

Economic development and diabetes prevalence in MENA countries: Egypt and Saudi Arabia comparison

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economic development, labor force diversity and the prevalence of diabetes.

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Core tip: The prevalence of diabetes across the Middle East and North Africa (MENA) region has been significantly rising with an increasing burden of healthcare costs. The economic changes occurring in the past decade throughout the MENA region have directed more of the labor force towards the service sector and low physically active lifestyle.

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Abstract

Diabetes is increasing in epidemic proportions globally, exhibiting the most striking increase in third world countries with emerging economies. This phenomena is particularly evident in the Middle East and North Africa (MENA) region, which has the highest prevalence of diabetes in adults. The most concerning indirect cost of diabetes is the missed work by the adult population coupled with the economic burden of loss of productivity. The major drivers of this epidemic are the demographic changes with increased life expectancy and lifestyle changes due to rapid urbanization and industrialization. Our focus is to compare MENA region countries, particularly Egypt and Saudi Arabia, in terms of their

INTRODUCTION

The Middle East and North Africa (MENA) region countries spans from the Pacific Ocean to the Persian Gulf and extending from the North Africa shores to the sub-Saharan desert. The Gulf Cooperation Council (GCC) region is part of MENA region but exclusive to countries surrounding the Persian Gulf Sea. The GCC consists of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. The climate, traditions, religious, and dietary habits are intertwined and shared across the region for eons^[1].

The MENA region had the highest comparative prevalence of diabetes in the world in 2012, with four countries in the region among the top ten worldwide

in terms of prevalence^[2]. The International Diabetes Federation (IDF) estimates that by 2030, patients with diabetes will double to current estimates of up to 59.9 million in the MENA region^[3]. Even though epidemiological studies document high diabetes prevalence in each country, there are specific regions within each country that have higher prevalence of diabetes than originally stated. For instance, one study reported a prevalence of diabetes in Basra, Iraq of more than 19%^[4], while, the national prevalence of Iraq is 7.4%^[2]. Thus, the diabetes epidemic in the region could be much worse than anticipated and the differences between rural or urban centers are yet to be investigated.

A number of reports have documented a relationship between increased per capita income and economic development on the drastic increase in diabetes prevalence^[5]. There is evidence that urbanization and economic progress in emerging economies, such as China, have also led to a drastic reduction in overall and occupational physical activity^[6,7]. In West Africa, major urbanization have enabled physical inactivity and diabetes is a major health concern^[8,9]. However, it is important to question the contributions of the sedentary lifestyle or economic development on the epidemic of diabetes *per se*. Developed countries have many similarities including demographic, economic, and population genetics. However, these countries also display varying proportions of diabetes prevalence, as the United States is leading with 12.3%^[10] while Japan has a diabetes prevalence of 7.6%^[2] with very similar economic status and urbanization demographics. These countries have high-income economies with very high Human Development Index. Yet, with their high economic development, they are not regarded as having a rapidly growing diabetes epidemic. The Middle East has the highest prevalence of diabetes in the world with Egypt leading the MENA region in the number of patients with diabetes and with Saudi Arabia leading in the highest prevalence of diabetes in its the adult population.

In this paper we review the economic development, physical activity, and prevalence of diabetes across the MENA and specifically its largest two states, Egypt and Saudi Arabia. We will attempt to understand whether the economic development and westernization of the region is a curse or a blessing concerning diabetes and its epidemic progression?

RESEARCH

We searched PubMed and Google for articles, reports, and major organization statistics related to diabetes mellitus in the MENA region published from 1990 to 2014 without language restriction. We used the following keywords: diabetes, MENA region, physical inactivity, and noncommunicable diseases and found 46 relevant publications. Linear correlation coefficient and statistical analysis was assessed by Minitab (State College, Pennsylvania).

FINDINGS

Diabetes prevalence varies greatly across the MENA region

Egypt and Saudi Arabia are on the separate ends of the spectrum with regards to diabetes prevalence in the MENA region with Egypt having the lowest rate of 7.2% and Saudi Arabia the highest 21.8% (Figure 1)^[11]. There is no significant difference in diabetes prevalence between genders within the Egyptian and Saudi population. The urban population within Egypt have higher prevalence of diabetes compared to the rural population (4.9%), regardless of higher (20%) or lower socioeconomic statuses (13.5%)^[12]. The increased prevalence of diabetes in urban areas could be partly explained by higher socioeconomic status was associated with decreased physical activity and increased prevalence of obesity^[13]. In Saudi Arabia, the same trend can be observed where diabetes was more prevalent among Saudis living in urban areas (25.5%) compared to rural Saudis (19.5%). Despite the readily available access to healthcare facilities, a large number of diabetics (27.9%) were unaware of having diabetes^[14]. Thus, not only diabetes prevalence varies greatly between countries but also among urban and rural regions. This may suggest that lifestyle changes associated with urbanization plays a pivotal role in the progression of the diabetes epidemic.

Arabs are genetically predisposed to diabetes

The incidence of type 2 diabetes is determined by the complex interplay between multiple genetic, epigenetic and environmental factors^[15]. The prevalence of diabetes was highest in the Eastern Mediterranean Region, which includes most MENA region countries, (11% for both sexes) and lowest in the World Health Organization (WHO) European Region (7% for both sexes)^[11]. Whether genetics are a contributing factor remains unknown but recent research may shed some light on this issue.

Approximately 40 single-nucleotide polymorphisms (SNPs) that display genome-wide associations with type 2 diabetes have been identified^[16]. How these SNPs predispose to type 2 diabetes is still limited and is only available for a few variants that mainly affect insulin secretion and sensitivity^[17]. However, there are patterns of SNPs across the MENA region which may bear a role in the diabetes prevalence diversity across the region and on the differences between Arabs and Caucasians.

A unique risk of SNPs for type 2 diabetes that are exclusive to Arab ethnicities has been identified, through a comparative meta-analysis of previously identified SNPs among Arabs and Caucasians^[18]. The study demonstrated diversity in the MENA region with countries on the Mediterranean Sea such as Egypt, Palestine, and Tunisia having similar SNPs as Caucasians. Whether the low prevalence of diabetes in those countries is

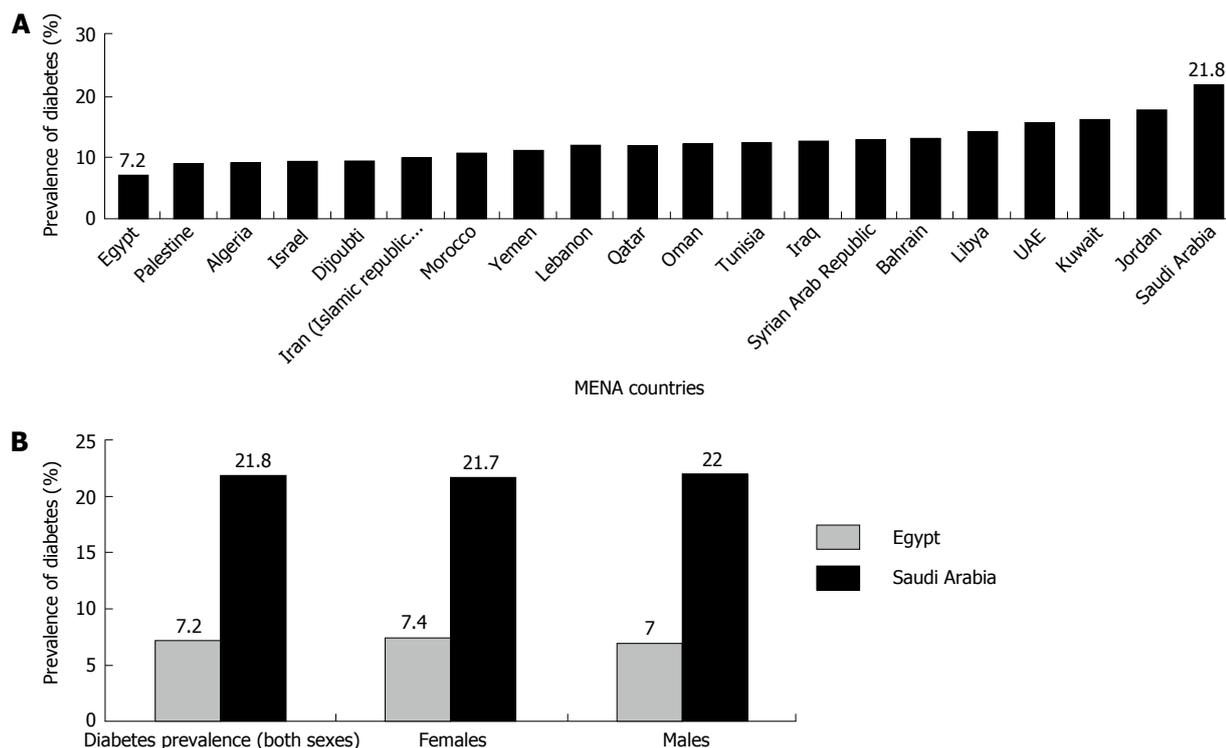


Figure 1 Prevalence of diabetes in Middle East and North Africa region. A: Middle East and North Africa (MENA) countries as defined by the World Bank arranged in increasing prevalence of diabetes; B: Prevalence of diabetes in both genders of Egyptian and Saudi Arabia population. From World Health Organization, 2008. UAE: United Arab Emirates.

influenced by genetic factors is yet to be determined. Conversely, countries from the GCC have different SNPs from Caucasians. North African countries have lower prevalence of diabetes than GCC nations and a similar pattern with the Organization for Economic Cooperation and Development (OECD) countries, which are predominately Caucasian. Egypt, with its low prevalence of diabetes, has a different pattern of SNPs to Saudis.

Other clinical studies comparing Arabs to Caucasians have confirmed that Arabs are more susceptible to diabetes^[19,20]. In particular, when comparing Iraqi immigrants (a state located on the Persian Gulf but not a member of GCC) with native Swedes, type 2 diabetes mellitus was twice as prevalent in Iraqis and the people were at a higher risk of developing diabetes^[21]. To underscore the implications of genetics on diabetes, consanguinity is prevalent in the Arab culture and that may enhance the diabetic genetic predisposition^[22]. A recent study investigated possible mechanisms of consanguinity on the etiology of diabetes in a Saudi population by genotyping SNPs associated with a higher risk of diabetes and measuring other risk factors. It concluded that consanguinity might increase the risk of diabetes by an earlier onset of the disease and by strengthening possible genetic effects on fasting blood glucose^[23]. It may explain why a family history of diabetes increases the risk of diabetes by 1.6, 1.8, and 2.4 times in studies among Palestinians, Iranians, and Kuwaitis, respectively^[24-26]. However, there are

variations in the degree consanguinity across the MENA region. In Saudi Arabia, the prevalence of consanguinity is as high as 60%^[22]. On the other hand, Egypt ranges from 8.3% to 17.2% for the urban and rural regions respectively^[27].

MENA region westernization and lifestyle changes due to its economic growth

Three out of the world's top five oil exporting countries are located in the GCC region^[28], with the world's second largest exporter of natural gas, Qatar. The diabetic population is increasing overall across the MENA region^[2] but the GCC states in particular are increasing at a staggering rate compared to others^[29]. Some have proposed that the degree of westernization and economic development of the GCC has reached comparable levels to OECD with respect to per capita income and have fueled this diabetes epidemic. However, the economic development in the OECD countries is based on industrialization, manufacturing, and other manpower dependent activities. On the other hand, the major driver of GCC economic development is export of raw materials, primarily crude oil and natural gas.

These resources varying allocation within the region created great disparities among MENA region countries. Not only is there a large difference between Egypt and Saudi Arabia with respect to diabetes prevalence but there is also a wide economic gap. Saudi Arabia has more than double the Gross National Income (GNI) of Egypt (Figure 2). Overall, the gap is wide across the

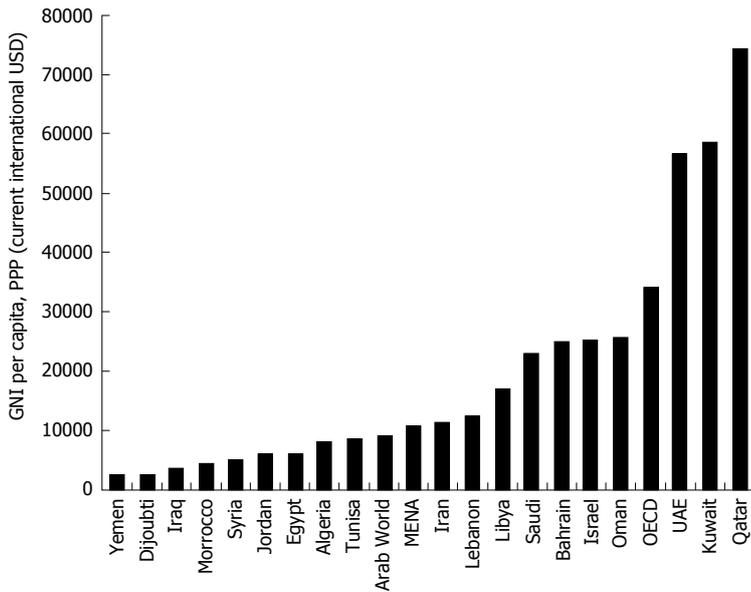


Figure 2 Gross national income per capita based on purchasing power parity of Middle East and North Africa countries. Egypt falls belows Arab world average (\$5710 vs \$8882) where Saudi Arabia is well above average (\$22760). OECD: Organization for Economic Co-operation and Development. From World Bank, 2008. UAE: United Arab Emirates; PPP: Purchasing power parity; GNI: Gross national income.

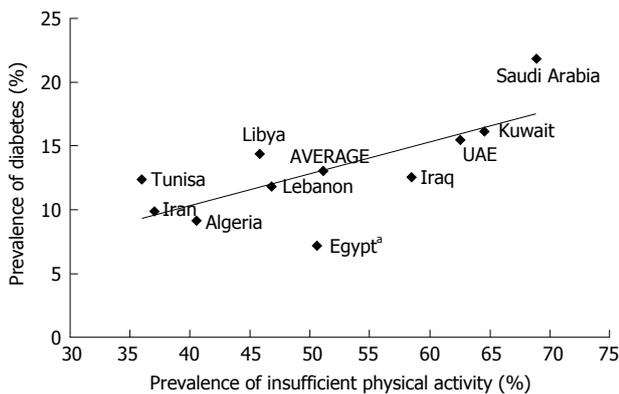


Figure 3 Prevalence of insufficient physical activity in Middle East and North Africa countries compared to prevalence of diabetes. The region's average of prevalence of insufficient physical activity is estimated to be 51.1%. Tunisia and Saudi Arabia are on the two ends of prevalence of physical inactivity in the region (35.9% vs 68.8%). Egypt's prevalence of insufficient physical activity is approximately at the region's average (50.6%). The correlation coefficient of the relationship between prevalence of insufficient physical activity and prevalence of diabetes indicate a moderate positive linear relationship ($R^2 = 0.51$). Regression Analysis of prevalence of Insufficient physical activity vs prevalence of diabetes showed statistical significance ($P = 0.01$). From World Health Organization, 2008. ^aMinistry of Health and population, Egypt Preventive Sector Central Epidemiology and Disease Surveillance (ESU). Non-Communicable Disease Surveillance Unit Community based survey study on non-communicable diseases and their risk factors, Egypt, 2005-2006. UAE: United Arab Emirates.

region with Qatar's GNI over USD 70000 while Yemen is as little as USD 2000, creating financial strains for some nations and lavish lifestyles for others. Furthermore, this overall economic progress has altered the lifestyle of the region. Where the Arab population once frequently participated in outdoor activities, everyone is now almost always inside in an air-conditioned environment, and physical activity has declined^[30].

Increased service sector jobs contributes to higher prevalence of physical inactivity and diabetes

Figure 3 shows that the prevalence of diabetes in a MENA country correlates with a higher prevalence of physical inactivity. Countries with the higher prevalence of physical inactivity and diabetes are mostly GCC countries which are also high income countries. We speculate that the exclusive reliance on export of raw resources by these GCC countries may have detrimental effects on the health of the adult population by decreasing their physical activity.

The statistics on the labor force compiled by the Arab Labor Organization, confirm the diversity of labor in countries that have a lower diabetes prevalence compared with the Gulf region with an economy that is entirely reliant on the service sector with low physically demanding occupations (Figure 4). In contrast, Egypt depends on manufacturing, fishing, and agricultural labor. Egypt's agricultural sector is reliant predominantly on manual labor and old farming techniques that require heavy manpower; mechanical farming is not prevalent nor invested in as labor cost is inexpensive. The labor pattern across the MENA region impacts the gross national income of the countries illustrating the economic disparity between Egypt and Saudi Arabia. The service sector tends to predominate in countries with higher GNI, whereas in Egypt, there is a demand for hard laborious jobs for the underprivileged class.

To emphasize the impact of physical inactivity on mortality, a recent study utilized life-table analysis to estimate gains in life expectancy if physical inactivity were to be eliminated^[31]. Saudi Arabia, with the highest prevalence of physical inactivity and diabetes, had the highest gain in the region, with an estimated additional 1.5 years of life expectancy (1.0 average for region).

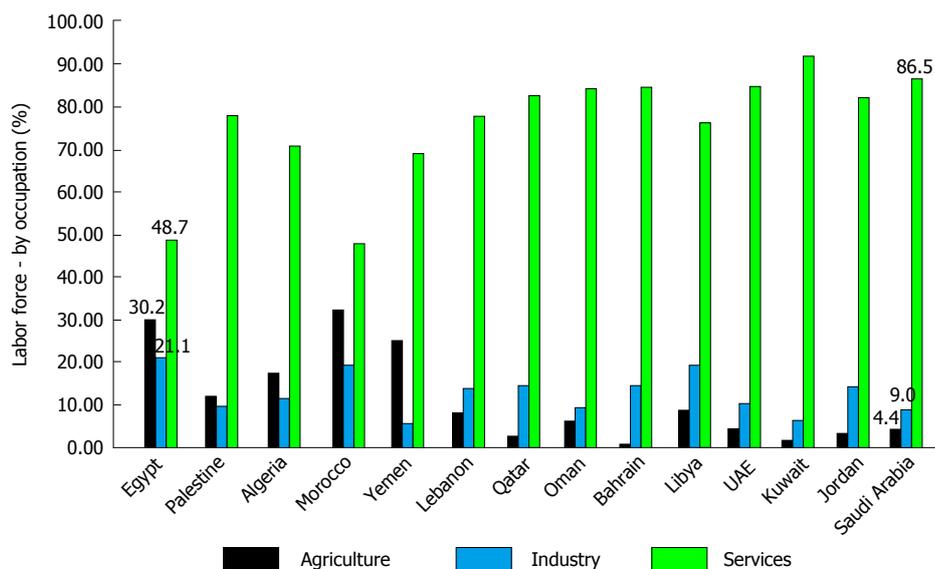


Figure 4 Middle East and North Africa countries labor force by occupation. Diversity of the workforce of Middle East and North Africa countries arranged horizontally from lowest diabetes prevalence (left) to highest diabetes prevalence (right). Data from Arab Labor Organization, but data collected from each country varies from 2006 -2008 (Egypt, 2008; Saudi Arabia, 2007). UAE: United Arab Emirates.

Tunis, with the region’s lowest prevalence of physical inactivity, benefited the least with only 0.6 years gain of life expectancy. Iran, second in terms of lowest prevalence of physical inactivity in the region, only gained 0.7 years of life expectancy. Other studies have confirmed the magnitude of health benefits of physical activity with respect to the prevalence and complications of diabetes on the MENA region population. One large study, with an average 3.2 years follow up, has reported that diabetes can be prevented solely by lifestyle changes even in high risk subjects^[32]. Currently we cannot identify which labor force sector contributed significantly to the increasing diabetes prevalence in the MENA region due to lack of epidemiological studies. However, a study identified the highest prevalence of diabetes was in the service sector above all sectors in the sub-Saharan country of Namibia, also a developing country^[33].

Serious consideration need to be taken to diversify the labor force in countries heavily affected by the diabetes epidemic. This will not only maintain economic growth and provide jobs but may also induce a physically active lifestyle that will eventually enhance the longevity of the adult population and decrease morbidity, mortality, and health care expenditure.

Direct healthcare cost of diabetes

Diabetes presents a severe economic burden as patients with diabetes require at least 2-3 times the health care resources compared to people who do not have diabetes^[34]. The direct diabetes healthcare expenditure varies across the MENA region due to economic inequalities. In the United Arab Emirates (UAE) treatment costs are USD 1605 per person^[35] vs USD 175^[36] in Sudan. The economic disparity and the different prevalence of diabetes between Egypt and Saudi Arabia

affects their healthcare expenditure for diabetes. Based on a large population study on global health care in diabetes^[37], Saudi Arabia’s healthcare expenditure for diabetes per person has reached USD 682, which is 21% of total healthcare expenditure. On the other hand, Egypt’s healthcare expenditure for diabetes has reached only USD 116 per person which is 16% of total healthcare expenditure. It is difficult to assess the exact economic burden of diabetes in each individual country across the region because not a single country has optimally invested in accordance to the magnitude of its diabetic epidemic. Further investigations needs to be conducted to identify risk factors within the region that propagate the diabetes epidemic and optimal healthcare strategies and investments tailored specifically to each country.

MENA region underinvests in diabetes related healthcare expenditure

When comparing OECD and GCC countries, there is a large gap in healthcare expenditure even though some GCC states surpass OECD’s GDP per capita. High incomes states such as, Kuwait, the UAE, and Qatar’s per capita health expenditures were USD 1500, 1640, and 1776, respectively, compared to an average of USD 4593 in OECD countries^[38].

This underinvestment in health care is likely the responsible for diabetes being the fifth leading cause of death in 2010 in the MENA region compared with 11th place in the 1990s^[39]. Epidemiological studies have noted that in high income countries, such as Oman, only 2% of the diabetes population surveyed had their blood glucose levels controlled^[40]. Such studies indicate the dire need for MENA countries, especially the GCC states, to invest in primary healthcare, outreach programs, lifestyle coaching, and self-management

education to produce long term healthy gains. This will not only enhance the longevity and quality of life of patients with diabetes but also ultimately reduce the economic burden of healthcare expenditure.

Improvement in life expectancy across MENA region despite increase in noncommunicable diseases

Economic development across the region has dramatically improved the overall life expectancy of many MENA countries. According to WHO, Lebanon, with the region's highest life expectancy at 80 years in 2012, has sharply risen from 67 years in 1990. Lebanon falls below the MENA region's average prevalence of diabetes (11.9% vs 12.4%) and physical inactivity (46.8% vs 51.1%) contributing to the high life expectancy^[11]. Even countries with the lowest life expectancy in the region have dramatically improved. For example, Yemen had a life expectancy of 58 years in 1990 but has risen to 64 years in 2012^[41]. When comparing GCC countries with lower middle income countries in the MENA region, there is also a difference in the life expectancy based on differences in overall economic development. Egypt's life expectancy is lower than Saudi Arabia, 71 compared to 76 in 2012, despite the higher prevalence of diabetes and physical inactivity. However, Egypt has an overall higher noncommunicable disease death rate than Saudi Arabia^[42].

Increased work hours does not increase risk of developing diabetes

A study was conducted on 40861 employees from four large companies in Japan to determine the effect of long work hours on the prevalence of diabetes^[43]. It was hypothesized that longer work hours would predispose employees to diabetes. Surprisingly, there was a decreasing trend of diabetes prevalence with increasing hours of overtime of up to 100 h/mo. In the participating companies, however, occupational physicians recommended employers to shorten working hours for patients with advanced disease, including diabetes. Exclusion of workers taking medication for diabetes did not appreciably change the results. Of the measured risk factors, short sleep duration and leisure time physical inactivity were associated with long working hours, but BMI was not. The physical demand of the job description was not considered in the study. Whether shorter periods of sleep and longer working hours (implying a more vigorous lifestyle) would have a direct causality in prevention of diabetes mellitus is yet to be determined. Taking these studies in account it is important not only to diversify the labor force in MENA region but to consider prolonging work hours for possible additional health benefits.

Dietary habits and prevalence of diabetes

Egypt is one of the few countries in the MENA region that has strictly adhered to the Mediterranean diet^[44] which consists primarily of raw vegetables, fruits, moderate amount of fat, and low amounts of meat^[45].

It has been suggested that the Mediterranean diet has numerous health benefits including diabetes prevention and management^[46,47]. The Egyptian population has a low alcohol consumption of 0.5% which will further decline to 0.3% by 2015^[48]. Low alcohol consumption is not specific to Egypt but is characteristic of the MENA region. This eliminates the risk of alcohol attributable and nonattributable diseases such as diabetes, cancers, and liver cirrhosis. However, infection with hepatitis B and C viruses (HCV) continues to be a risk factor^[49]. As the prevalence of diabetes is increased in cirrhosis due to HCV infection (compared to cirrhosis to other etiologies), this may be conducive to the development of type 2 diabetes *via* insulin resistance^[50]. The prevalence of HCV in Egypt is ten-fold higher than that in other countries^[51]. The contribution of HCV infections in Egypt on the prevalence of diabetes is not precisely known and remains to be investigated.

In contrast, the Saudi population, with its desert environment, infrequently consume vegetables and fruits and has been reliant on meat and heavy carbohydrates, primarily dates, as its main diet. When taken in the context of the country's current westernization, this unbalanced diet has progressively worsened to include high carbonated drink such as soda and processed food. Whether the dietary contrast of Saudi Arabia to Egypt may have direct causality to the large difference of diabetes prevalence between the two countries remains unknown but is an interesting speculation.

CONCLUSION

Diabetes inflicts unacceptable high human, social and economic costs on MENA region countries at all income levels. Increased economic development and the subsequent adaptation of a Western lifestyle and the emergence of low physically demanding job sectors on the expense of manual labor may have causal effects on the increased diabetes prevalence in the population independent of other lifestyle habits. Diabetes is more than a health issue and serious consideration need to be taken to initiate diversity in the labor force in the MENA region that might require change in current economic policies. This strategy would produce direct health benefits with lower healthcare expenditure and improved quality of life on the overall population.

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