# Non-Communicable Diseases (NCD) in the Middle East and North Africa: what macroeconomic savings can be expected from achieving SDG target 3.4?

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**Abstract:** Non-communicable diseases (NCDs) kill 40 million people each year, accounting for 70% of all deaths globally. Disability Adjusted Life Years lost to NCDs have also increased considerably over the last 3 decades. The Middle East and North Africa (MENA) are no exception to this increase in NCD deaths, and trends in behavioral risk factors and metabolic characteristics of populations in the region indicate that NCD deaths will continue to rise in the future. NCDs are diseases of long duration and slow progress, thereby imposing serious economic losses on governments and households. This paper estimates the macroeconomic gains for MENA economies of meeting target 3.4 of the Sustainable Development Goals: reducing by one third the mortality from NCDs by 2030. The gains are estimated for the period 2021-2030 using the WHO-EPIC model for five major NCDs including diabetes, stroke, ischemic heart disease, chronic obstructive pulmonary disorder and lung and breast cancers. The findings project sizable and growing savings over the transition period to the target, providing an opportunity for MENA countries to expand their fiscal spaces especially for government spending on health. These projected gains also suggest that the envelope for interventions to reduce NCD mortality that are budget neutral is quite ample. The gains are especially large in countries of the Gulf Cooperation Council.

**Keywords:** Non-communicable diseases, sustainable development goals, Middle East and North Africa, macroeconomic costs of disease.

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## Table of Contents



# Non-Communicable Diseases (NCD) in the Middle East and North Africa: what macroeconomic savings can be expected from achieving SDG target 3.4?

## Background and motivation

Non-communicable diseases (NCDs) kill 40 million people each year, accounting for 70% of all deaths globally. Fifteen million die between the ages of 30 and 69 years (WHO 2017). The 2017 edition of the Global Burden of Diseases (GBD) study revealed alarming trends with regards to NCD mortality and prevalence over the last three decades. While the number of Disability-Adjusted Life Years (DALYs) lost due to injuries remained constant worldwide between 1990 and 2017, those lost due to communicable, neonatal, maternal and nutritional disease decreased while DALYs lost due to NCDs continuously increased (GBD 2017 Disease and Injury Incidence and Prevalence Collaborators 2018). NCDs are diseases of long duration and slow progress, thereby imposing serious economic losses on governments and households. Four diseases are responsible for 80% of all premature NCD deaths: cardiovascular diseases (causing 17.7 million deaths annually), cancer (8.8 million), chronic respiratory diseases (3.9 million) and diabetes (1.6 million) (WHO 2017). Those diseases are also among those associated with the highest economic losses.

Globally, countries are undergoing an epidemiological transition towards NCDs. In 1990, 57% of deaths worldwide were attributed to NCDs, whereas in 2013, that share increased to 70%. NCDs account for more than one-half of global health loss and are affecting high-, middle- and low-income countries with 80% of premature deaths occurring in low-income countries (Benzinger, Roth and Moran 2016). This increase is firstly due to the increased prevalence of key modifiable behavioral risks, such as tobacco and alcohol use, obesity and reduced physical activity. Secondly, a growing and aging population increases the number of life-years lost from NCDs (Bollyky, et al. 2017).

The Middle East and North Africa (MENA) are no exception to the global trends in NCDs.[2] The incidence of lower respiratory infections, diarrheal diseases, tuberculosis, and meningitis decreased between 1990 and 2010 while the incidence of ischemic heart disease, stroke, chronic obstructive pulmonary disease (COPD) increased considerably; all remaining among the top 20 causes of deaths in 1990 and in 2010 (Mokdad, et al. 2014). NCD incidence is projected to increase even more due to growing trends in behavioral risk factors, and to demographic changes of the region, with a population that is both increasing and ageing (Bloom 2011). The gains in life expectancy are now accompanied by a longer period of unhealthy life expectancy for both women and men, partly due to NCDs (Mokdad, et al. 2014).

The MENA region is also one of the most urbanized in the world. It witnessed 400% urban growth between 1970 and 2010, and 200% growth is projected for the next 40 years. This rapid growth has resulted in unplanned urbanization that reduces options for physical activity and increases exposure to air pollution. Environmental and development failures have had a negative impact on health and more specifically through noninfectious diseases in the Arab World (El-Zein, et al. 2014). Behavioral risks also include alarming levels of tobacco use, unhealthy diets, physical inactivity and obesity in both adults and children (Abdul Rahim, et al. 2014). In addition to cigarettes, waterpipe smoking is widespread in the region, especially among the youth and across both genders, and is associated with increased risk of respiratory diseases. Prevalence of overweight in the MENA region has reached alarming levels. Between 1990 and 2011 the prevalence increased from 1.9% to 21.9% among preschool children, from 7% to 45% among school-aged children and from 25% to 81.9% among adults (Musaiger 2011).

The age-standardized prevalence of raised blood pressure is highest globally in Africa with 27.4% for both sexes, followed by the Eastern Mediterranean region with 26.3%. The Eastern Mediterranean region has the highest estimate of age-standardized prevalence of raised fasting glucose levels at 13.7%. As for the BMI and mean waist-hip ratio, it was recorded as highest in the Middle East for women and second highest for men (first highest being North America) (Musaiger 2011).

Chronic diseases not only impose a health burden on society, they also have a large economic impact on the individual, the household and the overall economy. With a disease burden so high and rapidly rising, the economic cost of NCDs in the MENA region is likely to heavy and growing.

As the epidemiological burden of NCDs has been evaluated in most MENA countries, in this paper, we aim to quantify the macroeconomic impact of NCDs in MENA countries. The NCDs we focus on are diabetes, COPD, cancer (lung and breast) and

[2] According to the latest World Bank classification, the MENA region includes 19 countries: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen. As such, MENA countries span different income levels: 37% are high-income level, 26% are upper-middle income and 37% are lower-middle income. The population is unevenly distributed between the different income groups: 15% of the MENA region population is in the high-income countries, 44% in the upper middle-income countries and 41% in the lower middle-income countries. 10 countries (53%) are oil-exporting countries.

cardiovascular diseases (ischemic heart disease and stroke). An estimate of the economic costs of NCDs can incentivize investment in Sustainable Development Goals (SDGs), in particular investments towards meeting target 3.4 of the SDG on health: reducing by one third the mortality from non-communicable diseases through prevention and treatment. Quantifying the cost of diseases can also help tailor health systems and policies to abate the increasing trends.

We estimate the potential macroeconomic gains from achieving target 3.4 of the SDG for health between now and 2030 using the WHO-EPIC model (Abegunde and Stanciole 2006) across all countries in the region for which data are available. The gains are estimated by forecasting GDP between now and 2030 under two scenarios: (i) a status quo scenario in which trends in mortality from NCDs are unchanged (ii) an intervention scenario in which target 3.4 of the SDGs is gradually achieved and mortality from NCDs is reduced by one third of its 2015 value by 2030. The difference in GDP between the two scenarios represents the potential gains from achieving target 3.4 in the transition period to 2030. It should be noted that these gains will persist well beyond 2030, but gains past that date are not included in our estimation as we refrain from assuming the comparison state (the status quo) will remain unchanged for longer than a decade.

## The literature on the cost of NCDs in MENA

Studies estimating the economic costs of NCDs in the region are typically focused on one family of diseases and for one country. The one exception is a study by Booz & Co estimates the macroeconomic impact of NCDs in the Gulf Cooperation Council (GCC) countries to be 39 billion in 2013. The estimate includes the direct and indirect costs of 5 NCDs using the cost-of-illness approach (Chahine, et al. 2013). They also find that the total direct and indirect costs of the selected NCDs would be rising to USD 72 billion by 2022. In this section, we review these briefly for the four families of NCDs that we focus on. For comparability across studies, all cost figures reported in the literature review have been converted to 2018 USD.

### Diabetes:

With the prevalence of diabetes rising worldwide, the diabetes literature shows an increasing number of studies on diabetes, especially those related to costs (NCD risk factor collaboration, 2016). Zabetian et al reviewed diabetes studies on the MENA region published between 1990 and 2012 and only found one study evaluating costs according to the classification of countries followed (Zabetian, et al. 2013): the United Arab Emirates in 2005 (USD 2148 per person) (Al-Maskari, El-Sadig and Nagelkerke 2010). A more recent review by Seuring et al expands the search period to 2014 but doesn't show any additional studies on the cost of diabetes in the MENA region (Seuring, Archangelidi and Suhrcke 2015). Lamri et al estimated the cost of diabetes in Algeria to be USD 16.6 million dollars in 2013 (USD 541 per person) (Lamri, Gripiotis and Ferrario 2014). The literature also shows very wide variation in the cost estimates of diabetes for the same country: Zhang et al estimated that diabetes in 2010 cost Saudi Arabia USD 785 per person (Zhang, et al. 2010) while Al-Howaish estimates it USD 4216 per person for 2010 (Al-howaish 2013), Al-Mutairi and Al-Kharfy USD 3733 for 2011 (Almutairi and Alkharfy 2013), Mokdad et al USD 1758 for 2014 for normal progression cases and USD 12450 for cases with acute

complications (Mokdad, Tuffaha, et al. 2015). Zhang et al also estimate the cost for Egypt at USD 134 per person. Bener and Al-Hamaq calculated the costs of diabetes in Qatar to be USD 3410 in 2015 (Bener and Al-Hamaq 2016). One study published in French in 1994 evaluates the differences in health care expenditure in Tunisia between persons with and without diabetes showing that diabetes would cost a person more than double (USD 198) the costs of a non-diabetic person (USD 82) (Rekik, et al. 1994).

One reason for the wide variation in cost estimates is that treatment costs for diabetes vary widely across MENA countries. The literature reports disparate figures worldwide: for example the direct costs of treating diabetes ranged from USD 242 in Mexico to USD 11917 in the USA. Regression analysis has shown that costs are closely and positively associated with a country's GDP per capita (Seuring, Archangelidi and Suhrcke 2015). This disparity can also be influenced by the methodological differences across studies, which include different variables and different types of costs: direct medical costs, indirect medical costs, cost of treating diabetes, total health expenditure of a diabetic patient and many others. Irrespective of the approach, diabetes costs show an increasing trend (Al-howaish 2013).

### COPD:

COPD has an average worldwide prevalence of 10.1% with a high variation across countries (Zaghloul 2015). The literature on the economic costs of COPD is surprisingly scant and as a result, there are very few estimates of the economic impact of COPD in developing countries (Pauwels and Rabe 2004). Most of the literature is focused on industrialized countries (namely Canada, the United States of America and Italy). In 2012, a study entitled BREATHE aimed at evaluating the regional prevalence of COPD symptoms and healthcare consumption by COPD patients in 11 countries, of which 9 are from the MENA region (El Hasnaoui, et al. 2012).[3] The assessment was performed through a questionnaire to determine the number of physician consultations, hospitalizations and emergency room visits incurred by the patients. However, the economic impact was not quantified. In Lebanon, a study by Karam estimated the hospitalization costs of tobacco related illnesses (which include COPD) to be USD 936 per hospitalization in 2012 (Karam 2014).

### Cardiovascular diseases (CVDs):

CVDs constitute an enormous health burden, causing 36% of deaths in the MENA region. CVDs also come with economic costs estimated at USD 987 billion in 2010 and expected to grow to USD 1160 billion in 2030 worldwide (Bloom, et al. 2012). The costs of stroke and ischemic heart disease are well documented in developed countries such as in the United States of America (Johnson, Bonafede and Watson 2016, Engel-Nitz, et al. 2010, Wang, et al. 2014) and the United Kingdom (Ekpu and Brown 2015, Patel, et al. 2017, Saka, McGuire and Wolfe 2009).

[3] The MENA countries included are Algeria, Egypt, Jordan, Lebanon, Morocco, Saudi Arabia, Syria, Tunisia and United Arab Emirates.

Despite this health impact, the literature shows a research deficit on CVDs when comparing proportional mortality rate and research output. Sibai et al estimated this deficit to be around 30% (Sibai, et al. 2017).

### Cancer:

Lung cancer is the cancer with the largest financial drain worldwide, costing the global economy nearly USD 221 billion, followed by colon/rectum cancer with USD 116 billion and breast cancer USD 103 billion in 2008 (John and Ross 2010). In the MENA region and according to GLOBOCAN 2018, lung cancer in men and breast cancer in women are the malignancies with the highest incidence and mortality rates (International Agency for Research on Cancer 2020). Some studies have specifically looked at some of the economic costs associated with lung cancer: Elias et al evaluated the financial burden of lung cancer drug treatment in Lebanon to an annual average cost per case of USD 5666 over the years 2008-2013 (Elias, et al. 2016) and Tachfouti et al estimated the direct costs of lung management in Morocco to be USD 4709 between 2000 and 2008 (Tachfouti, et al. 2012).

The economic impact of breast cancer in the MENA countries has not been widely quantified either. Elias et al evaluated the cost of breast cancer drugs in Lebanon to an average of USD 6379 per case (Elias, et al. 2016). Boutayeb et al performed a study in 2007 in Morocco and concluded that between USD 16.29 million and USD 35 million need to be devoted every year by the Moroccan health authorities to treat patients with breast cancer (Boutayeb, et al. 2010).

## Methodology: WHO-EPIC Model

The EPIC (Projecting the Economic Cost of Ill health) model was developed by the WHO to estimate the economic impact of noncommunicable diseases on aggregate economic output (Abegunde and Stanciole 2006).
Conceptually economic gains from achieving the target are quantified by comparing the economic performance under two scenarios:

- *Status quo scenario*: Output growth over the years 2018 to 2030 is forecasted yearly based on past trends in the evolution of macroeconomic variables and the most recent estimates of disease prevalence[4]

- *Intervention scenario*: Output growth over the years 2018 to 2030 is forecasted yearly assuming disease prevalence is gradually reduced starting in 2021 so that mortality from the disease is reduced by one third of its 2015 value by 2030

The economic gains from meeting SDG target 3.4 of reducing by one third mortality from each disease is represented by the difference in GDP between 2 scenarios.

The prediction of output using the EPIC model involves the simulation of a Solow growth model where aggregate economic output in country *i* at time *t* is obtained using a production function of the form:

$$Y_{it} = K_{it}^{\alpha}(H_{it}L_{it})^{1-\alpha} \quad (1)$$

[4] The "forecasting" starts in 2018 since the most recent macroeconomic data available for most countries in the region is for 2017.

where output ($Y$) in the economy is determined by the aggregate physical capital stock ($K$), an index of human capital ($H$) and the stock of labor ($L$). $\alpha$ is between 0 and 1, assumed constant over time and represents the share of physical capital in national income.

NCDs affect aggregate output through two pathways: they reduce the potential for accumulating capital because of the cost of treatment, and they reduce labor input because of mortality.

Firstly, NCDs affect capital accumulation. Physical capital accumulates based on:

$$K_{it+1} = s_{it}Y_{it} - \chi C_{it} + (1 - \delta_{it})K_{it} \quad (2)$$

where $s$ refers to the saving rate, $C$ represents the treatment costs, $\chi$ is the fraction of the treatment costs financed out of savings, assumed constant and uniform across countries and years (at 10%), and $\delta$ is the rate of depreciation. Treatment costs represent direct medical costs related to hospitalizations and outpatient visits.

Secondly, NCDs affect labor:

$$L_{it+1} = (1 - \mu_{it})L_{it} + N_{it} \quad (3)$$

Where $L$ is the number of people employed, $\mu$ is the mortality rate attributed to NCDs, and $N$ is the size of the population entering employment.

By using macroeconomic and epidemiological data on these variables, as well as estimates of the direct costs of treatment for these diseases, both scenarios are fit under certain assumptions about demographic and technological trends over the next 10 years.

## Data

The data used to fit the model come from a variety of sources. Macroeconomic variables that are at the core of the Solow model, namely $Y$, $K$, $H$, $L$ are from the Penn World Tables version 9.1. We also extract population figures from the same source. Data on these series from 2010 to 2017 are used to estimate the average growth rates of physical capital $K$, of the human capital index $H$, of the employed population $L$, and of the population. Annual data fit to equation (1) are used to estimate $\alpha$ for each year between 2010 and 2017. In the forecasting of variables for 2018 to 2030 in each of the two scenarios, the parameter $\alpha$ is assumed to remain constant between at its average value for 2010-2017.

In the estimation of the status quo scenario, it is assumed that between 2018 and 2030, $K$, $L$ and $H$ grow at their average annual growth rates between 2010-2017.

The estimation of the intervention scenario also requires data on direct medical costs $C$ and mortality rates $\mu$. We include two types of direct medical costs: hospitalization and outpatient visits. We use estimates from the literature for the average length of

hospitalizations and the average number of outpatient visits per patient for each disease.[5] We use cost estimates of the average hospitalization day and the average outpatient visit from the WHO-CHOICE database. These costs are scaled to the size of the overall economy by using prevalence data from the Institute for Health Metrics and Evaluation database for 2015 and population data from the Penn World Tables. The costs of the 5 diseases are added up together in calculating $C$ for each economy.

It is assumed that these costs increase at the rate of population growth, but prevalence is reduced uniformly starting in 2021 so that by 2030, it achieves SDG target 3.4 and reaches two thirds of its level in 2015. As in the status quo scenario, the growth rate of capital is also assumed to be constant and equal to the average annual rate of growth of physical capital between 2010 and 2017, but unlike the status quo scenario, the stock of capital is increased every year, starting in 2021, by the savings in treatment costs that result from the intervention following equation (2) (scaled by $\chi$, the fraction of treatment financed from savings).

The intervention scenario also affects the evolution of the size of the employed population. For each country, data on the distribution of deaths by disease is taken from the Institute for Health Metrics and Evaluation for 2015. The shares of the 5 NCDs under consideration in total deaths are added and applied to all-cause mortality to obtain mortality per 100,000 due to these diseases. In the intervention scenario, it is assumed that the mortality rate from these 5 diseases is reduced uniformly over the period 2021 to 2030 until it reaches two thirds of its value in 2015. This mortality rate is also assumed to apply to the population employed. As with the assumption made for physical capital, the annual growth rate in the employed population is assumed to be constant and equal to the average annual growth rate between 2010 and 2017. But each year starting in 2021, the lives saved from lowering mortality under the intervention scenario are added to the employed population, following equation (3).

## Findings and discussion

We estimate savings as the difference in real GDP (expressed in 2018 dollars) between the two scenarios. In Table 1 below, we report the net present value of these savings (using a 3% discount rate) for the years 2021 to 2030 for every MENA country for which the requisite data were available. We also express these savings as a percentage of current government spending on health and as a percentage of GDP as estimated for 2020. The last column shows savings per capita.

To the extent that any of the government's spending on healthcare covered part of the costs of direct hospitalization and outpatient visits related to these diseases, we

[5] For COPD, hospitalization days per patient are taken from (Serra-Picamal, et al. 2018), outpatient visits are taken from (Menzin, et al. 2008). For diabetes, we use estimates from (Comino, et al. 2015, Jiang, et al. 2003, Maciejewski and Maynard 2004). For stroke, we use estimates from (Webster, et al. 2011, Qureshi, et al. 2013, Lainay, et al. 2015, Lekander, et al. 2017). The length of hospitalizations and the number of outpatient visits for ischemic heart diseases are taken from (Tatari, et al. 2015). For lung cancer, estimates are extracted from (Lee, et al. 2018, Holmquist, Russo and Elixhauser 2008). The figures for breast cancer are taken from (Russo, Milenkovic and Steiner 2006, Laudicella, et al. 2016).

can expect that moving towards meeting target 3.4 of the SDGs will directly free up some of the public budget for healthcare. Scaling the economy's total savings to government spending on healthcare, the net present value of savings over the next decade ranges from 4.49% in Jordan to a substantial 21.9% in Morocco.

Savings per capita range from $21 per person in Iraq to $667 per person in Kuwait, with savings per head consistently larger for GCC countries and lower in countries with younger populations such as Iraq, Egypt and Jordan.

All four measures of savings tend to be higher in GCC economies, and lower among economies with relatively young populations, such as Iraq, Jordan and Egypt.

**Table 1: Savings from meeting SDG target 3.4**

| | NPV of savings over 2021-2030 (in millions of 2018 dollars) | Savings as % of current government expenditures on health | Savings % of GDP in 2020 | Savings per capita (in 2018 dollars) |
|---|---|---|---|---|
| | | *North Africa* | | |
| **Algeria** | 2,746 | 6.63 | 0.28 | 66 |
| **Tunisia** | 765 | 9.18 | 0.38 | 66 |
| **Morocco** | 1,839 | 21.90 | 0.49 | 51 |
| **Egypt** | 3,626 | 7.80 | 0.14 | 37 |
| | | *Western Asia* | | |
| **Lebanon** | 513 | 9.87 | 0.40 | 84 |
| **Iraq** | 786 | 4.60 | 0.08 | 21 |
| **Jordan** | 209 | 4.49 | 0.16 | 22 |
| | | *GCC* | | |
| **Kuwait** | 2,759 | 12.14 | 0.56 | 667 |
| **Bahrain** | 335 | 14.15 | 0.39 | 224 |
| **Oman** | 852 | 9.26 | 0.31 | 184 |
| **Qatar** | 2,001 | 13.73 | 0.29 | 758 |
| **Saudi Arabia** | 6,155 | 7.11 | 0.24 | 187 |
| **UAE** | 3,021 | 13.60 | 0.33 | 321 |

While the savings appear to be a relative small percentage of current GDP (ranging from 0.08% in Iraq to 0.56% in Kuwait), it should be noted that during the period 2021 to 2030, annual savings as a share of GDP are still not fully borne out, as the country is still on the gradual course to the full reduction in mortality dictated by the target. Annual savings as a share of GDP is highest once the target has been met in 2030 and onwards, but our simulation exercise stops at 2030 are we cannot confidently project the past trends in NCD mortality and prevalence inherent in the "status quo" scenario beyond a decade into the future.

The model almost certainly underestimates the full cost of these diseases on the economy for a number of reasons. While the diseases covered constitute the bulk of NCD cases, they are still not all NCDs. Furthermore, we are abstracting in our analysis from any costs related to co-morbidities between these five NCDs and other diseases: these chronic conditions compromise health in ways that make patients at risk of

other diseases and of complications if they contract other diseases. This was made amply clear during the COVID-19 pandemic.

By only including direct costs of hospitalization and outpatient visits, we are abstracting from other direct costs, such as costs of medication, transport, and care by other household members. We are also excluding the more indirect human capital costs from absenteeism and presenteeism and only including the loss of labor from mortality. Furthermore, in a region where all but the high-income countries have substantially higher out-of-pocket spending on health than the world average (Asbu, Masri and Kaissi 2017), by assuming that the share of direct costs that is financed through savings is constant at 10%, we are underestimating the size of investment in physical capital foregone to these diseases for these countries.[6] In light of these simplifying assumptions on which costs are included in the calculation and how they are integrated in the model, the calculated gains from the intervention are a conservative lower bound estimate of the associated savings.

Reducing mortality and prevalence of the five NCDs in question will come with different price tags in different countries. But the findings from our estimation show that in deciding on any investments towards achieving target 3.4, there are other substantial medium- and long-term macroeconomic gains that should enter the calculation. The fiscal space cleared by these savings suggest an expansive envelope for the cost of any intervention adopted toward reducing NCD mortality.

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[6] Out-of-pocket expenditures on health in lower- and upper-middle income countries in the region were 63.9% and 39.2% in 2014 (Asbu, Masri and Kaissi 2017), when the world average according to the World Development Indicators was around 18.4%.

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