., 2020; Yagi et al., 2021; Williams et al., 2020). The studies emphasize that, especially in the context of LMICs and among vulnerable groups, health literacy is crucial to effectively and efficiently use the health care system. Nevertheless, evidence for LMICs is scarce, and more research is needed (e.g., Yagi et al., 2021).

7.5 Pathways for future research

I want to conclude this dissertation with some thoughts on future research. In my dissertation papers (chapters 2-6) and the discussion above, I already mentioned the need for more long-term studies about the effects of COVID-19 and the government measures on health service provision in LMICs (chapters 3 and 4), more comprehensive studies of claim data for LMICs to understand insurance usage patterns, cost drivers, and the financial sustainability (chapter 2). Here, I want to elaborate two additional key research opportunities further.

First, as mentioned in the Broader Academic Contribution and chapter 2, barriers to health service take-up occur on both the patient and health facility side. The literature argues that poor knowledge of the scheme by the patients and profitability issues by the health facility lead to higher out-of-pocket health expenditures, even for patients covered by health insurance. To better understand where out-of-pocket health expenditures occur and how information provided to the patient (health literacy) can reduce it, my colleagues and I have already conceptualized and implemented an RCT (see chapter 1). Building upon those findings, I recommend additional research on how health facility profitability issues impact out-of-pocket expenditures. Due to the many inefficiencies in health facilities, there is a great opportunity to explore further how the implementation of an improved claim process can improve the profitability of the health facility, potentially improve quality of care and reduce the out-of-pocket health expenditures for insured patients, and thus ensure that no one is left behind. Those findings could provide essential insights into the driving mechanism of out-of-pocket health expenditures and would also contribute to the growing research area about the digitization of health interventions.

Second, as mentioned in the Broader Academic Contribution and chapter 6, the COVID-19 pandemic placed a large burden on mental health issues in LMICs. At the same time, it highlighted the health system's weaknesses in allocating resources to mental health issues and revealed social stigma. Since chapter 6 discusses different stress factors correlated with the increased mental health issues among different countries, I recommend doing more longer-term studies to understand the dynamics better, ideally also across countries. Additionally, in the case of Ghana and South Africa, where financial worries, knowledge about the pandemic, and partial government trust were leading stress factors, there is the opportunity to explore the effectiveness of financial support and non-specialist mental health support (to improve knowledge and build trust in government) during a crisis. The findings about financial support would contribute to the ongoing debate on unconditional cash transfers in LMICs to reduce mental health impacts during a pandemic. Pre-COVID studies show that cash transfer programs and other social protection measures can improve mental health (e.g., Bauer et al., 2021; Attah et al., 2016), however, during the pandemic Jacob et al. (2022) find that unconditional cash transfers led to no effects. The findings from the non-specialist mental health support would contribute to the growing literature that suggests that when trained mental health specialists are lacking, non-specialists are a cost-effective option (e.g., Bhat et al., 2022; Patel, 2022). Additionally, as Aksunger et al. (2022) point out, training community-based health workers could be a great option for support. This would contribute to the broad literature about trusted information sources in times of uncertainty, such as the COVID-19 pandemic, where community health workers or health care providers are highly trusted members (e.g., El-Elimat et al., 2021). Moreover, it would provide empirical evidence of some planned policy interventions, for example, by the Center for Disease Control and Prevention to support community health workers to address limited mental health care access (CDC, 2021a).

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