

## Health Inequality in West and Central Africa: Enhanced Evidence from a Spatiotemporal Distributional Dynamics Analysis

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**Abstract:** This study applies the exploratory space-time data analysis (ESTDA) with its new geo-visualization technique, the directional LISA, to explore a particular aspect of health inequality and its space-time dynamics in West and Central Africa. It takes the analysis of health distribution in West and Central Africa a step further and explores the dynamics of regions with the lowest and highest longevity proxied by life expectancy at birth. Moreover, the study questioned the widely held belief that capital cities, which are usually better off in terms of investments and infrastructures, are expected to have the highest levels of life expectancy. It examined the regions with the highest and lowest longevity in each of the 26 countries of the Economic Community of West African States and the Economic Community of Central African States over two subperiods, from 2008 to 2018. The study used the subnational life expectancy at birth provided in the new Subnational Human Development Index database. Results show that though it is true that health is improving in West and Central Africa, very few regions are moving in a positive or leading co-movement. Moreover, the dominant movement of the capital cities is a negative co-movement. Stronger West-Central cooperation on the issues related to emergency response, surveillance, research and development, and innovation, all in a political-instability-free setting, is among the recommendations to ensure West and Central African country have within reach the objective of closing the gap by 2030.

**Keywords:** Highest and lowest longevity • Life expectancy • West and Central Africa • ESTDA • Directional LISA.

### Introduction

This paper is the story of an old issue viewed from a new perspective. The old issue is health in sub-Saharan Africa, a question that has been for long in national and international agendas due to its particular importance in economic and development

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strategies. The region, as a matter of fact, still receives the lion's share of official health-related development assistance from the United States, the United Kingdom, the European Union, and particularly Japan, which is attempting to match China's expanding influence in Africa through initiatives related to the International Conference on African Development. Health is a fundamental human right, but most importantly, it is a precondition for enjoying other rights. Economists and development experts usually consider it as a particular good because health can be viewed as a consumption good and an investment good (Bloom et al. 2004; Bloom and Canning 2003). This study which focused on health inequalities in West and Central Africa, consider health from the investment perspective. This means increasing its quality and quantity is expected to affect households' productivity, local and national productivity positively, and by the same token, regional and international development. But hold on, that is not the new perspective I have mentioned above.

Health distribution analysis and related issues are often studied from national perspectives. However, it is becoming well-accepted in the development milieu, and especially in regional science that national pictures can still hide enormous disparities at the subnational level. This is even true when it comes to development dimensions measures (Smits and Permanyer 2019). Thus, the new perspective is to consider the unequal health distribution from subnational viewpoints. In West and Central Africa, the substantial difficulty researchers faced for years, has been the unavailability of data at the subnational level. Very little research has, therefore, been conducted at that level, within and across countries, and even fewer accounted for the role of space in the distribution of health and what its implications are in terms of policy design (Root 1999; Yourkavitch et al. 2018). For instance, Yourkavitch and her colleagues found that spatial locations matter in the distribution of six child health indicators in their study on 27 selected African countries, using global and local spatial autocorrelation analysis coupled with thematic maps. They concluded that if efforts are concentrated on the right spatial clusters, inequalities between and within countries can be effectively addressed.

With the same subnational perspective in mind, the present study ambitioned to take the analysis of health distribution in West and Central Africa a step further and explore the dynamics of regions with lowest and highest longevity, proxied by life expectancy at birth. For that purpose we use the novel Subnational Human Development database (Smits and Permanyer 2019) and consider the period 2008-2018. Additionally, the study questioned the widely held belief that capital cities, which are usually the better off in terms of investments and infrastructures, are expected to have the highest levels of life expectancy. Of course, health is improving in West and Central Africa but to stop the reflection there would be completely wrong.

With two different economic communities<sup>1</sup> and 26 countries gradually evolving in terms of leadership of their own development agendas, awareness of their legitimate sovereignty, their capacity to negotiate, elaborate better plans and a vivid willingness to guarantee better health to their populations, providing insights in these distributional patterns is crucial in ensuring that effort intended to accelerate the dynamic of closing the gap by 2030 are effectively targeted. That is mainly what this paper intends to contribute to.

Here is how the paper is organized. It begins by introducing the methodology and brings some background information. Next, I present the results and a brief discussion of their implications in terms of development policies and the final section concludes.

## **1. Data and Methods**

Recall that this study aims to explore the spatiotemporal dynamic of health in West and Central Africa with a focus on the subnational regions with the highest and the lowest life expectancy at birth. The timeframe of the study spans from 2008 to 2018, and I use the subnational life expectancy data for the 26 countries in the Economic Community of West African States and the Economic Community of Central African States. These economic communities have similar socioeconomic and cultural characteristics and are made of 15 and 11 countries, respectively. The choice of the time period is motivated by some key events in the international scene which were expected to have essential consequences on the health sector. Among other 2007 witnessed the launch of the Health Partnership Plus (IHP+) to accelerate progress on the health Millennium Development Goals. This important international cooperation effort is now called the International Health Partnership for UHC 2030.

Yet, many of the wished changes are struggling to materialize. In 2008, the global crisis has got serious effects on health financing and by the way, the health sector. To mention, in 2008, the WHO's Commission on the Social Determinant of Health publish its report with the conclusion that inequalities in health is still of a serious concern. The following decade has been a priority for health policies in low- and middle-income countries of which more than 70 percent are housed in sub-Saharan Africa. On the other hand, 2019 has witnessed a major health shock, the COVID-19 pandemic, that I have chosen, for research purpose, not to include in this study. I, therefore, considered 2 subperiods of roughly 6 years, 2008-2013 and 2013-2018, for the investigations and used a  $k=5$  nearest neighbors' weight matrix to define the spatial structure. That weight matrix was the most appropriate for the study.

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<sup>1</sup> The ECOWAS in West Africa and the ECCAS in Central Africa.

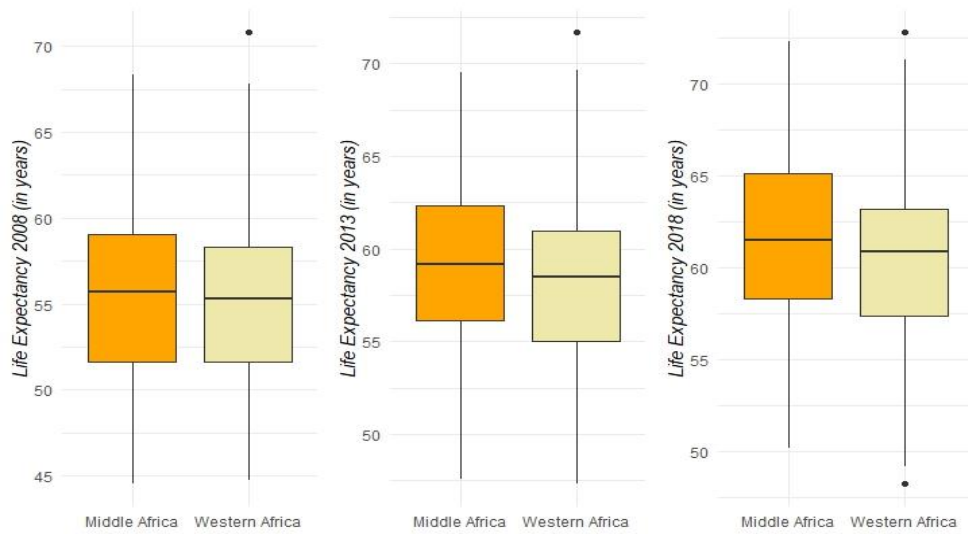
The study used choropleth maps to visualize the distribution of life expectancy at the beginning and end of each subperiod. I then compute a standardized Directional LISA plot (Murray et al. 2012; Breau et al. 2020) to capture the change in regional patterns of inequality over time. However, I do not get focused attention on the analysis of the Directional LISA plot. Instead, using data science technics, I identified for each subperiod, in each of the 26 countries, the regions with the highest life expectancy and the region with the lowest life expectancy. The characteristics of the movement vectors of these subnational regions and their pattern are then used for exploratory analysis. Indeed, the length of each vector indicates the magnitude of change in the regions normalized life expectancy and the direction of that change is indicated by where the arrowhead ends up pointing. Finally, among the highest and lowest life expectancy regions I find the cardinality of capital regions and analyzed their dynamics as well.

## **2. Results**

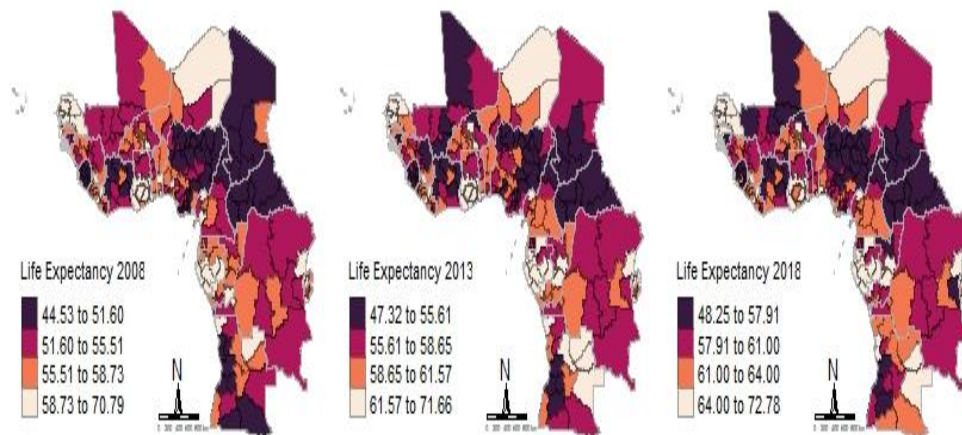
### **2.1. Health in West and Central African countries: a summary**

Life expectancy in West and Central Africa has increased over the last decade, even though both regions are the one with the lowest level of life expectancy in the world. Figure 1 depicts a summary of the subnational distributions in 2008, 2013 and 2018. As one can see, the subnation median which was still around 55 years of age in 2008, exceeds the 60 years in 2018. That demonstrates that there has been a significant gain in life expectancy in a growing number of subnational regions in West and Central Africa, where persons born today can expect to live well into their 60s.

This improvement can be attributed to increased efforts to reduce extreme poverty and hunger, the school canteen initiative that has led to more children staying in school longer, increased access to health interventions in rural areas, and increased access to sanitary facilities like clean water and toilets. However, it is apparent that Central Africa has a slightly longer life expectancy across the period than West Africa, which might be pointing to regional inequalities. But progress sets apart, the need for improvement in population's health, disease prevention and health inequality reduction remain high. Figure 2 shows the choropleth box maps of the above three time snapshots.



**Figure 1.** Distribution of Life Expectancy at Birth, Subnational Human Development database



**Figure 2.** Choropleth Maps in 3 Snapshots, Life Expectancy at Birth 2008-2013-2018

The box plot maps clearly show that regions in the lowest quartiles remains mostly in that position and regions in the highest quartiles as well. This means that regions with low longevity are likely to stay in that position while region with high longevity will keep enjoying their good health. This highlights the need to seriously consider inequality questions in West and Central Africa. That is important because,

most of these regions in the lowest quartile (the dark shaded regions) are located within and between countries, especially in the north of Nigeria, Central African Republic, but also in some coastal countries along the Gulf of Guinea. Compared to the regions with the highest longevity, there are significant health disparities. That is even of more concern because it is well known that the poor, disabled, and marginalized populations are more likely to have poor health outcomes in conflict zones, rural areas, urban slums, and fragile states.

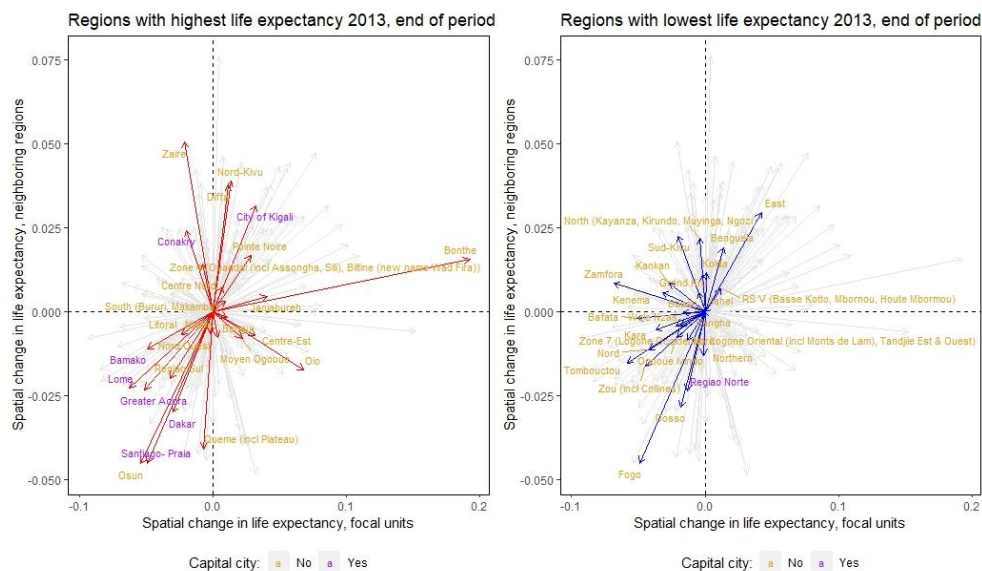
## **2.2.Spatiotemporal Health Inequalities Pattern in West and Central Africa.**

In West and Central Africa, health authorities acknowledge that the severe inequalities within and between nations should be expressly addressed in all initiatives to enhance health. Innovative methods of analysis are needed to understand the pattern and act accordingly. In this section, I look in detail the spatiotemporal distribution of longevity and investigate the position of capital city of each country. To reach that goal, I use directional movement vectors plotted on Directional LISA maps and identified the vectors of the subnational regions with the highest life expectancy (red arrows) and the regions with the lowest life expectancy (blue arrows). The other shaded arrows represent all the other subnational regions. These arrows have been shaded because the regions they represent are not of interest for this specific study, but they are important to show that there is a spatial cointegration in the distribution of longevity in West and Central Africa.

Though directional LISA analysis is not the core of the investigation, it is worth noting that the distribution of longevity in the first quadrant (northeast) reveals positive co-movements (or relative gains) between an area and its neighbors. In other words, these are subnational regions whose life expectancy has improved through time and are surrounded by other areas whose life expectancy has risen as well. In contrast, the third quadrant (southwest) exhibits negative co-movements (or relative loss) of subnational regions in the geographic distribution of health. This means low life expectancy regions surrounded by similarly low life expectancy regions, which is the opposite trajectory. As a result, changes within these two quadrants (either by gaining or losing relative ground within the distribution) reflect the development or strengthening of positive spatial clustering and are a sign of the growing significance of spatial dependence in health distribution dynamics in West and Central Africa.

Figure 3 shows the movement vectors for the subperiod 2008-2013, with the highlighted arrows representing each extreme group at the end of period. On the left-hand panel, we have for each country the regions with the highest life expectancy,

thus 26 subnational regions highlighted with red arrows. On the other side we have for each country the regions with the lowest life expectancy, thus 26 subnational regions highlighted with blue arrows. From that first token, we see that from the left panel with the highest life expectancy in 2013, the large number of arrows end up in quadrant 1 and 3. Regions like Nord-Kivu in DR Congo and Diffa in Niger have improved relatively little but their neighboring regions have improved better, while a region like Bonthe in Sierra Leone has considerably improved (from a life expectancy of 46.59 years in 2008 to 60.32 years in 2013) while its neighboring regions have improved just little. On the other hand, and even though they have the highest life expectancy in 2013, over the period, subnational regions like Oueme-Plateau in Benin and Osun in Nigeria have lost little in longevity while their surrounding regions have lost big and regions like Bamako or Lomé have lost relatively big while their surrounding regions have lost less in longevity. Also, some regions like Zaire in Angola and Oio in Guinea-Bissau have had an heterogenous pattern meaning while they are gaining their surrounding neighbors were losing in longevity or the way around. From the right-hand panel with the movement vectors of the regions with the lowest life expectancy, we see another interesting pattern. While the large number of arrows end up in quadrant 3, there is less of heterogeneity. In fact, there is no arrow pointing in quadrant 4. The bulk of the arrows points in quadrant 3 meaning that, these regions with the lowest life expectancy tends to lose in longevity over the period 2008-2013 and their neighboring regions too.

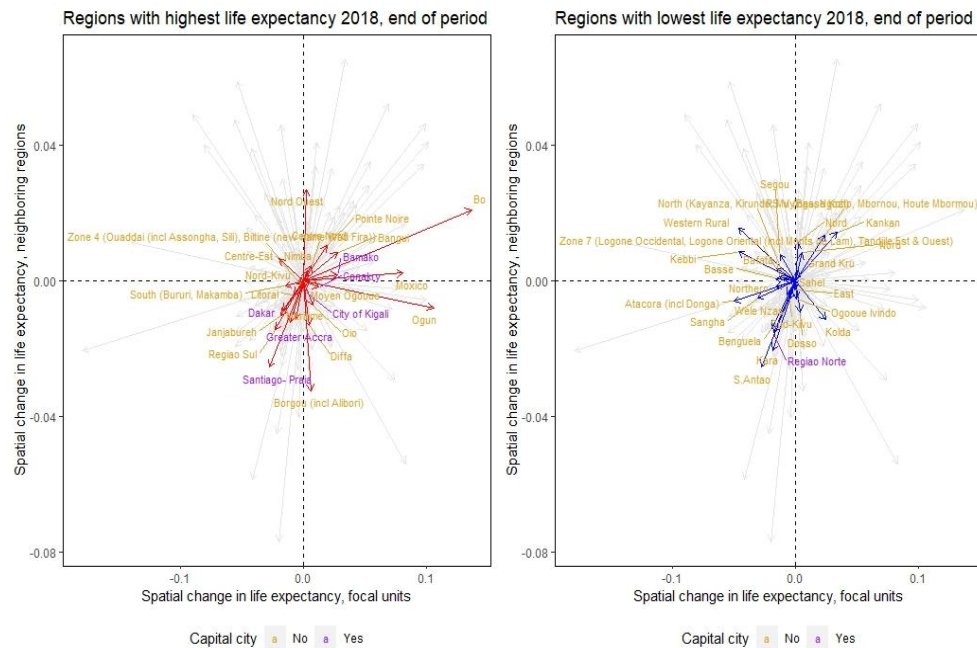


**Figure 3.** Standardized Directional Moran Scatter Plots on Longevity, End of Period 2013

The dynamic of the second subperiod, from 2013 to 2018 is not only different, but also worth examining. First both panel shows less change in variation of life expectancy. Recall that the length of vectors determines the intensity of the change over the period. Two features on the left-hand panel needs to be highlighted. First, quadrant 2 has very few arrows ending in. Again, the bulk of the arrows end up in quadrant 1 and 3, and one can notice a dynamic in the movement of the subnational regions. For instance, Bamako in Mali, which was in quadrant 3 in the first subperiod, moves in quadrant 1 at the end of the second subperiod. Also notice the city of Kigali whose neighbors' health started to deteriorate, or the Nord-Kivu with a completely opposite dynamic. There are some regions, however, how stands out: Bo in Sierra Leone and Nord Ouest in Cameroon, Ogun in Nigeria and the Borgou-Alibori in Benin and Santiago-Praia in Cape Verde where the focal city is losing less than its neighbors. On the right-hand panel, for the regions with lowest health level in 2018, the arrows pattern remains similar to the first subperiod, but with several change in the movement of the regions.

As for the capital cities, the results show an interesting story. First capital cities are seldomly regions with lowest health levels. The only and somehow concerning region identified is the Regiao-Norte in Sao Tome and Principe. The city remains in the third quadrant for both subperiod with its neighbor losing in longevity more than it does. Except this particular case, the pattern observed in the direction LISA maps is as follow. First, at the end of the first subperiod, of the 26 subnational regions with the highest life expectancy, seven were capital cities. Of those seven, only the city of Kigali in Rwanda had a positive co-movement with its neighbors. The dominant movement of the capital cities is a negative co-movement. These capital cities which are Bamako in Mali, Lomé in Togo, Greater Accra in Ghana, Dakar in Senegal, and Santiago-Praia in Cape Verde, all were West African countries. In the second subperiod, however, six capital cities were identified with Bamako moving in the first quadrant, Conakry and City of Kigali moving in quadrant 4. Dakar, Greater Accra, and Santiago-Praia stays in quadrant 3.





**Figure 4.** Standardized Directional Moran Scatter Plots on Longevity, End of Period 2018

### 3. Discussion

This study is probably the first to consider the analysis of the dynamic of health in regions with the highest and lowest longevity and challenge the idea that capital cities are expected to be better off. The directional movement vectors here, were practical and useful geo-visualization tool in providing a deeper understanding of the health dynamic of those subnational regions in West and Central Africa. If it is true that health is improving in West and Central Africa, yet very few regions are in the leading co-movement. The notion of co-movement here is crucial because the leading effect expected is regions to increase their health level as well as their neighboring regions' one. That should be the target if health authorities want to close the gap and reach a better health level for their population by 2030. Depicted with simple words, West and Central Africa health authorities should work at pointing the maximum of arrows in quadrant 1 and we are still far from reaching such a goal. More of concern is that in many countries, regions with the lowest health level at the end of period were found in a negative co-movement dynamic or behaving like outliers. Capital cities manifestly have better health level in general, but in West and Central Africa, very few capital cities have the highest longevity, and it would be incorrect to pretend that there are better off.

The question of health in West and Central Africa should be taken seriously. Achieving good health for all subnational regions, all citizens should be a political

and investment priority for every country in West and Central Africa. But most importantly, decision-makers and policy evaluators should increase effort to revert the current dominant negative co-movement in favour of the leading co-movement. Investment in health in each region should be design in such a way that it aligns priorities in the neighbouring regions so that increasing health in a focal region systematically contributes to improving the health level of its neighboring regions. In addition to a better life for the population in these regions, these investments will contribute to economic growth and sustainable development. There is also a need to strengthen the legislative framework and enhanced the civil society participation in the formulation of health policies.

Initiatives that encourage each country to align external and domestic resources for health on a national health strategy with specific subnational ramifications, encourage top-down discussions and support each country on its own sustainable path to improve health outcomes should all be encourage in a spirit of partnership. Investment in high quality education and research in universities, stronger West-Central cooperation on issue related to emergency response, surveillance, research and development and innovation all in a political-instability-free setting are among other, the recommendations to ensure West and Central African country have with reach the objective of closing the gap by 2030.

## **Conclusion**

Health is improving in West and Central. But still, the question needs a close attention. The aim of this study was to contribute to focusing that attention by exploring the dynamic of the subnational regions with the highest and lowest longevity and examine whether capital cities are completely better off. Results show that, at the end of each of the two subperiods considered for the study, the subnational regions with the highest and lowest life expectancy are both, mainly dominated by a negative spatial co-movement. In other words, in each of the 26 countries of the ECOWAS and ECCAS, the subnational regions with highest longevity on average tends to move to a lower health level as well as their neighboring regions. This overall pattern is true for the subnational regions with the lowest health level as well, raising a serious concern of inequalities. Evidence shows that capital cities generally have better health, except the specific city of Regiao Norte in Sao Tome and Principe, but pretending they are the better of would be incorrect. As a matter of fact, over the study period, only Bamako the capital city of Mali shows an appreciable dynamic over time.

I argued that geographical locations matter in understanding the spatiotemporal dynamic of those subnational regions, and each country should decide on the right mix between different policy interventions and strategic actions in order to close the

gap by 2030. Inequalities in health are still high among the subnational regions and smart leadership, governance and even stewardship are needed to drive the development of health systems in these countries. South-south cooperation should be reinforced and sharing of capacities, strengthening strategic level team leadership and synergy at work are among others the recommendation the study suggested. The Directional LISA maps we created could be used to support strategic decision making.

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