

Life Expectancy and Air Pollution: A Comparative Analysis of the United States and Chad.

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Abstract

In the past decade, air pollution and climate change remain an imperative issue, specifically between Chad and the United States who are both high polluters in the world. Unlike Chad, the United States has a very high life expectancy rate compared to Chad's very low expectancy rate, almost the lowest in the world. Previous studies have found that Chad's low life expectancy could be due to many factors outside of just air pollution. This includes lack of forest investments, low socioeconomic status, as well as the poor healthcare system that Chad has on hand. This study utilized a case study approach, comparing the United States and Chad through the methodological lens of Most Similar System Design (MSSD). Two prominent themes emerged among the findings: First, although both countries are high polluters of the world, Chad's pollution is mostly due to poor socioeconomic statuses while the United States have very loose business regulations that can cause it. Second, Chad's life expectancy rate is low due to very high infant mortality rate for children under 5. This can also be seen with a positive correlation between a lack of forest investment in Chad as well. Understanding the key to combat these other issues at hand for Chad as well as the United States. There is a chance that both countries, if understood their issue at hand correctly, can improve their lives expectancy.

Keywords: Chad; United States; Life Expectancy; Air Pollution

Introduction

Air pollution still stands as a significant challenge in our current day society. While this issue is affected globally, this paper chose to focus on Chad and the United States alone. It is insightful to specifically focus on these two countries is because Oladimeji (2019) indicates that Chad is classified as a country with a very high air pollution rate with extremely low life expectancy “Pollution is one of the major environmental problems confronting Chad area, this pollution ranges from air pollution to water pollution as well as land pollution. (p. 2)”. Bernard (2001) “Climate change may affect exposures to air pollutant (p. 199)” indicates that the United States on the other hand is also classified as a country with high air pollution levels as well while having a consistently high life expectancy rate. Furthermore, this paper aims to find out as to other potential variables that can affect the correlations. This extends the focus of the study to look at socioeconomic variables. Despite both countries' high levels of air pollution, they demonstrate very different levels of socioeconomic statuses. By recognizing these other variables, the insights of the outcome might lead the study to a more accurate finding on the matter.

Research Question and Rationale

“Comparing major air polluters, the US and Chad, with the objective of increasing life expectancy in developing countries, to what extent, if any, is there a correlation between air pollution and life expectancy? What other factors may account for differences in life expectancy between these major polluters?”

Rationale

The topic chosen for this undergraduate research was mostly about how much effect, if any, there is on life expectancy of a person within a country with high air pollution. The reason this topic was chosen was because this topic is very easy to find sources to do research on. Although it is a topic that can easily be researched on, it doesn't mean that it isn't original. There have been articles talking about how a country's life expectancy is low because of air pollution. There haven't any articles comparing the US to Chad's life expectancy specifically. This topic was also chosen because most would agree that human lives matter, no matter what country you are in. With life expectancy being this low in Chad, it is difficult not to be curious as to what is going on in that country. Another reason is that air pollution has no limits, soon it can spread to other countries right next to those countries. An example would be (Ku 2023) "Yellow dust is a seasonal ordeal for millions in North Asia, as sandstorms from the Gobi Desert that borders China and Mongolia ride springtime winds to reach the Korean peninsula" how air pollution is so bad in China that every year, Korea has a period every year where they get yellow dust.

Literature Review

The role of air pollution on life expectancy.

Karacan et al. (2020) note that air pollution from factories and local industry can be one contributing factor in calculating life expectancy rates. They argue that individual's life in highly polluted areas may have short lifespans than those in relatively unpolluted areas. Cao et al. (2020) similarly acknowledges that pollution can account for a life expectancy gap between industrial and postindustrial countries. In their targeted research on sub-Saharan Africa, Oyedele and Sheriffdeen (2023) add that investment in reforestation can help mitigate some of the effects of pollution, thereby likely increasing life expectancies. Similarly, Ochieng (2015) wanted to state that Chad has other issues that can lead to longer life expectancy also with improving health

care systems. Acknowledging the poor healthcare system in Chad, Ochieng (2015) aims to help the cause by first acknowledging the issue of poor healthcare system at hand.

Pollution and Life Expectancy in Chad.

Oladimeji (2019) Acknowledged one of Chad's biggest problems is pollution in every aspect such as air pollution, water pollution, as well as land pollution. With air pollution being the focus, some of the causes are uncontrolled waste burning practices, use of dirty old fuels, and badly managed public transport. Mondou is the second largest city in Chad, and this is the place where the research is being done. The methodology they used in this was using a dataset obtained from Multi-angle Imaging Spectroradiometer (MISR) over fifteen years of aerosol optical dataset to examine air pollution in Mondou. The result was determined by how much data was not lost to see how accurate the data is. Obiang (2020) on the other hand is specifically noting that they are aiming to examine whether Chad reduced risk of maternal and infant mortality after signing the Abuja Declaration in 2001. Using data from the World Bank's World Development Indicators and publications from the World Health Organization to assess their study. With those 2 ideas in mind, Caporale (2016) ties this back to a middle ground of analyzes trends in life expectancy and estimating life expectancy in Sub-Saharan Africa. The assumption was based on simple linear least squares regressions. However, many series are $I(d)$, where d is a fractional value, and are said to be fractionally integrated, and for them the standard approach is clearly inappropriate. The present study addresses this issue by using a fractional integration specification to estimate trends in life expectancy at birth in a group of 48 sub-Saharan countries. In this study, they will examine from the period 1960 - 2013.

Pollution and Life Expectancy in the United States.

Lee et. al (2023) Emphasizes although air quality has improved over time in the U.S. air pollutants are still unevenly spread throughout neighborhoods/areas. This article examines the link of air pollution exposure to socioeconomic disadvantages of neighborhoods in the U.S. among adults. Using observational study from an individual level they will try to find correlations between, health, socioeconomic status, and air pollution within neighborhoods. The result table shows a variety of factors as well as trends, race/ethnicity, male/female/, marriage, wealth, etc.... This article has documented that socioeconomic disadvantages as well as structurally disadvantaged buildings can be linked to air pollution and health as well. Medina (2021) analyzes over the past 4 decades, life expectancy in the U.S. has risen, although there are some groups within the country that have been decreasing in life expectancy. This report examines the trends in life expectancy and mortality rates within the U.S. throughout the years. Using the U.S. Census Bureau's 2017 National Population Projections, this report will examine the potential mortality and life expectancy changes in the coming decades. Separating race/ethnicity and gender to see the trends for every group in the U.S. as well as providing visual tables for me to see. They also put a table to compare the U. S's life expectancy to other countries as well. On the other hand, Bernard (2001) Dives deep into how climate change affects air pollution within the United States. Using various scientific breakdowns of elements, they were able to determine a link between climate change and air pollution. They were also able to find that emissions were one of the lead factors within climate change. A table was also shown in the article to show how climate change affecting air quality can affect health. In the end, a trend between air pollution and climate change can ultimately cause a lot of health-related issues which can lead to lowering life expectancy. Similarly, Thakrar (2020) Air quality in the U.S. has improved yet air pollution is a contributor to 100000–200000 deaths annually. This article

discusses solutions on ways we can combat this problem. They identify the problems and what is causing the pollution and present a visual in the article. They then were able to conclude that most of the causes of death are human-made emissions. One of the solutions they were able to find was coal-powered electricity generation can help this cause.

Research Design and Methodology

This research paper is a case study. This paper focuses specifically is on the United States and Chad alone. Oladimeji (2019) Bernard (2001) Recognizes that despite their similarity in high levels of air pollutions, the United States has a very high life expectancy compared to Chad. The country with the lowest life expectancy in the world. As stated by Tellis (1997) a case study is “done by giving special attention to completeness in observation, reconstruction, and analysis of the cases under study. Case study is done in a way that incorporates the views of the "actors" in the case under study.”. This case study uses Most Similar System Design to analyze the correlation if any between air pollution and life expectancy. The Most Similar System Design which seeks to locate different variables across similar cases has been utilized by many to determine an outcome for a study or research. Li (2022) From comparing cases in urban China on protests against PX plants “explains variations in the strategies Chinese local governments apply to address protests the planning, construction, or operation of paraxylene (PX) plants. (p. 01)” to Li (2022) “Using a most-similar-system design (MSSD), we compared government strategies” being used in political science since experiments are very difficult to conduct within situations like that. By utilizing this approach, the study aims to analyze various factors related to air pollution and life expectancy. Through this analysis, I’m looking for factors of air pollution and life expectancy from all angles, considering a range of factors that can influence each. Using my selection of academic sources, I seek to discover other existing factors that can either support

my correlation theory between air pollution and life expectancy or give me a new finding on it. Regardless of the outcome, I believe that Most Similar System Design would give my study the most accurate findings for my topic. Shedding light on the broader factors that contribute to variations in life expectancy outcomes.

Findings

	United States	Chad
Pollution Levels (as measured by aqicn.org)	Unhealthy 101 AQI	Very unhealthy 192 AQI
Bad Businesses Regulations (as stated by RSMUS and The World Bank)	Government regulation of businesses and industries fell to a new low of 28%.	Chad made starting a business easier by eliminating the requirement for a medical certificate.
Long Exposure to Air Pollutions (as measured by Interactive Country Fiches and Statista)	Concentration of PM2.5 35µg/m3	Concentration of PM 2.5 66 µg/m3

Despite Chad and the United States having similar characteristics such as being high polluters, loose businesses regulations, and long exposure to air pollution, they have a strong difference regarding the issue of life expectancy. Oladimeji (2019) an investigation over Mondou, Chad acknowledges “Pollution is one of the major environmental problems confronting Chad area (p. 1)”. Similarly, Bernard (2001) emphasizes on the fact that the United States’ “Climate change may affect exposures to air pollutants by affecting weather, anthropogenic

emissions, and biogenic emissions and by changing the distribution and types of airborne allergen (p. 1)”. Rieger (2019) study found that it is possible for developing nations with good business lack the environmental regulations as the United States and Chad are both nations developing with loose business regulation leading to air pollutants being bad in both countries. Additionally, the United States and Chad has an issue of long exposure to air pollution as emphasized by Lee et al. (2023) and Oyedele (2023) “Environmental pollution has been shown to adversely affect the fetus, causing congenital anomalies and birth defects. (p. 4)”. Despite the crazy similarities the United States and Chad possesses, their differences remain in life expectancy. Thakrar (2020) found that the life expectancy in the United States total men and women is very high, around 76 years old. It is also expected that by 2060, the lifespan will grow to 86 years old. To as Chad’s life expectancy is 55 years in the lowest life expectancy group according to Karacan et al (2020) “The group with the lowest life expectancy (55.667 years) included countries in sub-Saharan Africa. These countries are Angola, Burundi, Central African Republic, Chad.”

	United States	Chad
Socioeconomic status (as measured by the World Bank)	GDP per capita \$76,329	GDP per capita \$716
Infant mortality rate (as measured by the Knoema)	Under 5 mortality rates 6.98 deaths per 1000 birth	Under 5 mortality rates 107.1 deaths per 1000 birth
Lack of health care in Chad	High Quality healthcare Mediocre access	Low quality healthcare Low access rate

This strong difference may be the result of socioeconomic status between the United States and Chad. Starting with the domestic status between neighborhood areas within the United States. Lee et al. (2023) suggests that “cumulative disadvantage framework, which together suggest that... people with low incomes and minoritized people of color, face multiple... circumstances, such as fewer economic resources or lack of affordable health care options, that make them more vulnerable to the adverse physiological and psychosocial effects of air pollution exposure. (p. 2)”. Within the United States alone, areas with lack of affordable health care options that are making a demographic of low-income individuals more vulnerable to the effect of air pollutions. Applying that to a larger scale on a country like Chad *GDP per capita, PPP (current international \$) - chad. (2023)* with a very low GPD per capita compared to the United States *GDP per capita (current US\$) - united states. (2023)*. Additionally, Lee et al. (2023) included “in highly disadvantaged neighborhoods... there may be a multitude of ... factors, including elevated levels of community violence, structural decay, lack of access to medical care, and food and housing insecurity, that may be perceived as more immediate threats to health. (p. 2)”. This emphasizes on the fact that not only does low-income/disadvantaged neighborhood face vulnerability to air pollution, but other factors can cause it for them as well. Furthermore, Lee et al. (2023) found that “residents of more disadvantaged neighborhoods may interpret or consider the risks of air pollution as less salient for their perceived health status relative to other more pressing concerns. (p. 8)”. A very interesting finding that can negatively impact the disadvantaged even more. As residents of more disadvantaged neighborhoods keep interpreting the risk of air pollution less and less, it would eventually turn into a downward spiral of bad air pollution. Eventually leading to health concerns and residents would be too worried about their bigger health concern to worry about air pollution.

Another reason that can caused this strong difference is health status, maternal, and infant mortality health. This ties well into Oyedele (2023) “Sub-Saharan Africa remains one continent with poor population health status, characterized by a low life expectancy at birth and a high number of child deaths when compared with other continents (p. 1)” emphasizing countries in sub-Saharan Africa including Chad remains as a continent with very poor health status making it also vulnerable to air pollution not only due to socioeconomic status but health status as well. Oyedele (2023) stresses that “Despite the drop in the global under-5 mortality rate from 91 deaths per 1000 live births in 1990 to 43 in 2015...Children in sub-Saharan Africa are... 14 times more likely to die before the age of 5 than children in developed regions (p. 1)”. This is most likely the reason why life expectancy in Chad is so low, because children are dying before the age of 5 and having those statistics within the country’s overall lifespan can reduce it by a lot. With poor mortality rates for under 5 years old children, Oyedele (2023) wanted to see if forest investments were going to help this cause. It is found that investments in forest, in fact, can help life expectancy in countries like Chad. Oyedele (2023) “The results showed that forestland expansions contribute significantly to reducing under-five mortality rates and increasing life expectancy at birth in sub-Saharan Africa. The study found that forest expansion initially seemed to worsen health outcomes; however, after a turning point, it ultimately improved health outcomes as shown by its reduced effect on child death and its increasing effect on increased life expectancy at birth. (p. 12)”. It is very hopeful for Chad to be able to increase their life expectancy with forest investments in the future.

Moreover, a lack of healthcare coverage in Chad can be a contributing factor causing this strong difference in life expectancy between the United States and Chad. Ochieng (2015) recognize the importance of “Health is a resource which allows people to lead a productive life

because its acquisition conditions access to many goods. (p. 2)”. Furthermore, Ochieng (2015) want to emphasize that “Chad has...poor access to primary healthcare, a highly hazardous environment, deficiency in coordination, and a permissive epidemiologic surveillance system, coupled with a lack of public values and deontological arrangements that determine the functioning of social institutions. (p. 12)”. On the other hand, The United States is ranked 11th best healthcare country in the world according to FREOPP.org. Ochieng (2015) would like to note that “The realization of Right to Health requires a radical policy shift rooted in inter-sectoral collaboration, community participation, public accountability and transparency, and social justice in a country where democracy is still growing. (p. 12)”. With the bad health care system going on in Chad, it is imperative that the community take actions for the right to health to be an essential for all citizens in Chad. On the flip side, Hoffman (2008) want to acknowledge the United States effectiveness in their healthcare system stating, “they firmly concluded that, although health insurance *alone* would neither eliminate disparities in access to health care nor equalize health across subgroups of Americans, having health insurance is clearly connected to better health-related quality of life and longer lives”. Although the United States access to healthcare isn’t necessarily the best compared to the other top healthcare countries in the world. There is no denying in the development of healthcare and the quality of it once you have the access to it.

Conclusion

Despite the similarities in being high polluters in the world. The United States and Chad are very different when it comes down to life expectancy. Although, air pollution was a factor of the role, it was only a portion of it. Looking deeper into the socioeconomic state of Chad, we can see that the Chad *GDP per capita, PPP (current international \$) - chad. (2023)* with a very low

GPD per capita compared to the United States *GDP per capita (current US\$) - united states. (2023)*. Lee et al. (2023) An observation in the United States showed that lower income household in more disadvantaged neighborhoods are more vulnerable to air pollution. They are also more likely to brush off the effects of long exposure to air pollution as well due to the fact of having more financial issues to worry about. Leading to a downward spiral of a continuous bad health cycles and eventually shortening their lifespan. Applying this to a larger scale country like Chad, we can see that socioeconomic status plays a huge role in a snowball effect of life expectancy in Chad.

Furthermore, Oyedele (2023) Chad has a very serious issue when it comes down to the lens of maternal and infant mortality rates and their health statuses. One of the ways that we can help this is by investing in forest expansion. Oyedele (2023) strongly encourages this as their study was able to see a correlation between forest expansion and the lack of infant mortality rate. Ochieng (2015) again emphasizes on the fact that Chad has not only a very poor quality of the healthcare itself but the lack of access to it as well. With a specific emphasis on wanting to end this cycle of poor healthcare and wanting to give the right to health to all Chad's citizens. Ochieng (2015) "requires a radical policy shift rooted in inter-sectoral collaboration, community participation, public accountability and transparency, and social justice (p. 12)". With these issues being recognized, Chad as well as the United States can both better their lives expectancies. This in turn can help people of low-income families in the United States live better and longer lives and can help millions of mothers in Chad having to see their babies go away before they turn 5.

For future research recommendations, as this paper was being researched. There was some topic came across with a lot of depths. Recognizing that, some topics that can be

researched for the future would be “Forest investments, how they can improve quality of lives among citizens in Chad”. “Socioeconomic Status in Chad is there any correlation to poor health care status?”. “United States lack of business regulations, is there a correlation between that and air pollutions?”

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