Coronavirus and Government Response Conundrum in Africa: How Effective are the Stringency Measures?

Abstract

Reducing the spread of infections and deaths attributed to the coronavirus (COVID–19) are a major concern of countries, particularly in Africa. This concern has led governments to institute several restrictive measures aimed at containing the COVID–19 crisis. Notwithstanding the restrictions, the number of cases and COVID–19 deaths continue to increase, raising questions regarding the effectiveness of the restrictions. In addition to determining the impact of the restrictions on COVID–19 deaths, this study examines how the restrictions influence the COVID–19 mortalities through its impact on the confirmed cases. By relying on daily data from 49 African countries spanning 5th March to 21st July 2020, the study finds that higher restrictions measured by stringency index are associated with lower deaths. While the number of confirmed cases increase deaths, higher stringency index dampens the mortality–increasing effect of the confirmed cases. However, possible nonlinearities exist which suggest that the magnitude of reduced deaths is not the same for all countries. Based on the estimated optimal levels of restrictions, the study observes that while higher stringency index generally lowers death cases, its negative effect is huge for countries with stringency index above the threshold. Such countries are able to reduce the number of deaths by 23 when the stringency index increases by 10. However, for those below the threshold, the same change in the stringency index will only reduce deaths by 5. In addition to significantly increasing the number of deaths, the unbridled and inefficient lifting of restrictions will have weak counteracting impact on the number of confirmed cases. Balancing the desire for economies to build–back better against the proliferation of COVID–19 are two conundrums African governments face.

Keywords: COVID–19; stringency index; confirmed cases; deaths; Africa

"COVID came and has taken us quite far behind because we need to reassess where is it that we want to go and how we want to go. We definitely need to do things differently"

Dr. Vera Songwe [Executive Secretary, UNECA]

1.0 Introduction

The novel Coronavirus (COVID–19) which was first reported in Wuhan city, China in December 2019 has spread to almost every part of the globe. The World Health Organization (WHO) declared it as a global pandemic on 11th March 2020 given the severity of the spread. By May 16th 2020, over 300,000 COVID–19 related deaths were reported with more than 4.5 million confirmed cases across the world. Around the same time, Africa recorded over 78,000 cases and 2,600 deaths. Both the number of confirmed cases and deaths continue to increase. As at 1st August 2020, evidence from John Hopkins University COVID–19 Resource Center suggests that, the global confirmed cases increased to 17.6 million with death toll rising to over 680,000.[1] Similarly, Africa's confirmed cases rose to over 929,000 with almost 20,000 mortalities (Africa CDC, 2020).[2] With regard to regional bloc in Africa, more than 55% of the confirmed cases are recorded in Southern Africa which also accounts for about 43% of the total COVID–19 deaths in Africa. The highest number of cases and death toll in Southern Africa is followed by Northern and Western Africa with Central Africa recording the least. For the most part, the death tolls are proportionate with the confirmed cases.

While the pandemic was at first viewed as a global public health concern, the outbreak of the COVID–19 is taking an economic dimension with dire impacts on African countries (see UNECA 2020a; AU, 2020). However, while COVID–19 continues to permeate through countries with concomitant negative effects on economies, a vaccine is yet to be discovered. Given the absence of effective vaccines, containment interventions are implemented in order to control the viral transmission and spread (Kissler et al., 2020). In this endeavour, several governments worldwide including those in Africa have instituted various forms of restrictions including social distancing measures, albeit with varied timeliness and level of stringency. To contain the pandemic, these government restrictions include cancellation of public events, workplace and school closures, limiting public and

[1] See https://coronavirus.jhu.edu/map.html
[2] See https://africacdc.org/covid-19/

private gatherings, closing public transport systems, restricting internal movements and international travels, among others.

According to UNECA (2020b), at least 42 African countries have either imposed full or partial lockdowns on the movements and activities of their people. Anecdotal evidence suggests that such government interventions effectively limit the spread of the virus. Given their high number of confirmed cases and mortalities, Southern and Northern African countries have imposed the strictest restrictive lockdown measures aimed at reducing the COVID–19 infections and deaths.

The World Health Organization (WHO) recommends that people maintain at least one–meter (three feet) distance between persons in order to reduce spread of the virus (WHO, 2020). This recommendation entails maintaining a social, particularly physical, distance between persons. However, Adekunle et al., (2020) note that in the case of Africa, even if social distancing is enforced to inhibit human–to–human transmission, it may be difficult to implement in already overcrowded cities.

Relying on data from 140 countries, Koh et al., (2020) find that stringent restrictions including complete lockdowns and full border controls are effective, but less stringent measures notably working from home and staying–at–home are also effective provided they are implemented at the early stages. Hussain (2020) also notes that the effectiveness of social distance in influencing the spread and COVID–19 mortalities is contingent on the government's policy stringency level. The authors finds that, among the COVID–19 hardest–hit countries, a 10–point increase in government's stringency in responding to the virus leads to a 6.9 unit decline in people's mobility to workplaces.

Notwithstanding the implementation of restrictions in almost all countries in Africa, both the number of confirmed cases and deaths related to COVID–19 continue to increase raising questions regarding the effectiveness of these policy responses. Unfortunately, studies relating to the impact of government responses on COVID–19 deaths are sparse. More tellingly, how governments' stringent responses interact with number of confirmed cases in influencing the mortalities is yet to be rigorously examined, empirically in Africa. The lack of such studies makes policy decisions difficult and inconclusive. This study therefore aims at critically examining the tripartite relationships among governments' stringent responses, number of confirmed cases and COVID–19 deaths. In this endeavour, it contributes significantly to the literature in three ways. First, how the government policy responses influence the mortalities is often gleaned from public discourses without rich empirical backing. To the best of our knowledge, this study provides a pioneering empirical evidence on the impact of government restrictions on COVID–19 deaths in Africa. Second, it also investigates for possible nonlinearities in the relationship and attempts to uncover the optimal level of restrictions necessary to reduce the mortalities associated with COVID–19. Third, it also examines how levels of government responses interact with confirmed cases in influencing deaths attributed to COVID–19. In so doing, the study reveals whether government responses dampen or magnify the impact of the number of confirmed cases on mortalities.

By employing daily data from 49 African countries spanning 5th March to 21st July 2020, the study finds that higher government restrictions measured by the stringency index reduces the number of deaths, albeit weakly. However, the link between the stringency index and COVID–19 deaths exhibit threshold effects with 76 as the optimal minimum level of restrictions necessary to significantly lower deaths with only 18% of African countries operating above this threshold. Given the estimated restrictions threshold, the study documents that while stricter restrictions generally reduce death, its negative effect is huge when countries are above the estimated stringency index threshold. Specifically, for such countries, the number of deaths reduces by 23 when the stringency index increases by 10. Conversely, for countries below the threshold, the same change in the stringency index will only lower the number of deaths by 5. Further findings also reveal that government restrictions are significantly able to dampen the mortality–increasing effect of confirmed cases when countries are above this threshold. A key implication of the finding is that, unbridled and inefficient lifting of the restrictions will be catastrophic. Apart from increasing the mortalities, lowering restrictions will have an insignificant counteracting effect on the number of confirmed cases.

The rest of the study is organized as follows: the next section documents various government restrictions in containing the COVID–19 pandemic while Section 3 presents the methodology. Section 4 discusses the findings with Section 5 concluding the study.

2.0 A cross–section of government responses in tackling COVID–19 in Africa

Following the outbreak of the COVID–19, the pandemic has received an unprecedented global response aimed at containment. Countries across the globe have implemented stricter hierarchical actions domestically, including the closure of borders. Given the poor health care systems to tackle the COVID–19, African countries also responded more stringently in order to reduce the risk of spread which potentially puts pressure on the already fragile health infrastructure of countries. African countries implemented similar measures across sub–regional blocs.

For instance, South Africa recorded its first confirmed case on 3rd March 2020. By 27th March, 2020, the number increased to 1,170 with the country recording its first two deaths as the country's 21–day lockdown came into effect.[3] For the first time in the country's democratic history, the President of South Africa stripped–off basic freedoms of citizens to walk, socialize and congregate for prayers without any interference in order to contain the spread of the COVID–19. Indeed, the sale of alcohol and cigarettes were also banned with major cities under total lockdown of which offenders risked hefty fines or jail terms. The country's borders, gyms, beaches, swimming pools, spas and schools were also closed. Gustafsson (2020) argues that these restrictions especially with regard to commuting to workplaces were at least twice as stringent as one might expect. Despite these stringent measures, both the number of confirmed cases and deaths increased significantly. However, in April 2020, the President announced a 5–tier regulatory alert mechanism to gradually ease the stringency level of the initial imposed interventions.[4] This regulatory system aimed to sufficiently limit the prevalence of COVID–19 whilst gradually opening the sectors of the economy at different levels. In addition, other restrictions including those placed on public transport systems were relaxed.[5] Unfortunately, South Africa is currently the epicenter of the pandemic in Africa given that the country had recorded over 370,000 cases with about 5,200 deaths as at 21st July, 2020.

As the second[6] most populous country in Africa and the largest aviation hub in East Africa, Ethiopia also implemented restrictions to tackle the COVID–19. In January 2020, the government of Ethiopia started passenger–screening measures at Bole international airport with the country recording its first confirmed case on the 13th of March 2020 and by the close of March, the number of cases increased to 25 on the back of restrictions. On 8th April 2020, the government announced a State of

[3] See https://www.gov.za/speeches/minister-zweli-mkhize-confirms-total-1170-cases-coronavirus-covid-19-27-mar-2020-0000

[4] For the five levels, see https://www.gov.za/speeches/president-cyril-ramaphosa-south-africas-response-coronavirus-covid-19-pandemic-23-apr-2020

[5] See https://www.gov.za/speeches/minister-fikile-mbalula-review-transport-measures-during-covid-19-coronavirus-lockdown-16

[6] See for instance: https://www.worldometers.info/population/countries-in-africa-by-population/ accessed 18 August 2020

Emergency. However, relative to other countries, Ethiopia did not impose a full nationwide lockdown. The government rather implemented several critical measures including compulsory 14–days quarantine periods for all travelers, mandatory wearing of facemasks, restrictions on public gatherings, closure of educational facilities, bars, nightclubs and limiting the number of passengers on public transport system (Shigute et al., 2020). As the cases continued to rise, there were raft of restrictions and strict enforcement of physical distancing protocols. Despite these measures, the number of confirmed cases increased to almost 7,000 with over 100 deaths by the close of May 2020. However in June 2020, the government announced the gradual easing of the restrictions while reducing the mandatory 14–day quarantine of passengers arriving from abroad. The country's national airline – Ethiopian Airlines – subsequently announced the resumption of operations as the lockdown rules eased. The country has now recorded about 10,200 confirmed cases with almost 200 deaths as at 21st July 2020.

Ghana on the other hand, confirmed its first two cases on 12th March 2020. The government responded with social distancing measures on 15th March 2020 and thereafter, restricted foreign nationals from entering into the country followed by a closure of all air, land and sea borders. As the number of cases continued to increase, a partial local lockdown was imposed in the two big cities – Accra and Kumasi – which remained enforced for more than three weeks. Strict social distancing rules were enforced, followed by mandatory wearing of face masks. However, in his 7th address to the Nation on 19th April 2020, the President lifted the lockdown.[7] Similarly, on 31st May 2020, the President ordered the gradual reopening of schools to only final year students beginning on 15th June 2020, while educational institutions remain closed to non–final year students. By 15th June 2020, the President also signed a new Executive Instrument that criminalizes the failure to wear a face mask in public places, with those found guilty facing up to 10 years jail term. While restrictions on religious gatherings were lifted, albeit with strict adherence to COVID–19 social distancing protocols, the country's borders remain closed until further notice as announced by the President. Notwithstanding these restrictive measures, the number of confirmed cases continued to increase. As at 21st July 2020, Ghana had recorded 31,057 confirmed cases with 161 deaths (Ghana Health Service, 2020).[8] Nigeria also implemented similar measures but has also

[7] See https://www.graphic.com.gh/features/features/full-text-akufo-addo-s-7th-covid-update-speech-lockdown-lifted.html

[8] See https://ghanahealthservice.org/covid19/archive.php

moved to ease restrictions despite recording over 43,000 confirmed cases and almost 900 mortalities as at 1st August 2020.[9]

In the case of Egypt, the country also announced several restrictive measures including the closure of all educational facilities, monuments, restaurants, places of worships. Several tourist sites and cultural events were cancelled. Public gatherings were also banned with nighttime curfew enforced between 8pm and 6am. The public sector workers allowed at work were also halved. As the cases continued to increase, airports, supermarkets, gyms and bakeries were later closed. However, in May 2020, the government announced easing the lockdown due to the Ramadan (Muslim fasting) by permitting businesses to re–open while shortening the curfew time. The gradual lifting of the restrictions were occurring at a time the cases were also increasing reaching almost 90,000 with death roll increasing to over 4,000 by end of May 2020.[10] Morocco also implemented similar measures and declared a "Health State of Emergency" until May 2020. The country's lockdown and curfew were fully enforced by the police and the army who only allowed individuals with special permit to go their workplaces.

As governments across the world responded to the pandemic using several measures, the University of Oxford developed the COVID–19 Government Response Tracker (OxCGRT) which has robust data collected relying on the various policy responses to the pandemic. The OxCGRT is based on 17 indicators including school and workplace closures, cancellation of public events, closure of public transports, restriction of international travels and internal movement among others.

The OxCGRT is then used to create government response stringency index which shows the level of restrictiveness and stringency of the government policy measures to suppress the spread of the COVID–19. The index ranges between 0 and 100 where higher index implies stricter restrictions and vice versa. Figure 1 shows the government response stringency index while Figure 2 shows the number of COVID–19 deaths both from 5th March to 21st July 2020.

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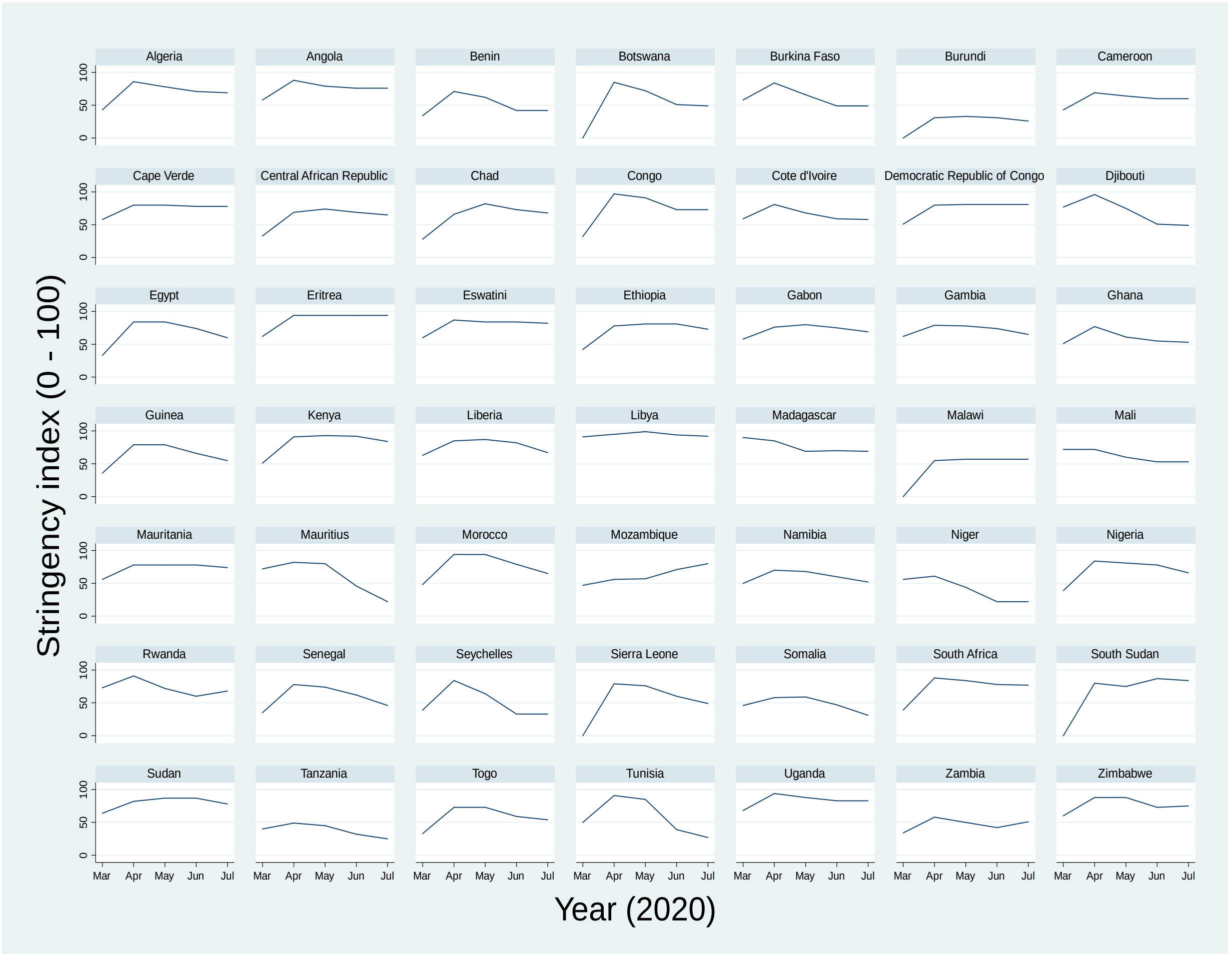
[9] See https://www.reuters.com/article/us-health-coronavirus-nigeria-lockdown/nigeria-reopens-main-cities-lagos-and-abuja-as-lockdowns-phased-out-idUSKBN22G225

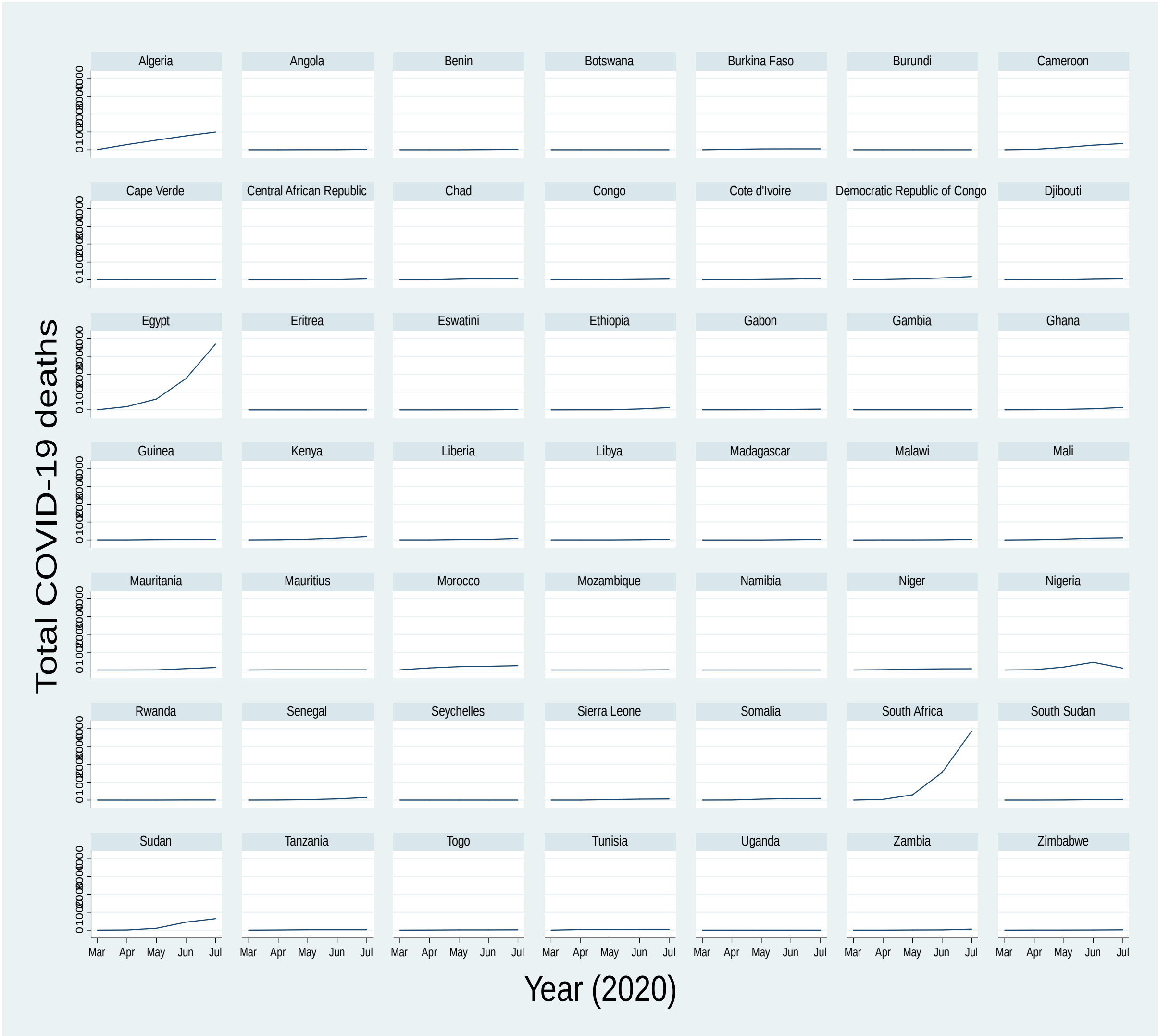
[10] See https://africacdc.org/covid-19/

Figure 1: Government response stringency index in Africa



Source: Author's construct using data from the University of Oxford COVID–19 Government Response Tracker (see Hale et al., 2020)

Figure 2: Total COVID–19 deaths in Africa



Source: Author's construct using data from the University of Oxford COVID–19 Government Response Tracker (see Hale et al., 2020).

From Figures 1 and 2, it is clear that almost all African countries implemented strict restrictions in April 2020 as the number of cases and deaths continued to rise with stricter measures experienced in North (Libya, Morocco and Tunisia) and Eastern (Djibouti, Eritrea, Kenya, Rwanda and Uganda) African countries. The republic of Congo also imposed stricter restrictions. All these countries had stringency index in April 2020 exceeding 90. The strict government measures were imposed at the time where both the number of confirmed cases and deaths in Africa were lower although increasing overtime. However, while the number of confirmed cases and deaths continued to rise, many African countries were easing restrictions particularly from

May 2020 with only Mozambique further tightening the restrictions even though it has far fewer mortalities relative to South Africa (see Figures 1 and 2).

Indeed, decisive restrictive measures were implemented across countries because it is believed to limit people's mobility which can potentially decrease the spread of the virus leading to lower death (Hussain, 2020). Ozili (2020) observes that social distancing rules were enforced in African countries to first isolate the virus before finding ways to contain it. However, Wilder–Smith and Freedman (2020) argue that the use of social or physical distancing cannot be the best measure to addressing the pandemic and that strict implementation of social distancing protocols could only lead to unintended consequences (see Ozili and Arun, 2020). Sadati et al., (2020) also opine that such restrictive measures, notably social distancing rules, are far from preventing the COVID–19 from mutating the body of infected persons, and that strict enforcement of non–pharmaceutical measures such as social distancing is only used when policymakers do not know what to do.

Notwithstanding these criticisms, evidence abound that, implementation of the social distancing rules significantly helped to flatten the curve of COVID–19 pandemic (Yilmazkuday, 2020). Hale et al., (2020) contend that, limiting the spread and deaths can be experienced when government policies across countries are more stringent as the outbreak gets spiked. In the case of Africa, examining the impact of government response measures is critical as the number of confirmed cases and deaths continue to increase on the back of reduced restrictions. Given the continent's dynamics regarding restrictions and the COVID–19 situation, several important questions linger. For instance, what is the precise impact of the stringency index on COVID–19 deaths? Does the impact of the stringency index on COVID–19 deaths exhibit threshold effects? What is the optimal level of restrictions necessary to significantly lower deaths? How does the stringency index play out in influencing the impact of the confirmed cases on the number of COVID–19 deaths? This study provides answers to these questions by first discussing the methodology in the next section.

3.0 Methodology

3.1 Data

This study relies on daily data from 49 countries in Africa spanning 5th March to 21st July, 2020.[11] The selection of the participating countries and the time period were

[11] These countries are Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Cote d'Ivoire, Democratic Republic of Congo, Djibouti, Egypt,

entirely due to data availability for our key variables of interest. The research uses the number of COVID–19 related deaths and number of confirmed cases across these countries. Data for the COVID–19 attributable death, case counts in addition to the new cases and deaths are all obtained from Our World in Data of the University of Oxford, UK.[12] To measure governments' responses to the COVID–19 pandemic, the study relies on government response stringency index which is a composite measure of additive score nine indicators organized on an ordinal scale. These nine indicators are: (i) closure of schools and universities; (ii) closure of workplaces; (iii) cancellation of public events; (iv) public gatherings restrictions; (v) closure of public transport; (vi) restrictions on internal movement; (viii) restrictions on international travel and (ix) record presence of public information campaigns. These indicators are rescaled to range between 0 (lax restrictions) and 100 (stringent restrictions).[13] This data is gleaned from the Oxford COVID–19 Government Response Tracker (OxCGRT) which systematically tracks government responses to COVID–19 across countries and time.

3.2 Linear estimation approach

Given the objective of this paper, the study sets up a baseline model where the extent of COVID–19 deaths depend on previous mortalities, governments' policy responses and number of confirmed cases. Specifically, the study specifies the following equation:

$$CD_{it} = \varpi_o CD_{it-1} + \varpi_1 SI_{it-1} + \varpi_2 CC_{it-1} + \mu_{it-1} \qquad (1)$$

where CD_{it} is COVID–19 related deaths; CD_{it-1} is its lag which is used to measure the initial conditions of COVID–19 mortalities; SI_{it-1} and CC_{it-1} represent stringency index and number of confirmed COVID–19 cases, respectively; μ_{it} is the error term; with *i* and *t* denoting the country and time indices, respectively.

It is imperative to note that, the stringency index and number of confirmed cases are lagged by one period because current COVID–19 related deaths are influenced by previous government responses and confirmed cases. Thus, the number of COVID–19 reported deaths exhibit lag effects. Indeed, since the government restrictions are

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Eswatini, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe. The other five countries namely, Comoros, Equatorial Guinea, Guinea-Bissau, Lesotho, and Sao Tome and Principe were not part of the study because they did not have data on the government stringency index.

[12] https://github.com/owid/covid-19-data/tree/master/public/data [Accessed on 22nd July, 2020]

[13] For details on these indicators and compilation approach, see Hale et al., (2020) [Available here: https://www.bsg.ox.ac.uk/sites/default/files/2020-05/BSG-WP-2020-032-v6.0.pdf]

aimed at reducing COVID–19 related deaths, the study hypothesizes that, $\varpi_1 < 0$ and significant at conventional levels with the absolute value of ϖ_1 measuring the linear changes in COVID–19 reported deaths resulting from government responses proxied by the stringency index. The number of confirmed cases is however expected to positively influence COVID–19 related deaths.

While equation (1) estimates the direct effects of stringency index and the number of confirmed cases, the study also estimates how the stringency index mediates the relationship between the number of confirmed cases and COVID–19 deaths. The study hypothesizes that, tight government restrictions should reduce the COVID–19 related deaths by dampening the number of confirmed COVID–19 cases. Thus, the effect of confirmed cases on COVID–19 deaths is also conditioned on countries' level of restrictions. In this essence, the study examines how COVID–19 deaths–number of confirmed cases nexus is mediated by the stringency index by including a multiplicative interactive term of SI_{it-1} and CC_{it-1} as given in equation (2) below:

$$CD_{it} = \varpi_o CD_{it-1} + \varpi_1 SI_{it-1} + \varpi_2 CC_{it-1} + \alpha(SI_{it-1} \times CC_{it-1}) + \epsilon_{it-1} \qquad (2)$$

$$\epsilon_{it-1} = \tau_{t-1} + \sigma_i + \mu_{it-1}$$

where τ_{t-1}, σ_i and ϵ_{it-1}, respectively denote the time effects, the unobserved country–specific fixed effects and the idiosyncratic error term. Based on the equation (2), the coefficient of the interactive term (α) measures the effect of the number of confirmed cases conditioned on the stringency of government responses to the COVID–19. The study therefore investigates for this conditional effect by taking the partial derivative of COVID–19 deaths with respect to the number of confirmed cases as shown in equation (3):

$$\frac{\partial CD_{it}}{\partial CC_{it-1}} = \varpi_2 + \alpha SI_{it-1} \qquad (3)$$

Intuitively, if tight government restrictions should reduce the COVID–19 deaths by dampening the effect of the number of confirmed cases, then $\varpi_2 > 0$ and $\alpha < 0$. The research evaluates the conditional effect of the confirmed cases at the mean, minimum and maximum levels of the stringency index.

The study relies on the two–step system generalized method of moments (GMM) estimation approach in order to control for potential endogeneity (Arellano and Bover, 1995; Blundell and Bond, 1998) and Nickell (1981) bias resulting from the inclusion of the lagged dependent which may be correlated with the error term. In addition, the country–specific effects may also be correlated with the regressors. Thus, the use of the GMM removes the country–specific effects and any potential time–related invariable country–specific variable contained in the data (Arellano and Bond, 1991).

In addition to addressing endogeneity problems, this approach does not require the pre–testing for unit roots since the first differencing associated with the system GMM ensures that the variables are stationary (Baltagi et al., 2009). However, in order to produce efficient and consistent results, the system GMM requires that the number of cross–sections (*N*) is sufficiently higher than the time period (*T*). Given the number of countries ($N = 49$), the study averages the daily data into monthly data thus producing a five non–overlapping periods: (i) 5th March 2020 – 31st March 2020; (ii) 1st April 2020 – 30th April 2020; (iii) 1st May 2020 – 31st May 2020; (iv) 1st June 2020 – 30th June 2020; and (v) 1st July 2020 – 21st July 2020. To the extent that $N = 49 > T = 5$ makes the use of the system GMM apt.

The study examines the efficiency of the results using: (i) the Sargan test of over–identifying restrictions which checks for the validity of the instruments; (ii) serial correlation which assesses the presence or otherwise of serial correlation in the error terms; (iii) Wald test in order to assess the overall significance of the models estimated. The research also tests for unobserved heterogeneity eminent in the human–to–human transmission by checking for cross–sectional dependence in addition to testing for slope homogeneity.

3.3 Nonlinear estimation approach

The above approach suggests that the impact of regressors (stringency index and confirmed cases) is linear and symmetric such that, a unit–change in the stringency index linearly influences COVID–19 deaths irrespective of the extent of restrictions across the different countries. In this section, the study argues that, the precise impact of the stringency index and its interaction with the number of confirmed cases may exhibit nonlinear effects. Particularly, the extent to which the government responses to the COVID–19 influences the number of COVID–19 related deaths is conditioned on countries' level of stringency. In other words, the magnitude of changes in COVID–19 deaths is threshold–specific contingent on whether, or not, countries are above or below this estimated stringency threshold level.

To account for the potential threshold effects, the study modifies the linear equation (1) into a threshold/nonlinear regression model following Hansen (2000). Relative to equation (1), the linear regression model is transformed by incorporating a threshold variable. Here, our threshold variable is the stringency index such that the precise effect of the government response is conditioned on the extent of the stringency index. Thus, the COVID–19 related deaths–reducing effect of government responses is based on the extent of how stringent the restrictions are imposed. In this case, the research posits the following nonlinear regression model:

$$CD_{it} = \begin{cases} \delta_1 SI_{it-1} + \delta_2 CC_{it-1} + \mu_{it-1} & if\ SI_{it-1} \leq \gamma \\ \emptyset_1 SI_{it-1} + \emptyset_2 CC_{it-1} + \mu_{it-1} & if\ SI_{it-1} > \gamma \end{cases} \quad (4)$$

where SI_{it-1} represents stringency index which is the threshold variable; γ is the threshold value which bifurcates the impact of government response on the mortalities. From equation (4), δ_1 measures the effect of the government responses when countries' level of stringency index is equal or less than the optimal restrictions while $\emptyset_1$ examines the impact of government responses when the stringency index is above the optimal threshold level.

Based on equation (4), the value of the threshold, γ is determined through the concentration approach which minimizes the sum of squared residuals. Indeed, examining the nonlinear effects is based on the existence of threshold where the null hypothesis does not favour the presence of threshold effect against the alternative hypothesis of a threshold. The study rejects the null hypothesis if evidence of threshold is found. In addition to identifying the threshold value γ, this approach also unearths the confidence interval within which the identified threshold lies where the confidence interval (C) is determined as $\gamma: LR(\gamma) \leq C$, where LR is the likelihood ratio. The next section discusses the findings.

4.0 Findings and Discussions

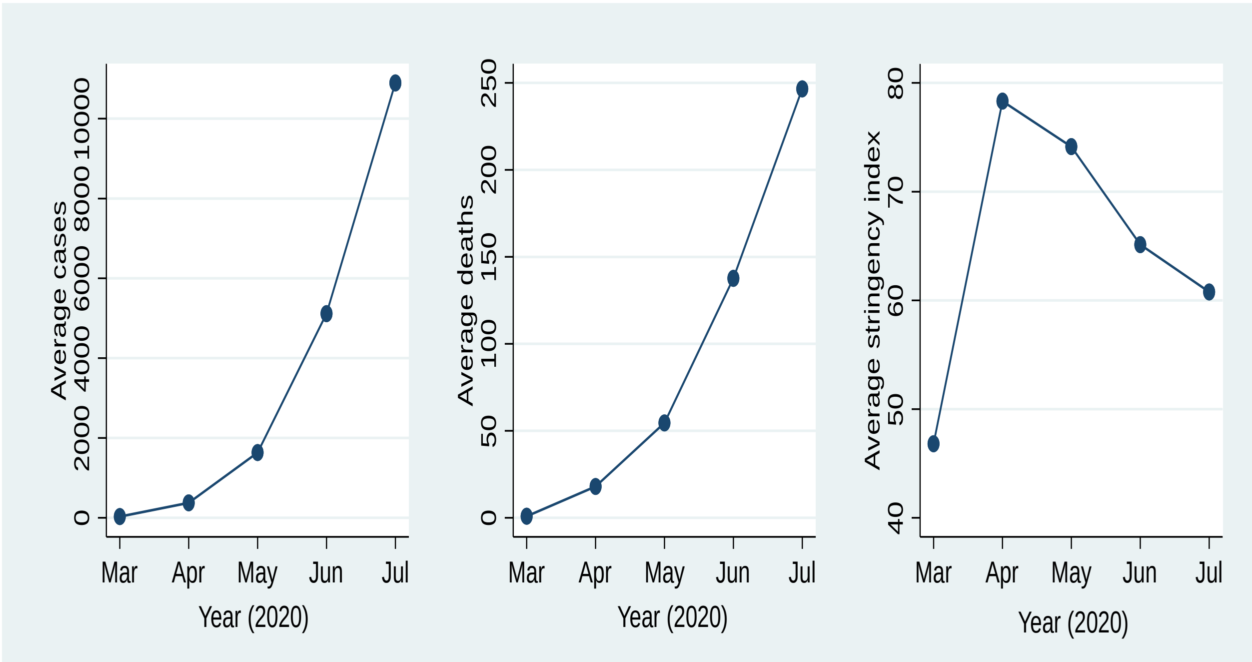
This section discusses the findings of the study beginning with the summary statistics in Table 1. The average confirmed cases is about 3,612 with the maximum confirmed cases of 255,425 recorded in South Africa. Beyond the confirmed cases, the study finds average COVID–19 attributed death of 92 with 3,860 as the highest number of causalities which was also reported in South Africa. The mean stringency index is 65.04 with highest restrictive index of 99 recorded in Libya.

Table 1: Summary statistics

	COVID–19 confirmed cases	COVID–19 deaths	Government response stringency index
Mean	3,611.559	91.559	65.037
Standard deviation	18,109.23	383.725	20.468
Coefficient of variation	5.014	4.191	0.315
Minimum	0	0	0
Maximum	255,425	3,860	99
Skewness	11.676	7.939	–0.843
Kurtosis	156.355	72.612	3.553

The study computes the coefficient of variation (CV) as the ratio of the standard deviation to the mean in order to examine the relative variations of the variables. It observes that among the three variables, the number of confirmed cases is the most volatile given the high value of the CV. This suggests that the confirmed cases significantly differ among the countries. This is followed by the number of deaths. However, the stringency index is the least volatile suggesting that government restrictions do not significantly vary across the countries. Values of the skewness suggest that both the number of confirmed cases and deaths are positively skewed while that of the stringency index is skewed to the left. Figure 1 plots a graphical overview of the trends in the COVID–19 mortality, confirmed cases and stringency index averaged over the sample period.

Figure 3: COVID–19 deaths, cases and stringency index (March 2020 – July 2020)



From Figure 3, it is observed that, both the number of confirmed cases and COVID–19 deaths have been increasing from March to July 2020 with no apparent evidence of a decline. More tellingly, between March and May, the number of cases and deaths were rising at a much slower rate and thereafter increased at a faster rate. Based on the sample evidence, while the average number of confirmed cases increased from 33 to 376 between March and April, the number of deaths attributed to COVID–19 also increased from 1 to 18 around the same period. Similarly, the number of cases rose from 376 to 1,636 between April and May. At the same time, mortalities also increased from 18 to 54. However, the number of confirmed cases increased by more than triple in June with the number of deaths increasing by almost three–folds. While the number of cases also rose from 5,117 to 10,896 between June and July, the attributed deaths to COVID–19 almost doubled around the same period.

Interestingly, while the both number of cases and deaths have been increasing at least from May to July, African governments' have been relaxing the restrictions. For instance, at the time of lower confirmed cases and deaths around March and April, countries placed several restrictions in order to reduce spread and casualties thus sharply increasing stringency index from 46.8 to 78.3. However, the stringency index has since declined consistently from 74.1 in May to 65.1 in June and finally to 60.8 in July. The consistent decline in the index is as a result of the relaxation of the restrictions which are done at periods where both the number of cases and death are rising. In addition to examining the impact of the stringency index on the mortalities, this study aims at determining how the stringency index interacts with number of confirmed cases in influencing the COVID–19 death cases.

The forthcoming discussions present the findings based on the econometric models beginning with the linear relationships in Table 2.

Table 2: COVID–19 deaths, stringency index and confirmed cases relationships

	1	2	3
Constant	3.2399	1.1424	1.8927
	(0.000)	(0.138)	(0.007)
Lagged of COVID–19 death	0.4347***	0.1906***	0.0434***
	(0.000)	(0.000)	(0.000)
Stringency index	–0.2635**	–0.2525**	–0.4016***
	(0.046)	(0.047)	(0.001)
Confirmed cases	–	0.6258***	0.2531**
		(0.000)	(0.016)
Interaction between stringency index and confirmed cases	–		–0.4946***
			(0.000)
Diagnostics:			
Wald χ^2	136.32	214.07	390.93
(*p*–value)	(0.000)	(0.000)	(0.000)
Sargan χ^2test	6.234	2.4126	4.2755
(*p*–value)	(0.2841)	(0.7896)	(0.5105)
AR(1) *p*–value	0.0906	0.0788	0.0613
AR(2) *p*–value	0.4968	0.4226	0.2070
Cross–sectional dependence:			
CD–test value	8.454**	9.852**	16.032***
p–value	(0.023)	(0.017)	(0.003)
Slope homogeneity test:			
Delta (*p*–value)	–2.899*** (0.004)	2.080** (0.038)	2.643** (0.023)
Adjusted delta (*p*–value)	–4.584*** (0.000)	4.650*** (0.000)	6.783*** (0.000)
Number of instruments	8	9	10
Number of countries	49	49	49

Notes: *** and ** denote significance at 1% and 5% respectively. Values in ( ) are the *p*–values.

Table 2 presents results on the linkages among the stringency index, confirmed cases and the COVID–19 mortalities. Our results suggest that higher stringency index is associated with lower deaths, albeit weakly. In Model 1 where stringency index is used as the only regressor, the study finds that an increase in the index by 10–points (say from the mean index of 65 to 75) reduces the number of deaths by 3 and this effect is statistically significant at 5% level. On the other hand, relaxing the restrictions increase the number of reported deaths by the same magnitude.

Thus, countries with sterner government measures experience slower COVID–19 deaths relative to countries with lax stringencies. This is because the speed of transmissions and number of deaths rise as the governments' move to lift some of the restrictions. The tightening of restrictions largely saves lives given the death–reducing effect of the stringency index. Hussain (2020) shows that, countries with stricter government responses have experienced higher compliance with social distancing recommendations, hence have recorded lower confirmed COVID–19 cases compared to countries with softer stringencies.

In Model 2, the study controls for the number of confirmed cases. Here, the coefficient of the stringency index maintains its negative and significant effect with qualitatively similar level of effect. However, higher number of confirmed cases raise the number of reported deaths attributed to COVID–19. In particular, a rise in the confirmed cases by 10 increases the number of mortalities by 6. This finding is consistent with Adekunle et al., (2020) who also finds that higher number of confirmed cases increases the number of reported deaths attributable COVID–19 in Africa. Indeed, the policy restrictions of governments are aimed at reducing deaths by first reducing the spread of the COVID–19 infections and number of confirmed cases. In this case, how does the stringency index interact with the number of confirmed cases in influencing the mortalities? The research answers this question by interacting the stringency index with the number of confirmed cases as shown in equation (3) and the results are presented in Model 3.

This study shows a negative coefficient of the interactive term and a positive effect of the confirmed cases. Remarkably, this evidence suggests that while the number of confirmed cases increases the related deaths, higher stringency index dampens the death–increasing effect of the confirmed cases. By including the interactive effect, the coefficient of the stringency index has marginally increased while that the effect of confirmed cases has significantly weakened. Specifically, a 10–point increase in the stringency index significantly reduces reported deaths by 4. Although the number of confirmed cases is associated with higher deaths, its mortality–increasing effect declines by double – from 6 to 3 when the interaction between the number of confirmed cases and stringency index is included in the model.[14]

Given the positive effect of the confirmed cases and the negative coefficient of the interactive term, the conditional (marginal) effects of the stringency index are evaluated at its mean, minimum and maximum levels. The minimum level of stringency index from the summary statistics is zero – implying a situation of no restriction. When evaluated at this level, the marginal effect of stringency index is equal to the level effect of the confirmed cases which has an elasticity value of 0.2531. In this case, without the restrictions, the number of confirmed cases will always increase the number of reported deaths. However, as government places restrictions to contain the pandemic, the conditional effect of confirmed cases at the average level of the stringency index is 32. This means that, the average number of deaths reduces by 32 at the mean level of government restrictions and this occurs through the dampening effect of the stringency index on the number of confirmed cases. Furthermore, as the restrictions are tightened with the stringency index increasing to its maximum level of 99, the marginal effect is 49. Thus, with higher restrictions, the number of deaths recorded is subdued across countries.[15]

For all the estimated models, the coefficients of the lagged COVID–19 deaths are positive and significant at conventional levels. This implies that, previous mortalities positively drive current reported deaths. This might also mean that even though our use of the system GMM controls for the endogeneity and simultaneity bias imminent in the panel, the effects of underlying health conditions of those who die from the COVID–19 cannot be ignored completely. UNECA (2020b) notes that, majority of African countries have underlying health vulnerabilities which potentially makes the COVID–19 more deadly. Specifically, the prevalence of known comorbidities, notably higher cases of HIV/AIDS in Southern Africa and the predominant chronic respiratory diseases in North Africa. In addition, several African countries have limited capacity in health care facilities with continental average of only 1.8 hospital beds per 1,000 people, in addition to only 34% of people having access to basic household handwashing facilities (UNECA, 2020b). All this historical information also contributes to exacerbating the number of COVID–19 mortalities.

[14] It is imperative to note that, both the number of confirmed cases and the stringency index are lagged by one period suggesting that, their immediate previous level influences current COVID-19 deaths. These results remain robust even when the second and third lags of the stringency index and number of confirmed cases are used.

[15] These are computed based on equation (3).

With regard to the diagnostic tests, Blundell and Bond (2000) opine that the usage of the system GMM estimators requires the existence of first–order serial correlation and the absence of second–order serial correlation. The null hypotheses suggest no serial correlation against the alternative hypotheses of serial correlation. Based on the serial correlation tests, while the study does not reject the null hypothesis of first–order serial correlation, that of the second–order serial correlation test is flatly rejected. The research finds evidence of the presence of first–order serial correlation and the absence of second–order serial correlation. The instruments, which are internally generated in the system GMM are valid based on the Sargan tests given the failure to reject the null hypothesis that the over–identifying restrictions are valid. The overall estimated models are also statistically significant based on the Wald tests. The study also tests for cross–sectional dependence following Pesaran (2004) where the null hypothesis of no cross–sectional dependence is rejected. Finally, the null hypothesis that the slope coefficients are homogeneous is also rejected for all the estimated models.[16] Given the validity and adequacy of the models, the findings can be used to make useful policy implications.

Indeed, the discussions so far have highlighted the effects of the stringency index and number of confirmed cases on COVID–19 deaths in addition to how their interaction plays out in dampening the number of reported deaths. These analyses are based on linear estimations which do not distinguish among the extent of restrictions across the countries. For instance, irrespective of the stringency index of countries, the number of reported deaths reduces by the same magnitude if the stringency index increases. Thus, if country A has lax restrictions and country B has strict restrictions, if both countries place the same restrictions resulting in a homogenous increase in their stringency index, the number of lives saved resulting from lower death is the same irrespective of their previous level of restrictions.

In this case, it would appear that the effect of the stringency index is linear and symmetric across countries. However, how stringency index reduces the number of reported deaths may depend on countries having a certain minimum level of restrictions that bifurcate the magnitude of effects resulting in a disproportionate impact given the extent of restrictions. More tellingly, given their initial stringency index, it is possible for country A and country B to record different numbers of reduced deaths if both countries place the same restrictions. Consequently, the

[16] To the extent that our regressors are lagged, the slope homogeneity tests are conducted to allow for the lags.

impact of the stringency index may be nonlinear thus exhibiting threshold effects depending on whether countries are above or below a certain level of restrictions.

In the next discussion, the study examines possible threshold effects of the stringency index on COVID–19 mortalities, where it begins by first testing for the existence of threshold in the relationship.

Table 3: Threshold effects of COVID–19 deaths, stringency index and confirmed cases

	Threshold test [Column 1]	**Regime 1 (SI ≤ 76) [Column 2]**	**Regime 2 (SI > 76) [Column 3]**
LM test for no threshold	11.228	–	–
Bootstrap *p*–value	0.024**	–	–
Threshold value (γ)	76	–	–
95% Confidence interval	[74, 76]	–	–
Constant		–2.1368	230.0295
		(1.5581)	(139.6512)
Stringency index		–0.4824***	–2.2672***
		(0.1061)	(0.5704)
Confirmed cases		0.4060***	0.1550***
		(0.0143)	(0.0106)
R^2		0.1530	0.7460
Number of countries		40	9

Notes: *** and ** respectively denote significance at 1% and 5% level. Values in ( ) are the standard errors. Heteroskedasticity correction is used. Bootstrap *p*–values are computed with 1,000 bootstrap replications at trimming percentage of 15%. LM= Lagrange Multiplier. SI=Stringency index.

Table 3 presents findings of the threshold estimations. The study finds evidence of the existence of a threshold in stringency index–COVID–19 death nexus. Given the high (low) LM test (*p*–value), the null hypothesis of no threshold is rejected in favour of the alternative hypothesis which suggests that the relationship between stringency index and mortalities could be nonlinear with the precise effect conditioned on whether a country is above or below an estimated threshold. An examination of the results produced a threshold value of 76 which lies between a confidence interval of 74 and 76 (see column 1). Interestingly, this threshold value, which is significantly higher than the continental average of 65 implies that governments in African countries are less restrictive with their policy responses to contain the spread and mortality of the COVID–19. The threshold results are also further confirmed by Figure 4 with the associated confidence interval in Figure 5.

Figure 4: Existence of threshold test graph

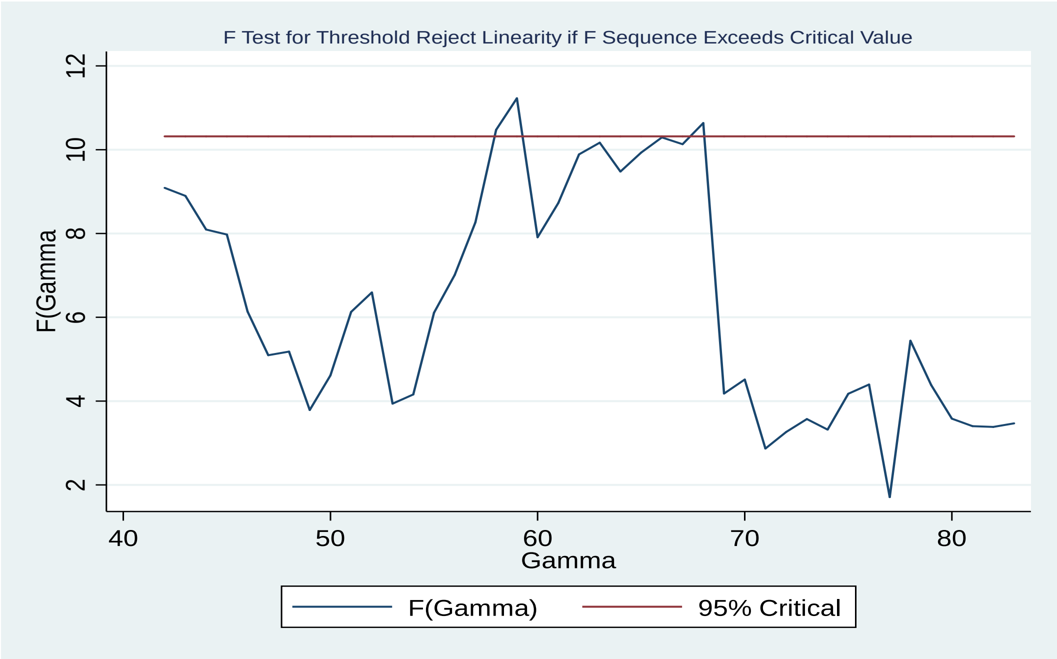
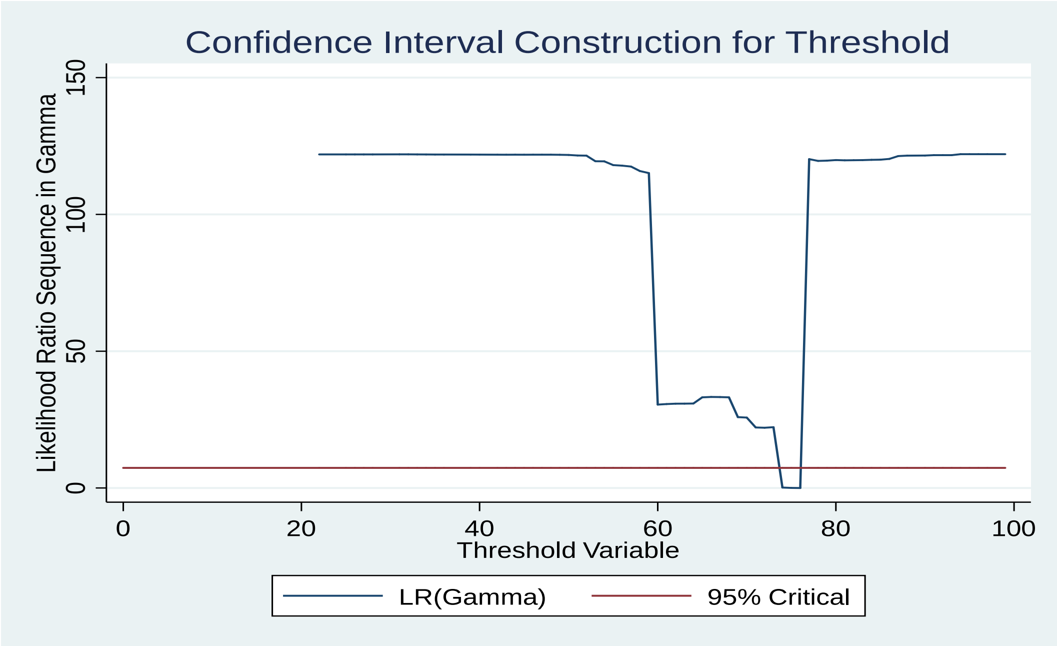


Figure 5: Confidence interval of the threshold

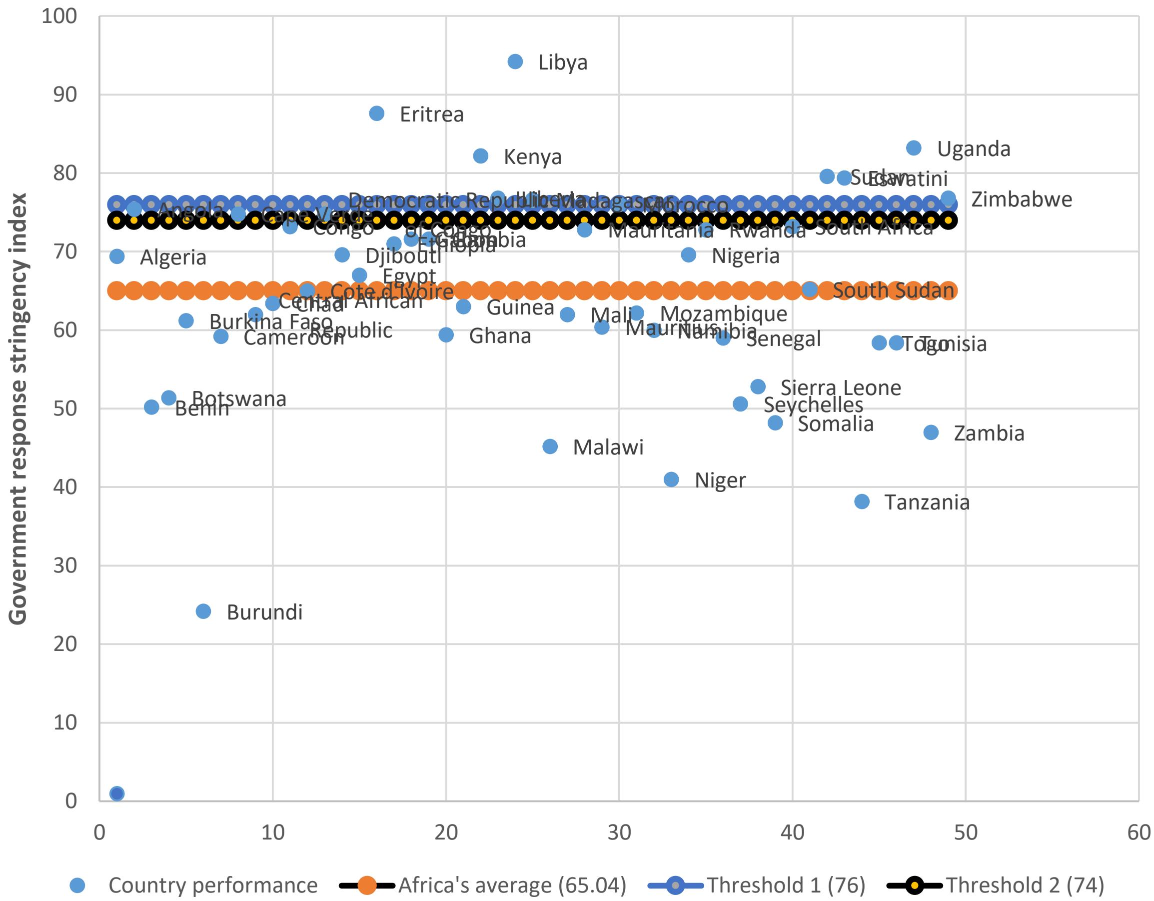


Remarkably, it can be observed that, the identified threshold is the same as the upper level confidence interval suggesting that the optimal level of the stringency index is precise. The existence of the threshold value of 76 therefore shows that, the impact of government restrictions on the number of reported deaths across countries depend on whether a country is below or above this threshold. Countries whose stringency index is less than or equal to 76 are classified in regime 1 (low stringency index) while those whose stringency index is above the 76 threshold are classified in regime 2.

Given the threshold value, the study finds that out of the 49 countries, only nine representing 18% have average stringency index above 76. As shown in Figure 6, these countries are Eritrea (87.6), Eswatini (79.4), Kenya (82.2), Liberia (76.8), Libya (94.2), Madagascar (76.6), Sudan (79.6), Uganda (83.2) and Zimbabwe (76.8). However, the remaining 40 countries (representing 82%) are in regime 1 with the stringency index lower than the threshold. Thus, for the most part, majority of African countries are less restrictive. How does government responses impact on COVID–19 related deaths given the different regimes?

The findings show that, irrespective of the regime, higher stringency index is associated with lower reported deaths. However, the stringent index's death–reducing effect is higher in countries above the threshold relative to those below the threshold (see regime 2, column 3). Specifically, while the number of deaths reduces by 23 for countries above the threshold when the stringency index is further increased by 10 units, the same change in the stringency index will reduce deaths by only five for countries below the threshold (see regime 1, column 2). Thus, countries with strict government responses where the stringency index is above the optimal level are able to reduce deaths by almost five times higher than those with lax restrictions. Conclusively, for the nine countries in regime 1, it is unlikely that the present restrictions will significantly lower the number of COVID–19 deaths unless the restrictions are increased above the threshold.

Figure 6: Country–level performances



With regard to the effect of the confirmed cases, consistent with earlier evidence, the higher number of confirmed cases is associated with higher deaths although the magnitude of effect is disproportionate. From Table 3, for countries operating in regime 1, the number of COVID–19 deaths will increase by 4 when the confirmed cases rise by 10. However, for countries above the threshold, the same change in the number of confirmed cases will increase the number of deaths by just under 2, at least 50% lower than the mortalities recorded in countries with low restrictions.

Given the evidence of threshold, how does the stringency index interact with the number of confirmed cases in dampening the number of COVID–19 at the different regimes? The study re–estimates the threshold regression by controlling for the interaction between the government responses stringency index and the number of confirmed cases. The results are presented in Table 4 below.

Table 4: Threshold effects of COVID–19 deaths, stringency index, confirmed cases and its interactions

	Threshold test [Column 1]	Regime 1 (SI ≤ 74) [Column 2]	Regime 2 (SI > 74) [Column 3]
LM test for no threshold	16.010		
Bootstrap *p*–value	0.012**	–	–
Threshold value (γ)	74	–	–
95% Confidence interval	[55, 76]	–	–
Constant		16.9939	247.0086
		(14.9438)	(105.6213)
Stringency index		–0.8345**	–2.8192**
		(0.3045)	(1.2067)
Confirmed cases		0.1673***	0.1460***
		(0.0375)	(0.0156)
Interaction between stringency index and confirmed cases		–0.0004	–0.0024***
		(0.0005)	(0.0007)
R^2		0.901	0.964
Number of countries		36	13

Notes: *** and ** respectively denote significance at 1% and 5%. Values in ( ) are the standard errors. Heteroskedasticity correction is used. Bootstrap *p*–values are computed with 1,000 bootstrap replications at trimming percentage of 15%. LM= Lagrange Multiplier. SI=Stringency index.

Consistent with the earlier findings, Table 4 shows that there is evidence of threshold in the relationship even in the presence of the interactive term. However, the identified threshold of 74 is slightly lower than the earlier threshold and lies between the confidence interval of 55 and 76. The finding on the threshold existence is also re–affirmed in Figure 7 with the corresponding confidence interval shown in Figure 8.

Given the new threshold, it is observed that 13 countries, representing 27%, are above this threshold while the remaining 36 countries are below the threshold. These 13 countries operating in regime 2 include: Angola (75.4), Cape Verde (74.8), Democratic Republic of Congo (74.8), Eritrea (87.6), Eswatini (79.4), Kenya (82.2), Liberia (76.8), Libya (94.2), Madagascar (76.6), Morocco (76), Sudan (79.6), Uganda (83.2) and Zimbabwe (76.8). The other 36 countries who are below the threshold can be seen in Figure 6.

Figure 7: Existence of threshold test graph in the presence of interactive term

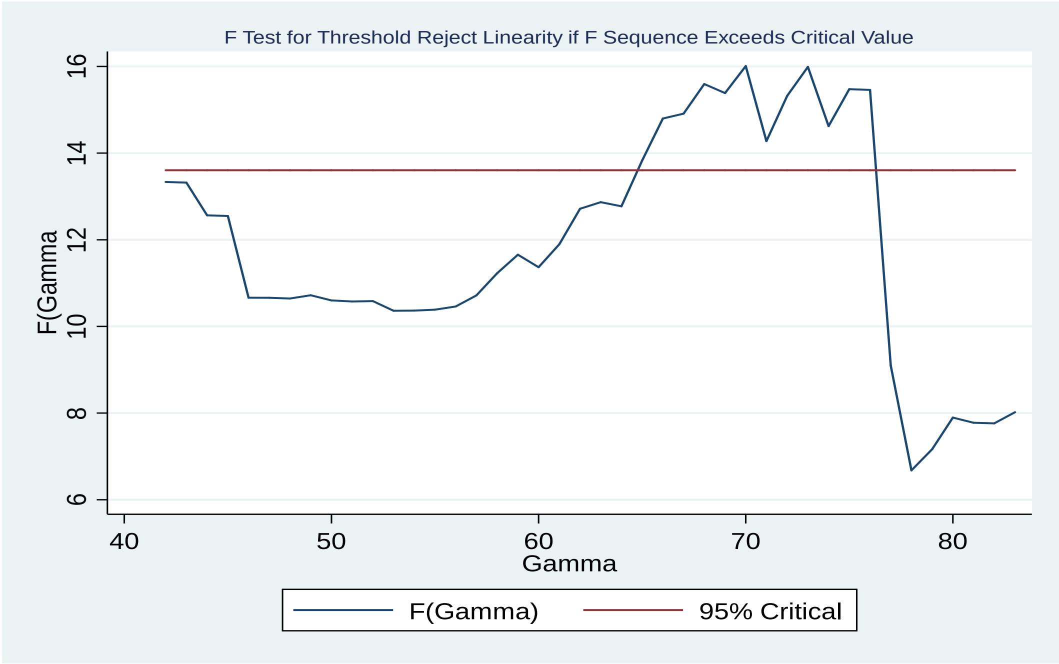
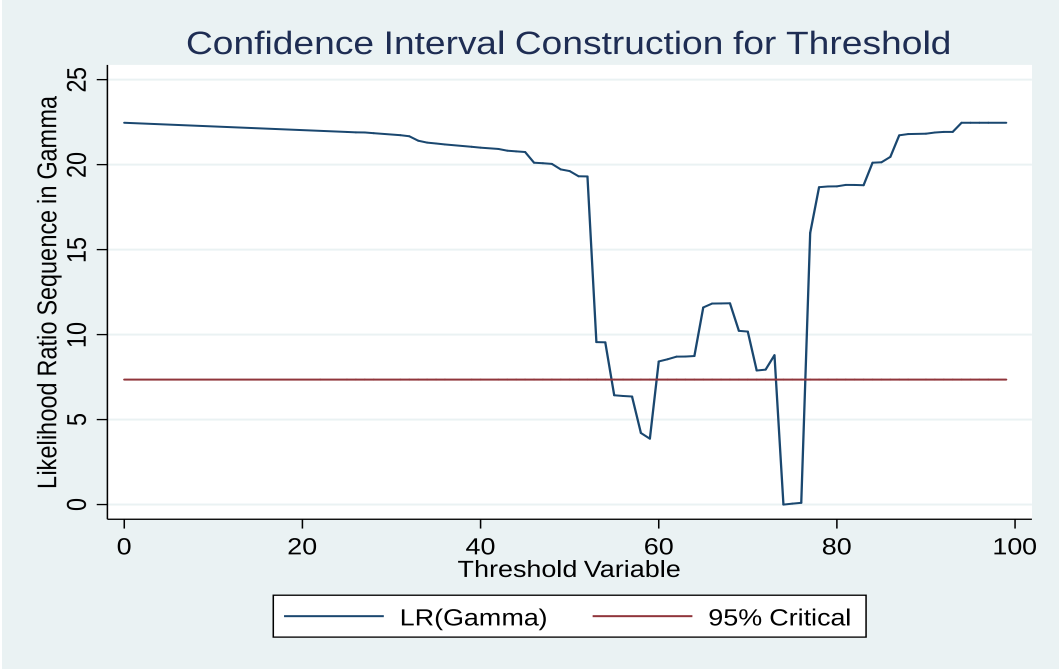


Figure 8: Confidence interval of the threshold in the presence of interactive term



From Table 4, the results on the impact of the explanatory variables (stringency index and the number of confirmed cases) are qualitatively similar to those previously obtained in Table 3. On the effect of the stringency index, it is observed that higher stringency index is associated with lower deaths in regime 2 relative to regime 1. More specifically, a 10–unit increase in the stringency index reduces COVID–19 deaths by 28 when countries' stringency index is above the threshold (see regime 2, column 3). However, the same increase in stringency index marginally reduces the number of deaths by 8 in countries below the index (regime 1, column 2). The number of confirmed cases is positively and significantly related to COVID–19 deaths irrespective of the regime. This notwithstanding, the increasing number of deaths resulting from the rising confirmed cases is twice lower when countries are above the threshold.

On how stringency index mediates the relationship between number of confirmed cases and COVID–19 deaths, the study finds a negative coefficient of the interactive term. Consistent with the previous finding, the implication is that, while higher confirmed cases increase mortalities, tighter restrictions dampen the positive effect of the confirmed cases on the number of reported COVID–19 deaths. However, the dampening effect of stringent index is statistically insignificant in regime 1 suggesting that, lower levels of government restrictions are ineffective in reducing COVID–19 deaths through its dampening impact on the reported death cases. In regime 2, the effect is however significant at all conventional levels. Our assessment of the marginal effects of the number of confirmed cases show a death reduction of 25 when evaluated at the mean of the stringency index and this figure increases to 38 at the maximum stringency index.

This evidence is largely consistent with the earlier finding that, while stringency index directly reduces the reported deaths, it also indirectly dampens the rising mortalities associated with the number of confirmed cases. Thus, lowering the number of death cases in Africa would require placing stringent and efficient government restrictions. Doing this does not only reduce the number of deaths, but it also lowers the rate of viral transmission and results in lower number of confirmed cases. The reduced number of confirmed cases also contribute to reducing COVID–19 deaths given the positive and robust relationship between confirmed cases and mortalities.

5.0 Conclusion and policy implications

Undoubtedly, the ramifications of the COVID–19 pandemic have been catastrophic to global economies as the case counts and deaths continue to rise. In the case of developing countries particularly those in Africa, the effects have been dire given that these countries are already having sluggish economic growth and rising inequality. For the most part, reducing the spread of infections and deaths attributed to the COVID–19 have been major preoccupations of countries. Consequently, governments in African countries have instituted several restrictive measures aimed at containing the COVID–19 crisis. These measures have largely included among others, the closure of educational institutions, workplaces, parks, public transport, restricting internal movements and international travels as well as limiting the number of public gatherings.

Notwithstanding these government responses through policy restrictions, the number of cases and deaths attributed to the COVID–19 continue to increase in Africa, raising concerns regarding the effectiveness of these restrictions in reducing the spread and mortalities. Unfortunately, the majority of the existing literature have focused on examining the socio–economic effects of the COVID–19 on economies without investigating how the restrictions have impacted on the number of reported deaths. The lack of studies in this regard have limited policy making as it is difficult to assess whether the right policy antidotes have been implemented. To the extent that the number of cases and deaths continue to increase despite these restrictions in Africa calls for the need for nuanced and in–depth analysis.

This study therefore deviated from examining the effects of the COVID–19 on economies to thoroughly investigating the impact of government restrictions on mortalities. More specifically, in addition to determining the precise impact of restrictions on COVID–19 deaths, this study examined how the restrictions influenced the mortalities through its impact on the number of COVID–19 confirmed cases. The study relied on daily data from 49 countries in Africa spanning 5th March to 21st July 2020 transformed into five non–overlapping periods. By using the stringency index of the Oxford COVID–19 Government Response Tracker (OxCGRT) to proxy government response to the COVID–19, this study found that higher stringency index is associated with lower deaths. In particular, when all African countries are pooled together regardless of the level of restrictions, the number of COVID–19 deaths marginally reduces between 3 and 4 when governments place tighter restrictions that results in increasing the stringency index by 10 points – say from Africa's average value of 65 to 75. While the number of confirmed cases increase the number of deaths, higher stringency index (stringent restrictions) dampens the mortality–increasing effect of the confirmed cases in Africa.

Beyond this evidence, the study also found possible nonlinearities (thresholds) in the relationship between stringency index and reported deaths, suggesting that the magnitude of reduced deaths stemming from the restrictions is not the same for all countries. A threshold value of 76 is identified as the level of restrictions that bifurcate the impact of government responses on COVID–19 deaths in Africa. Given this threshold, the study finds that only nine out of the 49 countries have stringency index above the threshold with the remaining 40 falling below the threshold. On the impact of stringency index, the study observed that while higher stringency index lowers death cases in Africa, its negative effect is huge for countries with stringency index above the threshold. Specifically, countries with stringency index above the threshold are able to reduce the number of deaths by 23 when the stringency index increases by 10. However, for those below the threshold, the same change in the stringency index will only reduce deaths by 5. Further findings also revealed that while the number of confirmed cases increase COVID–19 deaths, the number of deaths reported is higher in countries with lax restrictions and operating below the threshold.

How does the stringency index interact with the number of confirmed cases in influencing reported deaths in Africa? The research showed that while the number of confirmed cases increase COVID–19 deaths, higher stringency index have counteracting effect on the mortalities by lowering the positive impact of the confirmed cases. However, the dampening effect of the stringency index is statistically insignificant when countries are below the threshold. This suggests that, the counteracting effect of government responses on confirmed cases is weak when countries have softer inefficient restrictions.

Based on the findings of this study, some key implications for policy can be documented. First, while government restrictions are generally associated with lower deaths, more lives can be saved when countries have stringent restrictions relative to countries with lax restrictions. Second, while the number of confirmed cases increase the number of reported deaths, higher restrictions save significant human lives in countries with more stringent restrictions. For those with lower stringent restrictions, there is very little evidence that such restrictions support in significantly reducing the number of reported COVID–19 deaths. Thus, to further reduce the number of deaths and save more productive lives, it is imperative for governments in Africa to tighten restrictions in the face of rising cases.

Given the evidence provided by this study, it might be unlikely for African countries to win the fight against COVID–19 with the present level of restrictions. While majority of the countries are already below the estimated threshold necessary to significantly lower deaths, unbridled and inefficient gradual lifting of restrictions at this time will be catastrophic unless substantially restrictive and efficient measures are put in place until a lasting scientific solution is found. Indeed, a cross–section of Africa countries have already started relaxing the restrictions amidst rising number of cases and deaths. As governments weigh their competing decisions on the dire economic impact of the COVID–19 against calls for easing of restrictions, this study finds that it might not be the right time for countries to lift the restrictions as increases in both the COVID–19 confirmed cases and subsequent deaths are eminent resulting in a second wave of the pandemic.

In addition to significantly increasing the number of deaths, the gradual lifting of restrictions will have weak counteracting impact on the number of confirmed cases. Efficiency in the application of the restrictions and strict observance of the COVID–19 protocols are exceedingly important. Balancing the desire for economies to build–back better against the proliferation of the confirmed cases and deaths are two difficult conundrums African governments have to face.

While this study carries important implications for policy, the following limitations should be noted. First, it does not control for the quality of health care given to the COVID–19 confirmed patients across the countries. Second, the study is limited to data obtained at the time of the write–up given that the government measures and the evolution of the COVID–19 are only nascent. Moreover, the role of the status of testing and contact–tracing has not been considered in the study. Caution should, therefore, be taken when interpreting the findings.

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