

Simple Analysis of COVID-19 Numbers in Sudan (May 11th, 2020) Elfatih ELTAHIR

Global Perspective:

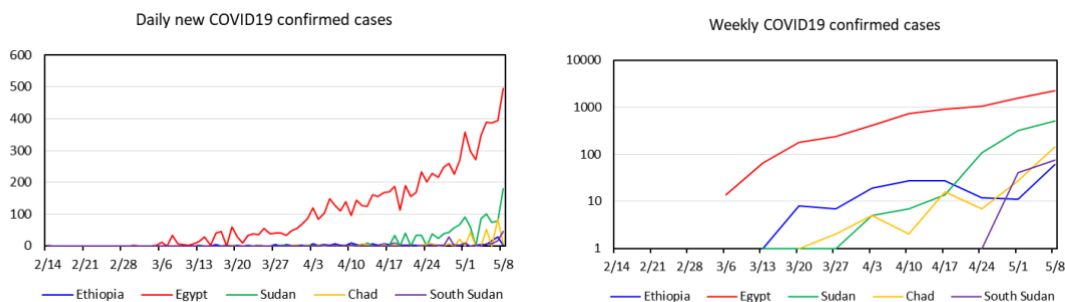
The average global count of confirmed cases is about 530 cases per million. The cases count in Sudan is about 30 per million. The count in the US is about 4000 per million, and in Italy is about 3700 per million. The case fatality rate in Sudan (ratio of total death to total number of confirmed cases) is about 5%, which is lower than the global average of about 7%. So, as it stands now, the numbers in Sudan are relatively low compared to the global numbers, consistent with similar statistics in other African countries. However, the disease is now introduced into the country resulting in significant community transmission. The potential for large spread combined with the relatively poor state of the health system present a high risk.

African Perspective:

In comparison to other African countries, Sudan ranks as 26th out of 51 in total confirmed cases per million, and 20th out of 51 in number of total deaths per million. This comparison indicates that COVID-19 conditions in Sudan are typical of the African continent, and the country does not stand out either way in comparison to other African countries.

Regional Perspective:

Compared to its major four neighbors: Egypt, Ethiopia, Chad and South Sudan, Sudan ranks as 2nd behind Egypt, but ahead of the other three neighbors in confirmed cases count normalized by population size. Egypt leads the region with about 85 cases per million, and Ethiopia is close to being the lowest country in Africa with less than 2 cases per million. Chad is close to Sudan with about 16 cases per million, and South Sudan recorded about 11 cases per million. Given this comparison, Sudan is better advised to study the Ethiopian experience, and to compare its mitigation approaches and methods to those of Ethiopia in order to learn from their apparent success in controlling the spread of the disease so far.



Local Perspective:

About 84% of the Sudanese confirmed cases reported are in Khartoum state. According to the [latest report available from the website of Federal Ministry of Health that includes local distribution of the cases, May 3rd 2020](#), about 77% of the Khartoum cases are patients from the central localities (Khartoum, Omdurman, and Bahri). The off-center localities (Ombada, Jabal-awlea, Shrg-alneel, and Karrari) account for only 23% of the cases, although these localities host 74% of the Khartoum state population. If the reported localities truly represent the home addresses for the patients, then we have a significant disparity in local disease distribution. The

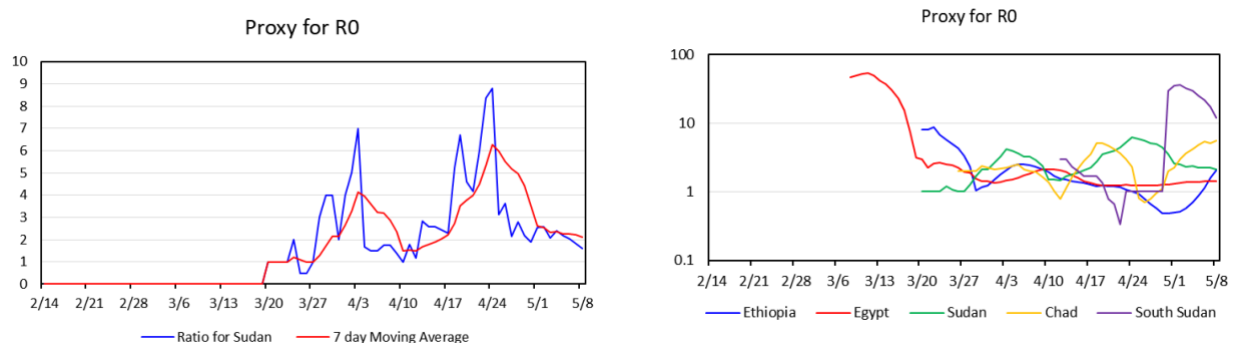
relatively more affluent neighborhoods seem to be the hotspots. This finding runs contrary to experience in western countries where the least affluent neighborhoods carry disproportionately higher share of the burden. Such conclusion, if confirmed, can be quite informative about future evolution of COVID-19 in Sudan, and should inform design of future mitigation measures.

Dynamics of COVID-19 Transmission:

The dynamics of disease transmission follows a geometric progression pattern. Viral infection works to propagate the spread of the disease such that each of the existing cases N_0 reproduces (infects) multiple new cases R_0 . The resulting new cases are $N_1 = N_0 \times R_0$. R_0 is defined as the reproduction number, the most important parameter describing the transmission process.

On average each existing case results in R_0 new cases. The magnitude of the parameter R_0 is controlled by how strictly the public follows the mitigation measures (curfew, social distancing, hygiene, etc). If $R_0 > 1$, disease progresses geometrically. If public health measures succeed in reducing R_0 to <1 , then natural momentum turns to our side, and more people recover than get sick. Estimates of this parameter then allows us to monitor success in controlling the disease.

Just like the number of cases, the impact of any mitigation effort is geometrically amplified with time. Hence, any strict **early** action, now, makes larger and larger impact in the future!



In the above figures, a proxy measure of R_0 is estimated by the ratio of weekly cases to number of cases in the preceding week. This is a simple but approximate measure, not following rigorous definition of the variable. Estimates of proxy R_0 describe dynamics of disease in the region around Sudan, relatively stable above 1 in Egypt, but fluctuating rapidly elsewhere.

During March and early April, case counts were low in Sudan, and fluctuations in proxy R_0 may not have been meaningful. On April 18th, a curfew was introduced in Khartoum state. Starting about April 24th, the proxy R_0 started declining, first dropping significantly then declining slowly. This is good news indicating that mitigation measures are working. However, proxy R_0 is still too high, currently between 1 and 2, and ongoing mitigation efforts need to be sustained and strengthened significantly to bring R_0 down, and keep it below 1. Until proxy R_0 is less than 1, daily numbers are expected to rise. A stricter curfew seems necessary extending for at least the coming 3 weeks before assessing the need for further action. This simple framework may help in guiding such assessment by monitoring if proxy R_0 is successfully controlled, and maintained below 1. This proxy can be estimated easily by all interested in monitoring conditions in Sudan.