



Health Effects of Exposure to Air Pollution in North African Countries between 1990 and 2019

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ABSTRACT

Africa, particularly West and North Africa, has some of the highest levels of average PM pollution, second only to South and East Asia and the Middle East. This study reports the PM_{2.5} and PM₁₀ concentrations and their emissions sectors in North Africa from 1990 to 2019. The data were collected online from the following platforms: EDGAR (Emissions Database for Global Atmospheric Research), Climate Watch, Our World in Data, and the World Bank. The analysis of data indicated that outdoor air pollution in North Africa is the 4th leading risk factor for death, with 3.4 million deaths in total from 1990 to 2019.

The two main drivers of the rising number of deaths in North Africa, as is the case for the rest of the world, are air pollution mortality rates and population growth and aging. Tunisia, Algeria, and Egypt all had higher death rates in 1990 meaning they have since decreased. However, Morocco and Libya, have higher death rates in 2019, indicating that they had risen in recent decades.

the number of deaths related to outdoor air pollution in all 5 North African countries has increased in 2019 compared to 1990.

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INTRODUCTION

The UN's Geoscheme divides the African continent into five distinct subregions: North Africa, West Africa, Central Africa, East Africa, and Southern Africa. Northern Africa is the largest subregion in terms of land area and consists of 5 countries: Algeria, Egypt, Libya, Morocco, and Tunisia. 43.8% of people (587,737,793 in 2019) are expected to live in urban areas according to the World Atlas. Its location makes it an important transit route for the world's energy markets as well as a crossroads between Europe, Africa, and the Middle East.

Due to its extreme water scarcity, North Africa is especially susceptible to the effects of climate change. With potential health consequences, the entire region is anticipated to rank among the most exposed and vulnerable to "hotspots" caused by climate change.

Free databases made accessible through global platforms were downloaded and used for this investigation. Examining the levels and sources of particulate matter (PM_{2.5}) and the health consequences of exposure to outdoor air pollution in North African countries from 1990 to 2019 were the main objectives of the present study.

METHODS AND MATERIALS

This study reports the levels and sources of particulate matter (PM_{2.5}) and the health consequences of exposure to outdoor air pollution in North African countries from 1990 to 2019. The data were collected from four different online data platforms

- EDGAR 'Emission Database for Global Atmospheric Research' (<https://edgar.jrc.ec.europa.eu/>) is a multipurpose, independent, global database of anthropogenic emissions of greenhouse gases and air pollution on Earth..
- Climate Watch (<https://www.climatewatchdata.org/>) is an open and online data platform that brings together dozens of datasets to let users easily search, analyze, and compare countries' climate progress and commitments under the Paris Agreement.
- Our World in Data (<https://ourworldindata.org>) is a data portal produced by the Oxford Martin Programme on Global Development at the University of Oxford and is made available as a public good. It serves as a helpful tool for researchers, making it easy to explore data sources and analyses on a variety of topics.
- State of Global Air (www.stateofglobalair.org): The data used in the State of Global Air website is part of the Institute for Health Metrics and Evaluation's (IHME) annual Global Burden of Diseases, Injuries, and Risk Factors (GBD) project, which is a systematic, scientific effort to quantify the magnitude of health loss caused by all major diseases, injuries, and risk factors by age, sex, and population.

Health Impact of Outdoor air pollution in North Africa

Outdoor air pollution is a risk factor for several of the world's leading causes of mortality, including stroke, heart disease, lung cancer, and respiratory disorders like asthma (WHO, 2018). The 'Global Burden of Disease,' published in the medical magazine 'The Lancet,' is a large global assessment on the causes and risk factors for mortality and disease, and the annual number of deaths linked to a wide range of risk factors is presented in study (Cohen et al., 2017). Figure 1 illustrates the total number of deaths by risk factor in North Africa, from 1990 to 2019. As it is shown in this Figure, the 'Outdoor air pollution' in North Africa is the 4th leading risk factor for death, with 3.4 million deaths over the period 1990-2019.

Generally, the number of deaths caused by outdoor air pollution has risen dramatically in recent decades around the world. The total increase in mortality and the age of the population, according to several research, were the two main factors for the rising number of deaths. Figure 2 compares the number of deaths in North African countries due to outdoor air pollution in 1990 (on the y-axis) to the number of deaths in 2019 (on the x-axis). The grey line in this Figure symbolizes parity: a country that falls along this line experienced the same number of deaths in both years. Countries above the grey line had a greater mortality rate in 1990 (indicating that it has since decreased), whereas countries below the grey line had a higher death rate in 2019 (indicating that it has climbed in recent decades). In North Africa, the number of deaths related to outdoor air pollution in all 5 countries has increased in 2019 compared to 1990, as can be observed from Figure 2.

The two main drivers of the rising number of deaths in North Africa, as is the case for the rest of the world, are air pollution mortality rates and population growth and aging. Figure 3 shows a comparison of the death rate from outdoor air pollution in 1990 (shown on the y-axis) and 2019 (shown on the x-axis), in North African countries. The country which lies along the dashed grey line had the same death rate in both years; the country which lies above this line had a higher death rate in 1990, and the country below had a higher death rate in 2019.

Tunisia, Algeria, and Egypt all had higher death rates in 1990 (Figure 3) meaning they have since decreased. However, Morocco and Libya, have higher death rates in 2019, indicating that they had risen in recent decades.

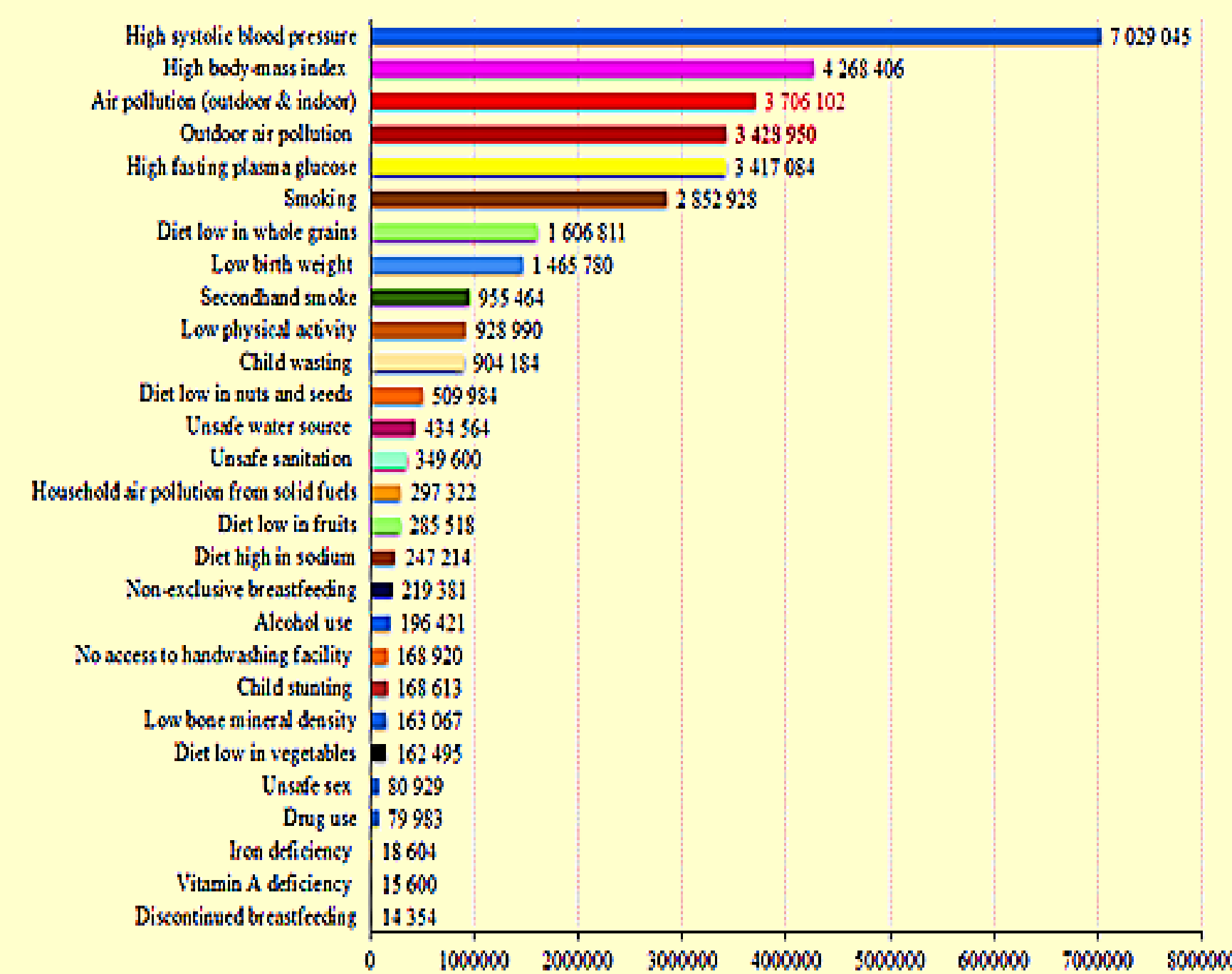


Figure 1. Label The total number of deaths by risk factor, measured across all age groups and both sexes in North Africa, over the period 1990-2019.

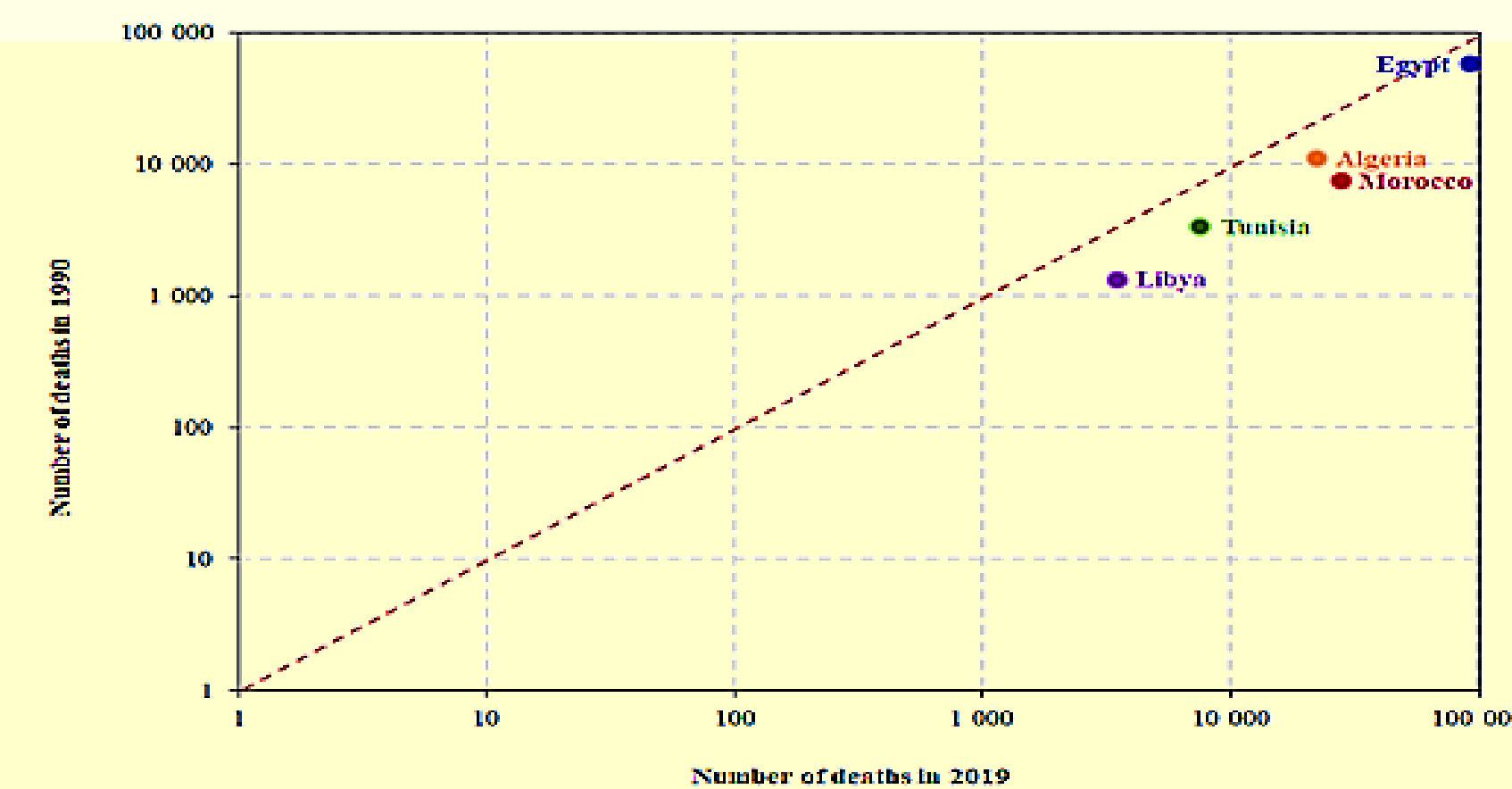


Figure 2. Outdoor air pollution deaths in 1990 vs 2019 in North African Countries .

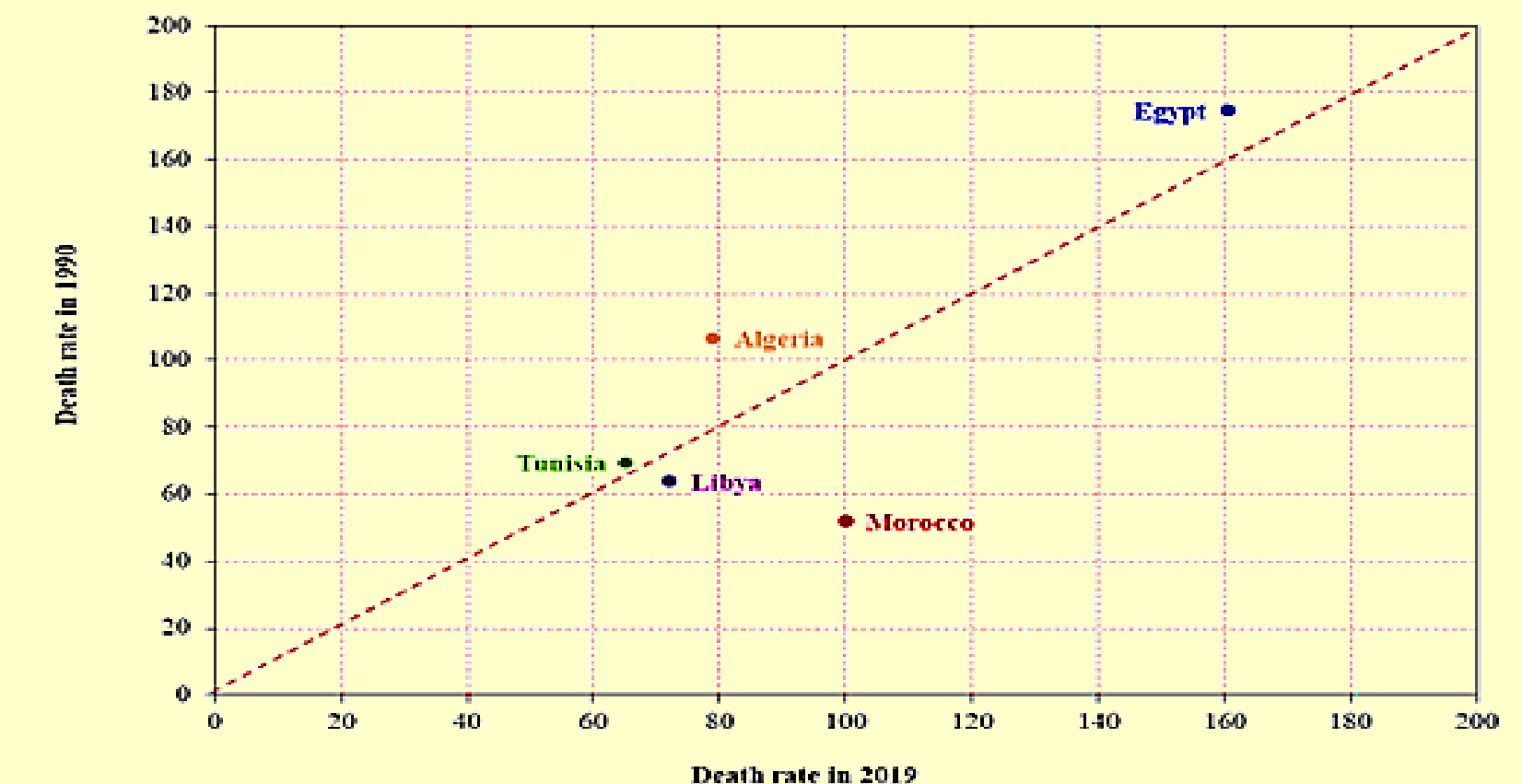


Figure 3. Death rates from outdoor air pollution in 1990 vs. 2019 in North African Countries (death rates from outdoor air pollution are measured as the number of deaths per 100,000 individuals).

Health Impact of PM2.5 in North Africa

In 2021, the WHO updated the global guidelines for air quality management (WHO, 2021) and set a new guideline value of annual PM_{2.5} concentrations was set to 5 micrograms per cubic as the lower range of air pollution exposure, over which adverse health effects occur. In addition, the WHO has provided 4 interim targets of 35µg/m³, 25µg/m³, 15µg/m³, and 10µg/m³.

Figure 4 presents the trend in PM_{2.5} annual exposure mean in North African countries, over the period 1990-2019, compared to PM_{2.5} annual WHO air quality guideline (AQG) and PM_{2.5} annual WHO Interim Target 1 (IT-1).

The exposure in all the North African countries continues to exceed the updated annual WHO AQG of 5 µg/m³ (Figure 4.1.4.4) which is, according to WHO, are the lowest levels at which total, cardiopulmonary, and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to PM_{2.5} (WHO, 2006; Krzyzanowski and Cohen, 2008; Pope et al., 2002). Furthermore, the North African countries exceed even the first intermediate goal set by the WHO, Interim Target 1 (IT-1), which is 35 µg/m³ (WHO, 2021). According to WHO, this level is estimated to be associated with about 15% higher long-term mortality than at AQG (WHO, 2006).

Exposure to air pollution has serious health consequences and ambient PM_{2.5} is the largest driver of air pollution's burden of disease worldwide (Health Effects Institute, 2020). Figure 5 shows the death rate from PM_{2.5} ambient air pollution in the North African countries (measured as the number of deaths per 100,000 individuals.), over the period 1990 to 2019.

The North African countries with the highest numbers of PM_{2.5}-attributable deaths are Egypt, followed by Algeria, Tunisia, Libya, and Morocco. But since 2010, except for Egypt which has kept its leading position, the ranking of the other 4 North African countries according to the number of PM_{2.5} attributable deaths has changed as follows: Morocco has climbed to the second position after Egypt, followed by Algeria, Libya, and Tunisia.

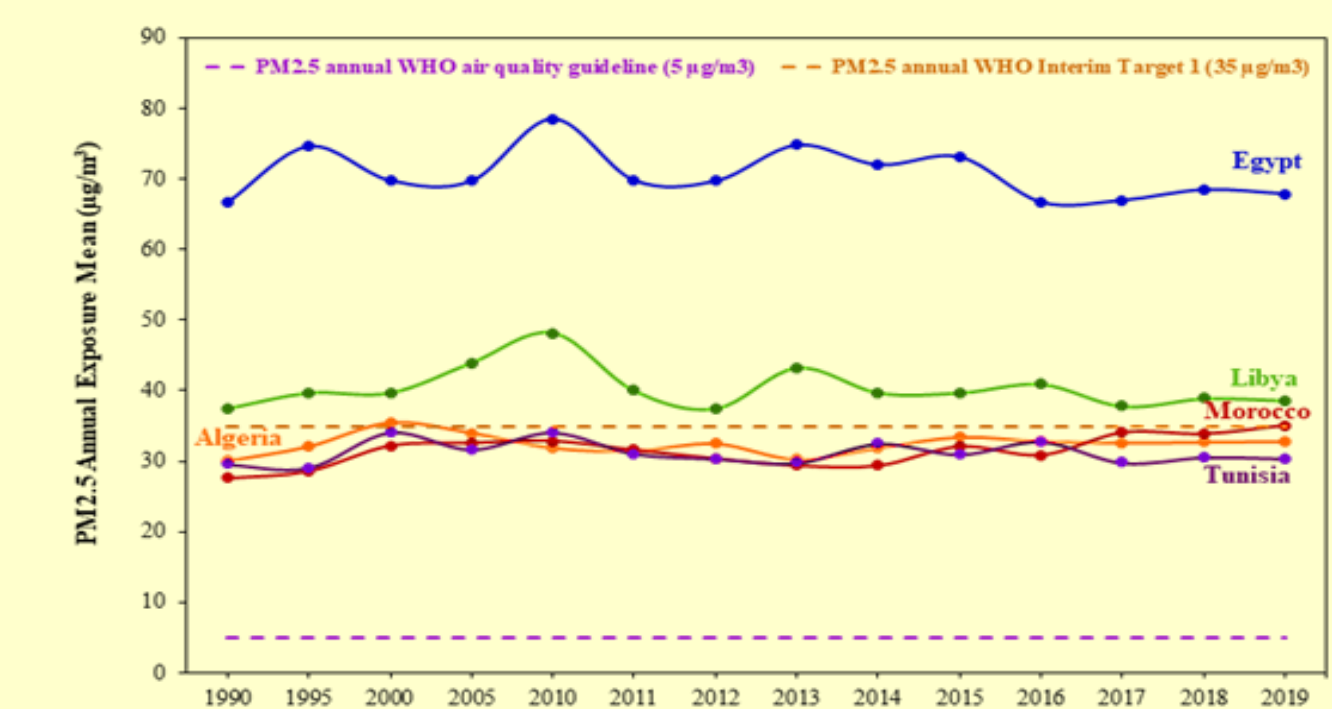


Figure 4. Trends in PM_{2.5} annual exposure mean in the North African countries, over the period 1990-2019, compared to PM_{2.5} annual WHO air quality guideline and PM_{2.5} annual WHO Interim Target 1.

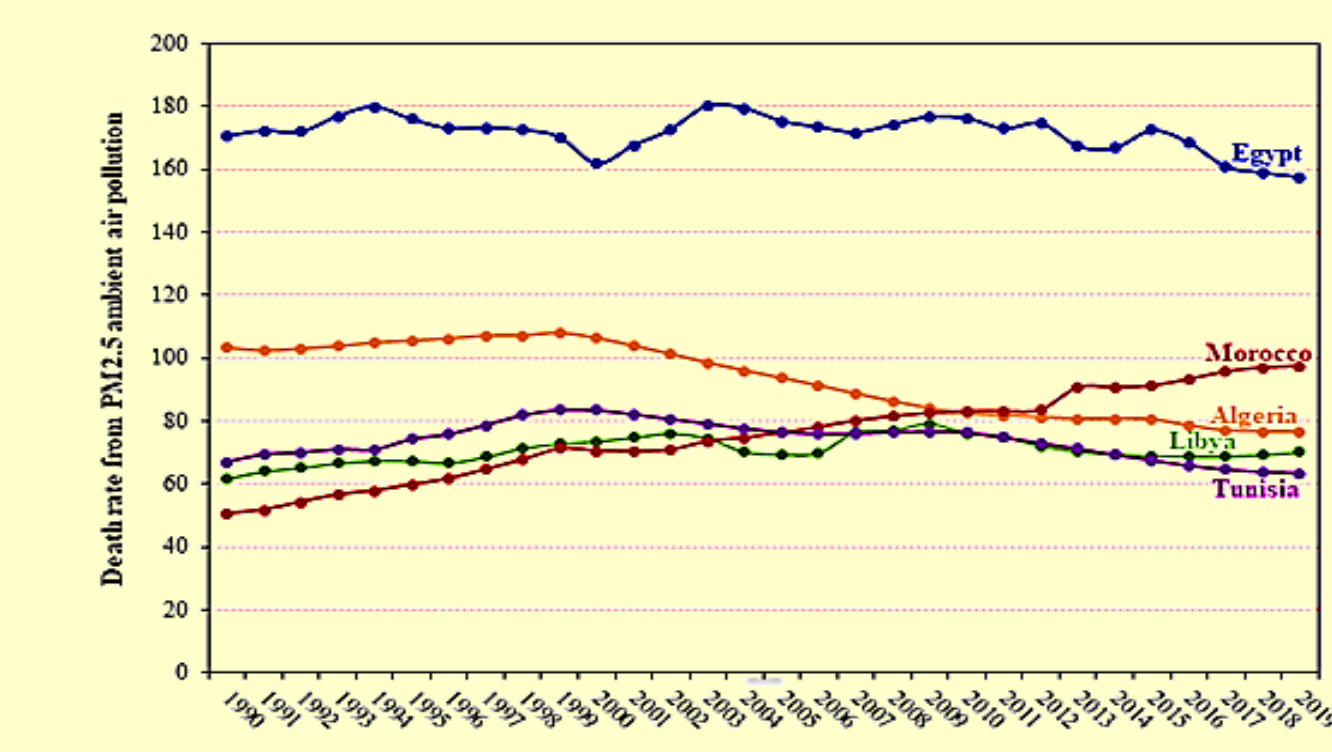


Figure 5. The death rate from PM_{2.5} ambient air pollution in the North African countries (measured as the number of deaths per 100,000 individuals.), over the period 1990-2019.