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## Abstract

**Background**: The prevalence of noncommunicable diseases (NCDs) has been increasing in Saudi Arabia.

**Aims**: Our objective was to estimate the effect of NCDs on direct medical costs and workforce productivity in Saudi Arabia.

**Methods**: To estimate direct medical costs, we estimated the unit cost of treating 10 NCDs, then multiplied the unit cost by disease prevalence and summed across diseases. To estimate workforce productivity losses, we multiplied gross domestic product per person in the labour force by the loss in productivity from each NCD and the prevalence in the labour force of each NCD.

**Results**: We estimated annual direct medical costs of 11.8 billion international dollars (Int$) for the 10 NCDs assessed (13.6% of total annual health expenditure). We estimated workforce productivity losses of Int$ 75.7 billion (4.5% of gross domestic product).

**Conclusion**: The economic burden of NCDs in Saudi Arabia – particularly the effect on worker productivity – is substantial.

Keywords: noncommunicable diseases, health expenditure, workforce, Saudi Arabia

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## Introduction

The prevalence of many noncommunicable diseases (NCDs) – especially diabetes mellitus (1) – has increased sharply in Saudi Arabia in recent decades. This increase has been widely attributed to rising rates of obesity due to changes in diet and physical activity brought on by westernization, such as the proliferation of fast-food restaurants and sugar-sweetened beverages and reductions in active lifestyles due to new technology. The rising cost of NCDs, which often include expensive long-term treatment, is a major economic challenge to Saudi Arabia's health care system in which most health costs are financed by the public sector.

The purpose of this study was to estimate two types of costs that arise as a result of NCDs: (i) direct medical costs (including the cost of hospitalizations, outpatient visits, emergency department visits, general practitioner visits and prescription drugs); and (ii) productivity losses in the workplace due to increased absenteeism and presenteeism (diminished productivity while at work).

## Methods

We identified 10 NCDs for which data were available: (i) asthma, (ii) breast cancer, (iii) chronic obstructive pulmonary disease (COPD), (iv) colon cancer, (v) coronary heart disease, (vi) diabetes mellitus, (vii) major depressive disorder, (viii) osteoarthritis, (ix) rheumatoid arthritis, and (x) stroke. We excluded many NCDs for which data were unavailable.

To estimate direct medical costs, we estimated the prevalence and per unit cost – the cost of treating one person's illness for 1 year – for each of the 10 NCDs separately. We used prevalence data from the Institute for Health Metrics and Evaluation's Global Disease Burden database (2). Our per unit cost estimates for breast cancer, colon cancer, coronary heart disease, diabetes mellitus, and stroke are from a 2016 global analysis of major NCDs (3). We obtained per unit cost estimates for other illnesses – asthma, COPD, major depressive disorder, osteoarthritis and rheumatoid arthritis – from the literature (4–15). We adjusted estimates upwards or downwards based on per capita health spending in Saudi Arabia compared with the countries in which these studies were conducted.

We updated monetary figures in local currencies to 2019 costs using inflation data (16). We converted these figures to 2019 international dollars (Int$) by dividing the local currency by the purchasing power parity exchange rate (17). We multiplied the prevalence rate for each disease by the population of Saudi Arabia (18) to obtain estimates of the number of cases of each disease, and then multiplied the number of cases by per unit annual costs to arrive at an estimate of total annual direct medical costs for each condition in the country. We summed the costs of each disease to obtain estimates of total annual direct medical costs of the 10 NCDs.

We used the same estimates as in a report to the United States Chamber of Commerce regarding the percentage productivity loss due to each NCD – defined as the percentage increase in absenteeism costs plus the percentage increase in presenteeism costs (19). We multiplied the loss of productivity for each disease by the estimated number of cases of each disease among workers and by per capita gross domestic product (GDP) among those in the workforce to generate disease-specific productivity losses. We again summed the estimates of

all 10 diseases to generate total worker productivity losses for the country as a whole.

To put these estimates in perspective, we compared the estimated direct medical costs to Saudi Arabia's annual health expenditure, and productivity losses to Saudi Arabia's GDP.

To assess the robustness of our results, we conducted several sensitivity analyses. We considered the effect of replacing our base case per unit cost estimates for diabetes mellitus (3), COPD (4), major depressive disorder (8) and osteoarthritis (11) with lower and higher estimates from the literature (5,6,9,10,14,20,21). We also replaced our base case type 2 diabetes prevalence estimate (2) with a higher estimate from the International Diabetes Foundation (22).

## Results

The estimated prevalence and direct medical costs of the 10 NCDs are shown in Table 1 . The estimated annual per capita cost ranged from a high of Int$ 3056 for COPD to a low of Int$ 414 for asthma. The most prevalent NCD among the 10 we assessed was diabetes mellitus (estimated prevalence 7.2%), followed by osteoarthritis (4.4%). The least prevalent NCDs were breast cancer, colon cancer and rheumatoid arthritis, all estimated at 0.1%. Multiplying the estimated number of cases by Saudi Arabia's population showed that the estimated annual direct medical costs of these 10 NCDs totalled Int$ 11.8 billion, which is equal to 13.6% of the total annual health expenditure in Saudi Arabia. Diabetes mellitus accounted for 40.6% of the estimated direct medical costs among the 10 NCDs, followed by osteoarthritis (21.2%). Rheumatoid arthritis was the least costly of the 10 NCDs, accounting for just 0.2% of total estimated costs.

Table 2 shows estimated worker productivity losses due to each of the 10 NCDs in our analysis as well as combined worker productivity losses due to all 10 NCDs. The total estimated worker productivity loss was Int$ 75.7 billion a year, equal to 4.5% of GDP. Whereas diabetes mellitus was the largest driver of direct medical costs, major depressive disorder was the largest driver of worker productivity losses at Int$ 21.1 billion (1.3% of GDP). The smallest driver of workplace productivity losses was colon cancer, at Int$ 173 million (0.0% of GDP).

In the base case analyses reported above, we used the per unit diabetes mellitus cost from a 2016 global analysis of major NCDs (3). When we used a higher estimate from a 2014 Saudi Arabian study (20), the estimated direct medical costs increased more than twofold to Int$ 29.3 billion (33.7% of health spending). When we replaced our base case per unit diabetes mellitus cost with a lower estimate from a 2013 study in Saudi Arabia (21), combined estimated direct

medical costs fell to Int$ 11.0 billion (12.6% of total health spending). Replacing base case estimates for COPD, major depressive disorder and osteoarthritis costs with higher or lower estimates from the literature (5,6,9,10,14) did not greatly change total direct medical costs. When we replaced our base case type 2 diabetes mellitus prevalence estimates with higher estimates from the International Diabetes Foundation (22), the estimated direct medical costs and workplace productivity losses increased to Int$ 15.3 billion (17.6% of health expenditure) and Int$ 89.9 billion (5.4% of GDP), respectively. A summary of our sensitivity analyses is provided in Table 3 .

## Discussion

Our base case cost estimates are significantly lower than those reported in previous studies. The United Nations Interagency Task Force on NCDs used data from national health accounts to estimate that the direct medical costs of cancers, cardiovascular diseases, endocrine and metabolic diseases, and respiratory diseases accounted for just above 20% of total health expenditure in Saudi Arabia (23). A World Health Organization study that compared costs in many European and North American countries for these four disease classes reported estimates of the percentage of annual total health expenditure ranging from 19% for Canada to 44% for Estonia (24). The discrepancy between these estimates and our estimates may be due our limited list of NCDs and our use of diabetes mellitus per unit cost and prevalence estimates on the lower end of published estimates.

Even our conservative estimates, however, make it clear that NCDs impose a considerable economic burden on Saudi Arabia, especially in terms of productivity losses. Indeed, workforce productivity losses in our base case analysis are more than six times as large as direct medical costs.

Because the median age in Saudi Arabia is 27.5 years (18) and the people at highest risk of most NCDs are middle-aged and elderly adults, the economic burden of NCDs is likely to increase without interventions, which provides further financial justification for implementing programmes aimed at reducing risk factors for NCDs.

The largest contributors to NCDs are lifestyle factors (in particular, diet and exercise choices that lead to obesity) and tobacco use. Interventions that tackle these factors, including targeted sin taxes, restrictions on advertising, low-cost education programmes and warning labels on the most harmful products, should continue to be priorities.

Lastly, it is worth noting that our estimates predate the emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes coronavirus disease 2019 (COVID-19). Interventions addressing NCDs should take on even greater importance during this time since evidence suggests that that people with obesity and some NCDs are at increased risk of developing severe COVID-19 (25–27), which increases both the costs and likelihood of poorer health outcomes. Thus, as a result of the COVID-19 pandemic, the rationale for reducing NCDs is even more compelling than would otherwise be the case.

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**Competing interests**: None declared.

## Impact des maladies non transmissibles sur les coûts médicaux directs et la productivité des personnels (Arabie saoudite)

### Résumé

**Contexte** : La prévalence des maladies non transmissibles (MNT) est en augmentation en Arabie saoudite.

**Objectifs** : L'objectif de la présente étude était d'estimer l'effet des maladies non transmissibles sur les coûts médicaux directs et la productivité des personnels en Arabie saoudite.

**Méthodes** : Pour évaluer les coûts médicaux directs, nous avons estimé le coût unitaire du traitement de dix MNT, puis nous avons multiplié ce coût unitaire par la prévalence de la maladie et avons fait la somme pour toutes les maladies. Pour apprécier les pertes de productivité des personnels, nous avons multiplié le produit intérieur brut par personne dans les personnels par la perte de productivité due à chaque MNT ainsi que par la prévalence de chaque MNT dans les personnels.

**Résultats** : Nous avons estimé les coûts médicaux directs annuels à 11,8 milliards de dollars internationaux pour les dix MNT évaluées (13,6 % des dépenses de santé annuelles totales). Nous avons évalué les pertes de productivité des personnels à 75,7 milliards de dollars internationaux (4,5 % du produit intérieur brut).

**Conclusion** : Le fardeau économique des MNT en Arabie saoudite – en particulier l'effet sur la productivité des personnels – est considérable.

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