Cost of premature mortality attributable to smoking in the Middle East and North Africa

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Abstract

Background: Tobacco smoking is a leading cause of premature mortality, incurring substantial economic costs.

Aims: To estimate the rate and cost of premature mortality attributable to smoking in the 24 Middle East and North Africa (MENA) countries in 2015.

Methods: Smoking attributable fractions were estimated. Twenty-four smoking-related diseases were included in the analysis. For each country, the total number of deaths by disease, age, and gender among individuals aged \geq 15 years were derived from a World Health Organization database. Human capital approach was used in calculating cost of premature mortality.

Results: Smoking was responsible for 465 285 deaths in MENA countries, resulting in 7 122 706 years of potential life lost, or an average of 15.23 years lost per smoking-related death. Of the total 465 285 smoking-related deaths, 412 415 (88.6%) occurred in men, accounting for 37% of all deaths from the diseases considered in this analysis among men. The total mortality cost attributable to smoking was estimated at US\$ 29.7 billion in 2015 (0.76% of MENA's gross domestic product). Turkey was the country most affected by the tobacco epidemic, representing 41% of smoking-related mortality cost in the whole region, followed by Saudi Arabia (8.76%) and Egypt (7.88%).

Conclusion: Smoking is an important preventable cause of premature mortality in MENA countries. Substantial decline in smoking-attributable deaths and significant economic cost saving can be achieved in this region through more effective tobacco control policies.

Keywords: cost, MENA, premature mortality, smoking attributable fraction, smoking

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Introduction

Tobacco smoking has been established as an important risk factor for many types of diseases, such as cardiovascular diseases, cancer, chronic obstructive pulmonary disease (COPD), lower and upper respiratory tract infections, and asthma (1). Tobacco smoking is recognized as the leading *preventable* cause of death (1), and was responsible for ~6.4 million deaths (11.5% of global deaths) in 2015, ranking it among the 5 leading risk factors for disability-adjusted life years loss in 109 countries (2).

The economic impact of tobacco smoking is substantial, especially in terms of premature mortality. The total economic cost of smoking was estimated at US\$ 1436 billion, which accounted for 1.8% of the world's annual gross domestic product (GDP) in 2012 (3). Globally, the cost of premature mortality due to smoking was estimated at US\$ 657 billion in 2012, representing 51% of the total cost of smoking (3).

The Middle East and North Africa (MENA) is a diverse region consisting of high-, middle- and low-income countries. The population of the MENA region is at least 750 million or 10% of the world's population (4). The definition of MENA is controversial and variable, with many overlapping regions. In terms of World Health Organization (WHO) regions, most countries in MENA are member states of the Eastern Mediterranean Region, except for Algeria and Mauritania, which are members of the African Region and Turkey, which belongs to the European Region.

Despite the decline in smoking prevalence in several high-income countries, the prevalence in many MENA countries remains high and is increasing (5). The prevalence of smoking in the MENA Region ranged from an average of 50% among men and 5% among women. Surprisingly, > 50% of young people have initiated smoking before age 10 years (5). Lack of political commitment to tobacco control and tobacco industry tactics are considered the major challenges in reducing the tobacco epidemic in the MENA Region.

Due to population ageing and marked demographic and socioeconomic transitions, several diseases currently pose a major challenge to healthcare systems in the MENA Region. In 2012, > 800 000 new cancer cases and 360 000 cancer deaths were estimated (6). Furthermore, cancer mortality in the MENA Region is expected to increase dramatically with the rate of 181% over the next 15 years (7). In addition, cardiovascular diseases are the leading cause of death in the WHO Eastern Mediterranean Region, causing 1.4 million deaths (34.1% of all deaths in the Region) in 2015 (8). Lower respiratory tract infections (LRTIs) resulted in 191 114 deaths and 11 million disabilityadjusted life years in the Eastern Mediterranean Region, which is higher than global rates, making it the third leading cause of deaths (9).

The objectives of this study were to estimate the rate of premature mortality, years of potential life lost (YPLL), and cost of premature mortality attributable to smoking in MENA countries in 2015. Such information clearly depicts the number of deaths that could be prevented as well as the cost that could be saved by more effective tobacco control policies. The findings can provide clear economic evidence for governments in the MENA Region to respond effectively to the tobacco epidemic by strengthening their existing tobacco control policies and regulations.

Methods

Study design

This was a descriptive, prevalence-based, cost-of-illness study. Smoking-attributable fractions (SAFs) were calculated to estimate the number of premature mortality attributable to smoking. To estimate the cost of premature mortality attributable to smoking (10), we used the human capital method (HCM). HCM is commonly used to estimate indirect cost due to productivity loss. Under this method, the cost of productivity loss was estimated by multiplying the total period of absence from work due to ill health, disability or premature mortality by the wage rate of the absent person. For cost of premature mortality, the productivity loss was valued in terms of the present value of expected future earnings throughout the remaining years of life expectancy at time of premature death.

Study settings

We adopted the widest definition of MENA by including the countries as stated by the World Bank (11) plus Afghanistan and Pakistan. Turkey was also included as it shares many characteristics with the listed countries and is often included in the Middle East. Somalia and Sudan were included according to the definition by The Joint United Nations Programme on HIV/AIDS (UNAIDS) and United Nations Children's Fund (UNICEF) (12), and Mauritania was included according to the definition by United Nations High Commissioner for Refugees (UNHCR) (13). Thus, our analysis extended to 24 countries (Table 1). Palestine was not included in this analysis due to the unavailability of relevant data.

Smoking-associated diseases

Sixteen types of cancer that showed a causal relationship with tobacco consumption in large epidemiological studies were included in this analysis (1,14,15). These included malignancies of the lip and oral cavity, nasal cavity, pharynx, oesophagus, stomach, colorectum, liver (not including cancers secondary to hepatitis B, hepatitis C or alcohol consumption), pancreas, lungs and trachea, breast, uterine cervix, ovaries, kidneys, urinary bladder and larynx, and leukaemia (1). Four cardiovascular diseases [ischaemic heart disease (IHD), rheumatic heart diseases, hypertensive heart disease, and stroke] along with 3 respiratory diseases (asthma, LRTI and COPD) and diabetes mellitus were included in the analysis due to a causal relationship between smoking and their etiology (1).

Estimation of SAF

SAF for each disease (i) was calculated by the following formula (10):

$$\text{SAF}_{i}(\%) = \frac{P(RR_{i}-1)}{1+P(RR_{i}-1)} \times 100$$

where *P* is the prevalence of current smoking of any tobacco product for each country (aged \ge 15 years), and RR_i is relative risk of smoking for disease *i* (1,2,-24) included in this analysis.

Prevalence of current smoking (cigarettes, cigars, water pipe, etc.) among individuals aged \geq 15 years was obtained from various sources (16–21) (Table 1). Prevalence in 2010 or a few years before was adopted for estimating SAF, to capture the accumulated hazard of smoking. This is because incidences of diseases observed in 2015 reflect past exposure to smoking. If we were unable to find the prevalence rate for 2010, we used the closest available estimates.

The RRs of tobacco-smoking-related diseases were obtained from recent, well-designed meta-analyses (1,14,15,22–24) (Table 2). It should be noted that LRTI is a term that usually includes pneumonia and bronchitis. In this study, RR for bronchitis (24) was used to represent LRTI.

Estimation of mortality attributable to smoking (MAS)

The total numbers of deaths in 2015 (aged \ge 15 years) from each disease by sex and age were derived from a WHO database (25) and multiplied by the corresponding SAF to estimate the number of premature mortality attributable to smoking for disease i (MAS) in 2015.

Estimation of mortality cost attributable to smoking (MCAS)

Based on HCM, premature mortality cost attributable to smoking for disease *i* according to sex *k* (MCAS_{*ik*}) was calculated as follows:

$$MCAS_{ik} = \sum_{i=1}^{n} (MAS_{ik} \times PVLE_{ik})$$

where

$$MAS_{ijk} = SAF_{ik} \times Tdeath_{ijk}$$

 SAF_{ik} = smoking attributable fraction of death from disease *i* and sex *k* (1 or 2)

Research article

Country	Population as of July 2015	GDP/capita US\$ in 2015 (refs)	Prevalence	e of smoking (%)	Year of prevalence estimation (refs)
	in millions		Male	Female	
Afghanistan	32.5	627 (27)	22.9	2.8	2010 (20)
Algeria	39.7	4151 (27)	27.0	3.0	2010 (16)
Bahrain	1.4	24063 (27)	35.0	6.0	2010 (16)
Djibouti	0.9	1788 (27)	24.8	1.7	2017 (17)
Egypt	91.5	3731 (27)	42.7	0.5	2010 (16)
Islamic Republic of Iran	79	4723 (27)	22.2	1.3	2010 (16)
Iraq	36.4	4869 (27)	27.0	3.0	2006 (16)
Jordan	7.6	5506 (27)	62.7	9.8	2010 (16, 19)
Kuwait	3.9	27885 (27)	42.3	4.4	2006 (16, 17)
Lebanon	5.9	11178 (27)	41.6	27.5	2010 (16)
Libya	6.3	2813 (27)	50.0	1.0	2009 (16)
Mauritania	4.1	1307 (27)	38.6	4.5	2010 (16)
Morocco	34.4	2965 (27)	41.7	2.0	2010 (16)
Oman	4.5	18485 (27)	18.0	1.0	2010 (16)
Pakistan	189.0	1425 (27)	37.9	3.7	2010 (16)
Qatar	2.2	67537 (27)	21.3	0.6	2013 (17)
Saudi Arabia	31.5	21095 (27)	25.9	2.8	2010 (16)
Somalia	10.8	426 (28)	19.7	2.3	2013 (20)
Sudan	40.2	2119 (27)	23.8	2.1	2010 (17)
Syrian Arab Republic	18.5	1821 (29)	56.9	17.0	2006 (18, 21)
Tunisia	11.3	3884 (27)	65.4	1.2	2017 (17)
Turkey	78.7	10915 (27)	45.9	14.6	2010 (16)
United Arab Emirates	9.2	37361 (27)	36.8	1.3	2017 (17)
Yemen	26.8	1334 (27)	21.0	6.0	2013 (16)

GDP = gross domestic product; MENA = Middle East and North Africa.

Tdeath_{ijk} = total number of deaths (aged \ge 15 years) from disease *i* for age group *j* (1,2-5) and sex *k*

 $PVLE_{jk}$ = total discounted present value of lifetime earnings for age group *j* and sex *k*.

n = the number of age group in the analysis (i.e., 15–29, 30–49, 50–59, 60–69, and 70+).

For each country, YPLL was calculated for each age group for all diseases. We used life tables published by WHO for 2015 that provided age-specific death rates by country for men and women to find the remaining life expectancy at the time of death (26).

PVLE was estimated for each sex and age group by combining the annual income per capita, discount rate, and corresponding life expectancy for that age group. GDP per capita during 2015 for each country was derived from the International Monetary fund (IMF) (27), along with World Bank (28), and United Nations (29) and then were used as an annual income rate (Table 1). A discount rate of 3% was applied in this study.

Ethical approval

Ethical approval was not required for this study since it did not include human subjects.

Results

The number of premature deaths, cost, and YPLL attributable to smoking for each disease are presented in Table 3. Of the total 2 126 379 deaths that occurred from 24 diseases in MENA in 2015, smoking was responsible for 465 285 deaths – 412 415 for men (88.6%) and 52 870 for women (11.4%). This accounted for 22% (37.2% among men and 5.2% among women) of all deaths occurring from the diseases considered in this analysis, resulting in 7 122 706 YPLL – 6 306 254 years in men and 816 452 years in women. The average years of life lost per each smoking-related death in MENA was 15.23 years. The total MCAS was valued at US\$ 29 729.7 million. This represents 0.76% of MENA's total GDP in 2015.

The greatest association was seen between smoking and trachea, bronchus and lung cancer (71.3%), followed by laryngeal cancer (62.1%), and pharyngeal cancer (48.2%) (Table 3). The highest MAS was from IHD (173 351 deaths in men and 19 479 in women); stroke (68 920 deaths in men and 10 164 in women); COPD (43 135 deaths in men and 6117 in women); and trachea, bronchus and lung cancers (38 335 deaths in men and 3500 in women). The top 3 diseases attributable to MCAS were IHD (US\$ 11 430.4 million), followed by lung cancer (US\$ 4572.2 million)

Table 2 Relative risks of smoking-related diseases			
Disease (refs)		Relative risk	
	Male	Female	All
Bladder cancer (14)	2.77	2.77	2.77
Breast cancer (1)	4.16	1.06	NA
Uterine cervix cancer (14)	NA	1.83	NA
Colorectal cancers (14)	1.13	1.40	1.20
Oesophagus cancer (14)	2.50	2.50	2.50
Kidney cancer (14)	1.52	1.52	1.52
Larynx cancer (14)	6.98	6.98	6.98
Lip and oral cavity cancer (14)	3.43	3.43	3.43
Liver cancer (14)	1.56	1.56	1.56
Myeloid leukaemia (1)	1.86	1.13	NA
Nasal and sinus cancers (14)	1.95	1.95	1.95
Ovary cancer (14)	NA	2.07	NA
Pancreas cancer (14)	1.70	1.70	1.70
Pharynx cancer (14)	6.76	6.76	6.76
Stomach cancer (14)	1.74	1.45	1.64
Trachea, bronchus, lung cancers (15)	10.92	10.92	10.92
Diabetes mellitus (23)	1.89	1.89	1.89
Hypertensive heart disease (24)	1.96	2.12	NA
Ischemic heart disease (1)	2.71	3.01	NA
Rheumatic heart disease (1)	2.17	2.01	NA
Stroke (1)	2.47	2.15	NA
Asthma (15)	1.61	1.61	1.61
Chronic obstructive pulmonary disease (15)	4.01	4.01	4.01
Lower respiratory tract infection (22)	3.41	3.41	3.41

NA = not available.

and stroke (US\$ 4345.8 million). In terms of YPLL, IHD resulted in the largest YPLL (2 841 554) followed by stroke (1 145 540) and lung cancer (789 489).

Table 4 presents the total number of premature deaths, cost, and YPLL attributable to smoking for each country. The highest SAF was observed in Lebanon and Turkey (33%) followed by Jordan (32%), Syrian Arab Republic (31%), United Arab Emirates (UAE) (30%), and Kuwait and Tunisia (29%). The highest MAS was found in Pakistan (134 130), followed by Turkey (87173), and Egypt (55,606). The highest MCAS was found in Turkey (approximately US\$ 12.2 billion) which accounted for ~41% of total MCAS in MENA, followed by Saudi Arabia (approximately US\$2.6 billion), Egypt (approximately US\$2.3 billion), Pakistan (approximately US\$ 2.3 billion), and UAE (approximately US\$ 1.7 billion). The costs incurred by these 5 countries accounted for 71% of total MCAS in MENA in 2015. MCAS incurred by men was 6 times greater than incurred by women. MCAS accounted for 1.85% of GDP in Lebanon, 1.68% in Turkey and 1.32% in Tunisia.

Discussion

The findings of this study found that smoking was responsible for 465 285 deaths, resulting in 7.12 million YPLL in the MENA Region during 2015. This accounted for 22% of all deaths from 24 diseases in the Region. This estimation is in line, but slightly higher, with a recent study in the United States of America, which found that ~18% of deaths were attributable to smoking (*30*). In contrast to that study, which found that SAF in men was higher in women (20.6% vs 15.1%), but similar to a study in the Association of Southeast Asian Nation (ASEAN) countries (*31*), we found that SAF among men was higher than in women (*37.2%* vs 5.2%). This could be explained by the low prevalence of smoking among women in MENA and ASEAN countries.

In our study, the SAF for all cancer types was estimated at 24.5%, which is comparable to the global estimate of 22% (36) but lower than that in Asian countries (30.5%) (31). This is probably due to the higher prevalence of smoking in ASEAN countries. When comparing across diseases, similar to the global estimate (32), we found that the highest SAF was in lung cancer (71%). We found that SAFs for IHD and stroke were estimated at 22.2% and 18.8%, respectively. These estimates are higher than the global estimates, which found that ~12% and ~7% of IHD and stroke was attributable to smoking (32). This is possibly due to the different sources of RRs used in the SAF calculation. More updated RRs were used in our study.

Table 3 Mortality, mortality cost, a	and YPLL attribut	able to smoking	by diseases (in 2015	(
Disease		MAS (SAF %)			MCAS (\$ Millio	(u		APLL	
	W	F	Total	W	F	Total	W	Ĥ	Total
Bladder cancer	6832 (39.9)	300 (7.7)	7132 (34.0)	493.9	28.4	522.3	95424	4656	100080
Breast cancer	5 (55.6)	154 (0.3)	159 (0.3)	0.3	16.8	17.1	92	4,070	4162
Uterine cervix cancer	NA	290 (3.2)	290 (3.2)	NA	24.9	24.9	NA	7098	7098
Colon and rectum cancers	890 (4.7)	356 (2.4)	1246 (3.7)	84.6	44.3	128.9	17202	7734	24936
Oesophagus cancer	3343 (31.7)	493 (5.6)	3836 (19.9)	216.5	48.7	265.2	60215	11051	71266
Kidney cancer	938 (16.5)	116 (3.4)	1054 (11.6)	90.5	16.3	106.8	17311	2552	19863
Larynx cancer	4409 (68.1)	229 (23.2)	4638 (62.1)	303.9	27.6	331.4	80253	5923	86176
Lip and oral cavity cancers	3313 (46.1)	448 (8.3)	3761 (29.9)	141.1	22.3	163.4	73264	10104	83368
Liver cancer	258 (17.0)	21 (1.8)	279 (10.3)	16.3	1.6	18.0	4643	420	5063
Myeloid leukaemia	2739 (22.8)	53 (0.6)	2792 (13.7)	247.2	6.6	253.7	71793	1481	73274
Nasal and sinus cancers	631(24.5)	42 (3.7)	673 (18.1)	56.0	4.5	60.5	15343	1155	16498
Ovary cancer	NA	600 (5.1)	600 (5.1)	NA	73.6	73.6	NA	14740	14740
Pancreas cancer	1538 (21.3)	200 (4.2)	1738 (14.5)	153.9	25.3	179.2	28556	3846	32402
Pharynx cancer	1968 (67.2)	276 (16.0)	2244 (48.2)	93.7	15.1	108.9	34888	6174	41062
Stomach cancer	4139 (19.8)	362 (2.9)	4501 (13.5)	374.7	48.0	422.6	74377	7540	81917
Trachea and lung cancers ^a	38335 (79.5)	3500 (33.4)	41835 (71.3)	4112.0	460.2	4572.2	714854	74635	789489
Diabetes mellitus	17475 (24.8)	3309 (3.6)	20784 (12.9)	1050.1	254.1	1304.2	250238	48250	298488
Hypertensive heart disease	7776 (24.5)	1989 (4.7)	9765 (13.1)	392.2	162.4	554.6	106625	26430	133055
Ischaemic heart disease	173351 (36.7)	19479 (4.9)	192830 (22.2)	10174.7	1255.7	11430.4	2575759	265795	2841554
Rheumatic heart disease	3111 (29.7)	414 (3.5)	3525 (15.8)	124.2	19.3	143.5	70058	10143	80201
Stroke	68920 (33.7)	10164 (4.7)	79084 (18.8)	3624.8	720.9	4345.8	996834	148706	1145540
Asthma	2909 (17.2)	388 (2.6)	3297 (10.4)	150.3	26.9	177.2	49431	7172	56603
COPD	43135 (52.5)	6117 (12.3)	49252 (37.4)	2242.2	453.6	2695.8	539407	84608	624015
LRTI	26403 (44.9)	3570 (8.3)	29973 (29.4)	1536.5	293.1	1829.6	429687	62167	491854
Total	412415 (37.2)	52870 (5.2)	465285 (21.9)	25679.6	4050.1	29729.7	6306254	816452	7122706
"Includes trachea, bronchus, and lung cancer. MAS Infection, NA= Not Applicable Round up in calculations,	= Mortality Attributable 1	to Smoking, MCAS= Mor	tality Cost Attributable to Sr	noking, YPLL= Years oj	Potential Life Lost, M= M	ale, F= Female, COPD= C	hronic Obstructive Pulmo	nary Disease, LRTI= Low	er Respiratory Tract

Table 4 Mortality, mortality	cost, and YPL	L attributable	to smoking by	7 countries (i	n 2015)						
Country		MAS (SAF %)			APLL		W	CAS (\$ Millio	(u	MCAS as % of the	MCAS as % of
	W	H	Total	W	Ł	Total	W	4	Total	total in MENA	National GDP
Afghanistan	9702 (28)	1318 (3)	11 020 (15)	16 4919	24 965	189 884	79.17	11.48	90.65	0.3	0.46
Algeria	15 686 (31)	1576 (3)	17 262 (18)	287 709	25 336	313 045	914.77	83.99	998.76	3.36	0.57
Bahrain	381 (35)	54 (7)	435 (23)	7633	878	8511	135.46	16.64	152.10	0.51	0.49
Djibouti	289 (28)	25 (2)	314 (15)	5279	446	5725	6.99	0.60	7.58	0.03	0.43
Egypt	53 858 (40)	1748 (1)	55 606 (20)	747 451	23 366	770 817	2268.00	73.94	2341.95	7.88	0.70
Islamic Republic of Iran	30 021 (26)	1292 (1)	31 313 (14)	389 072	17 405	406 477	1567.27	68.39	1635.66	5.5	0.41
Iraq	11 112 (31)	1586 (5)	12 698 (18)	163 725	23 572	187 297	659.08	91.87	750.95	2.53	0.45
Jordan	4256 (48)	668 (10)	4924 (32)	66 047	10 395	76 442	283.61	46.00	329.61	1.11	0.86
Kuwait	1483 (41)	123 (6)	1606 (29)	26 841	2005	28 846	556.99	43.21	600.21	2.02	0.49
Lebanon	5275 (41)	2656 (24)	7931 (33)	69 195	37 326	106 521	661.08	345.40	1006.48	3.39	1.85
Libya	4360 (46)	101 (1)	4461 (26)	63 836	1561	65 397	145.95	3.45	149.40	0.5	0.50
Mauritania	1536 (40)	294 (6)	1830 (21)	22 858	4008	26 866	23.54	4.31	27.85	0.09	0.60
Morocco	20 738 (41)	1339 (2)	22 077 (20)	290 484	18 328	308 812	700.12	44.54	744.66	2.5	0.72
Oman	794 (22)	26 (1)	820 (14)	17 072	479	17 551	227.31	6.68	233.99	0.79	0.39
Pakistan	122 170 (39)	11 960 (4)	134 130 (23)	1 817 755	170 609	1 988 364	2121.34	193.82	2315.16	7.79	0.85
Qatar	262 (25)	3 (1)	265 (18)	5840	73	5913	279.48	3.53	283.01	0.95	0.15
Saudi Arabia	8741 (30)	1063 (5)	9804 (19)	134 282	16 923	151 205	2318.12	286.19	2604.31	8.76	0.41
Somalia	1961 (24)	290 (3)	2251 (13)	36 934	5005	41 939	11.70	1.61	13.31	0.04	0.20
Sudan	13 994 (28)	1380 (3)	15 374 (15)	270 768	26 496	297 264	430.27	41.26	471.52	1.59	0.56
Syrian Arab Republic	12 475 (43)	3784 (16)	16 259 (31)	217 662	57 953	275 615	264.15	70.56	334.71	1.13	1.36
Tunisia	12 619 (51)	278 (1)	12 897 (29)	172 975	3886	176 861	571.60	12.45	584.05	1.96	1.32
Turkey	68 936 (47)	18 237 (16)	87 173 (33)	1 113 527	290 983	1 404 510	9637.15	2527.16	12 164.31	40.92	1.68
United Arab Emirates	2535 (37)	34 (2)	2569 (30)	64 141	745	64 886	1658.83	19.85	1678.68	5.65	0.50
Yemen	9231 (26)	3036 (9)	12 267 (18)	150 252	53 708	203 960	157.63	53.18	210.81	0.71	0.60
Total	412 415 (37)	52 870 (5)	465 285 (22)	6 306 254	816 452	7 122 706	25 679.61	4050.10	29 729.71	100	0.76
F = female; GDP = gross domestic product	t; M = male; MAS = n	nortality attributabl	e to smoking; MCAS =	= mortality cost att	ributable to smoki	ing; UAE = United A.	rab Emirates; YPLL	= years of potentic	ıl life lost.		

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This could also be because death from cardiovascular diseases was more likely to occur among adults aged 30–44 years, and that age group is large in MENA countries. Similarly, SAF of LRTIs in the MENA Region was 29%, which is higher than global estimates of 12% (32). Additionally, the MAS, MCAS and YPLL from IHD and stroke were high in the MENA Region, not only because of the high SAFs but also the high absolute mortality for IHD and stroke.

In our study, MCAS in the MENA Region was estimated at US\$29.7 billion, which represented 0.76% of GDP in 2015. This is lower than the global estimates, in which mortality costs were US\$657 billion (2012 value), representing ~0.90% of global GDP (3), but higher than in China, where mortality costs were US\$22 billion and represented 0.50% of national GDP (33). If the definition of MENA by the World Bank (exclude Afghanistan, Pakistan, Mauritania, Turkey, Somalia, and Sudan) was adopted, the total cost was equal to US\$14.65 billion.

MAS varied by country due to the differences in population size, background risk of diseases, and prevalence of smoking in each country. Similarly, MCAS also varied by country due to the differences in life expectancy and income rates. We found that SAF was highest in Lebanon and Turkey (33%), Jordan (32%) and Syrian Arab Republic (31%). The lowest SAFs were found in Somalia (13%), Oman and Islamic Republic of Iran (14%). This can be explained by the variation in the prevalence of smoking in each country. However, we found that MCAS was highest in Turkey (41% of MCAS in MENA Region), Saudi Arabia and Egypt. It should be noted that not only MAS but also income contributed to the highest MCAS. The income of the countries in the MENA Region varied widely. In terms of YPLL, life expectancy in the MENA Region was shorter than in other parts of the world due to long-lasting conflicts and natural disasters, which cause substantial increases in death rates and shorter lifespan estimations. This could have led to the low YPLL estimation in our study. A similar impact was found for MCAS, which might be lower estimates when compared to other parts of the world where life expectancy is longer.

It should be noted that our analysis included mortality in the population aged \geq 15 years. The reason for this was that ~50% of smokers in the MENA Region started smoking before age 10 years (5) due to the ease of access to tobacco products and lack of legislation to prohibit smoking before adulthood.

In this study, information on GDP per capita was derived from the IMF. Compared to the World Bank data, most of the estimates were similar (difference is less than $\pm 10\%$). Nevertheless, it should be noted that IMF estimates were slightly lower for Djibouti, Libya and Yemen but higher for Oman and Jordan.

Although this study was the first attempt to estimate MAS, MCAS and YPLL in the MENA Region, the

estimates might have some limitations, which should be noted. First, this study did not incorporate smoking intensity and former smokers into SAF estimation due to the unavailability of such information. Second, this analysis included only deaths caused by active smoking and not those caused by second-hand smoking exposure. Therefore, it might have underestimated the number of deaths caused by tobacco use. Third, owing to data scarcity, the RRs used to calculate SAF were mainly specific to cigarette smoking. This could have underestimated the final results because previous evidence indicates that water pipe smoking results in greater nicotine yield and other toxicants, and may result in greater harm than cigarette smoking (34). Additionally, RRs used in this study were based on international records and depended on studies carried out outside the MENA Region in countries with different smoking patterns and profiles. Fourth, although our estimates were based on 24 diseases currently established by the US Surgeon General Report as caused by smoking, it was recently found that smoking is significantly associated with other diseases as well (35). Fifth, this cost estimation was only based on premature mortality using human capital approach which in reality undervalues mortality costs for housewives, self-employed personnel, children, and any workforce outside the formal sector. Additionally, HCM undervalues mortality costs in settings where labour market imperfections exist as the official income does not reflect employees' true opportunity cost of time, especially in developing countries. Furthermore, the direct health expenditure attributable to tobacco use was not estimated as data were scarce to estimate the health costs of treating tobacco-related diseases. Also, productivity loss such as disability, absenteeism and presenteeism were not included. It should also be noted that in this estimation, we did not apply income growth in calculating present value of lifetime earnings as the fluctuation of income in MENA countries may have resulted in a biased estimation of income growth. Nevertheless, income growth should be taken into account when the reliable data are available.

Conclusion

Smoking is a leading preventable risk factor for mortality in MENA countries, resulting in 465 286 deaths or accounting for 22% of total deaths from 24 diseases in 2015. The cost of premature mortality attributable to smoking in the region is substantial. This analysis suggests that dramatic declines in smoking-attributable deaths, increase in life-years saved, and significant reduction in mortality costs can be achieved by reducing smoking prevalence. More effort on smoking control should be a policy priority and further efforts are needed towards the implementation and enforcement of effective and comprehensive tobacco control strategies and policies in the MENA Region.

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Coût de la mortalité prématurée imputable au tabagisme dans la Région Moyen-Orient et Afrique du Nord

Résumé

Contexte : Le tabagisme est l'une des principales causes de mortalité prématurée et entraîne des coûts économiques considérables.

Objectifs : Estimer le taux et le coût de la mortalité prématurée attribuable au tabagisme dans les 24 pays de la Région Moyen-Orient et Afrique du Nord en 2015.

Méthodes : Les fractions attribuables au tabagisme ont été estimées. Vingt-quatre maladies liées au tabagisme ont été incluses dans l'analyse. Pour chaque pays, le nombre total de décès par maladie, par âge et par sexe chez les personnes âgées de 15 ans et plus a été obtenu à partir d'une base de données de l'Organisation mondiale de la Santé. L'approche du capital humain a été utilisée pour calculer le coût de la mortalité prématurée.

Résultats : Le tabagisme était responsable de 465 285 décès dans les pays de la Région Moyen-Orient et Afrique du Nord, ce qui représente 7 122 706 années potentielles de vie perdues, soit une moyenne de 15,23 années perdues par décès lié au tabagisme. Sur le nombre total de décès imputables au tabagisme, 412 415 (88,6 %) sont survenus chez des hommes, soit 37 % de tous les décès dus aux maladies considérées dans cette analyse chez les hommes. Le coût total de la mortalité attribuable au tabagisme a été estimé à 29,7 milliards de dollars des États-Unis d'Amérique (US) en 2015 (0,76 % du produit intérieur brut de la Région Moyen-Orient et Afrique du Nord). La Turquie était le pays le plus touché par l'épidémie de tabagisme, représentant 41 % du coût de la mortalité liée au tabagisme dans l'ensemble de la Région, suivie par l'Arabie saoudite (8,76 %) et l'Égypte (7,88 %).

Conclusion : Le tabagisme est une cause importante et évitable de mortalité prématurée dans les pays de la Région Moyen-orient et Afrique du Nord. Il est possible de réduire considérablement le nombre de décès imputables au tabagisme et de réaliser d'importantes économies dans cette région grâce à des politiques de lutte antitabac plus efficaces.

تكلفة الوفيات المبكرة الناجمة عن التدخين في الشرق الأوسط وشمال أفريقيا

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الخلاصة

الخلفية: يُعد تدخين التبغ أحد الأسباب الرئيسية للوفاة المبكرة، وينجم عن ذلك تكبُّد تكاليف اقتصادية كبيرة.

الأهداف: هدفت هذه الدراسة الى تقدير معدل وتكلفة الوفيات المبكرة الناجمة عن التدخين في 24 بلدًا في إقليم الشرق الأوسط وشهال أفريقيا في عام 2015.

<mark>طُرق البحث</mark>: قُدِّرت الأعداد الكسرية للأحداث الناجمة عن التدخين. وشمل التحليل أربعة وعشرين مرضًا مرتبطًا بالتدخين. وكانت قاعدة بيانات منظمة الصحة العالمية مصدر الحصول على إجمالي عدد الوفيات حسب المرض والعمر والجنس في صفوف الأفراد الذين تبلغ أعمارهم 15 عامًا فأكثر، وذلك في كل بلد. واستُخدم نهج رأس المال البشري في حساب تكلفة الوفيات المبكرة.

النتائج: تَسبَّب التدخين في وقوع 465286 وفاة في بلدان الشرق الأوسط وشيال أفريقيا، وهو ما أدى إلى فقدان 7122706 سنة من الحياة المحتملة، أو فقدان متوسط قدره 15.23 سنة لكل وفاة ناجمة عن التدخين. ومن إجمالي عدد الوفيات الناجمة عن التدخين، وقعت 412415 وفاة (8.8.6٪) لدى الرجال، أو مثَّلت 37٪ من جميع الوفيات الناجمة عن الأمراض التي يتناولها هذا التحليل لدى الذكور. وقُدِّرت التكلفة الإجمالية للوفيات الناجمة عن التدخين بنحو 29.7 مليار دولار أمريكي في 2015 (0.6.٪ من الناتج المحلي لدى الذكور. وقُدِّرت التكلفة الإجمالية وكانت تركيا البلد الأكثر تأثرًا بوباء التبغ، حيث تكبيرت 14. من تكاليف الوفيات الناجمة عن التدخين وقعت 20.5% العربية السعودية (7.8.٪) ومصر (7.8.٪).

الاستنتاجات: يُعد التدخين سببًا مهمًّا للوفيات المبكرة يمكن الوقاية منه في بلدان الشرق الأوسط وشهال أفريقيا. ويمكن تحقيق انخفاض كبير في الوفيات الناجمة عن التدخين وتوفير كبير في التكاليف الاقتصادية في هذا الإقليم من خلال وضع سياسات أكثر فعالية لمكافحة التبغ.

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