

## Original Article

# Smoking Attributable Inpatient Healthcare Expenditure among Adults in Alexandria, Egypt

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## Abstract

**Background & Objective(s):** The growing burden of non-communicable diseases (NCDs) in developing countries has highlighted the importance of monitoring the economic cost of tobacco use. The aim of this work was to calculate the inpatient smoking-attributable health care expenditure (SAE) for cardiovascular diseases (CVDs) and chronic respiratory diseases (CRDs) among adults in Alexandria, Egypt.

**Methods:** A household survey was carried out in Alexandria, Egypt and included 1354 adults. To estimate one of the direct healthcare costs of smoking, namely the inpatient costs of treating smoking-related CVDs and CRDs, a predesigned structured interviewing questionnaire was used to collect data on smoking status, history of CVDs and CRDs, number of inpatient admissions and expenditure per inpatient hospitalization. Estimation of the SAE for CVDs and CRDs among ever smokers in Alexandria was carried out based on the World Health Organization (WHO) economics of tobacco toolkit.

**Results:** About 56% of adults were ever smokers. Ever smokers had 7.7 and 2.015 times more risk for CVDs and CRDs compared to never smokers. About 79% of CVDs and 36% of CRDs among ever smokers were attributed to smoking. The SAE on inpatient care for CVDs and CRDs among ever smokers in Alexandria was equivalent to US\$ 257 million and 10.256 million annually, respectively.

**Conclusion:** The cost of inpatient SAE for CVDs and CRDs is enormous. Tobacco control is a very important element in achieving sustainable development goals.

**Keywords:** Cardiovascular diseases; chronic respiratory diseases; inpatient; smoking; smoking-attributable healthcare expenditure

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## INTRODUCTION

Tobacco use is highly prevalent worldwide. The World Health Organization (WHO) estimates that there are 1.1 billion smokers in the world, 80% of them live in low- and middle-income countries, where the burden of tobacco-related illness and death is heaviest. <sup>(1)</sup> Tobacco use is the leading preventable cause of morbidity and mortality. <sup>(2,3)</sup> Cardiovascular diseases (CVDs), and chronic respiratory diseases (CRDs) are among smoking-related causes of death. <sup>(2)</sup> Tobacco is responsible for 10% of the 15.2 million global deaths from CVDs, <sup>(4,5)</sup> and 42% of the three million global deaths from CRDs in 2012. <sup>(6)</sup> Egypt has a heavy burden of tobacco-related ill health and tobacco control is a major challenge. <sup>(7,8)</sup> The growing burden of non-communicable diseases (NCDs) in

developing countries has further highlighted the importance of monitoring the economic cost of tobacco use. <sup>(9)</sup> The term 'costs of smoking' is defined as the difference between healthcare or other costs that occur due to smoking and the costs that would have occurred had there been no smoking. Economic costs of smoking distinguish between direct and indirect costs. Direct costs represent the monetary value of goods and services consumed because of smoking and smoking-related illness, and for which a payment is made. <sup>(2)</sup> Indirect costs include loss of productivity, smoking-attributable deaths and years of life lost. <sup>(1)</sup> In high income countries, the economic cost of smoking has been estimated. <sup>(10,11)</sup> These estimates have proven to be helpful for tobacco control efforts. <sup>(12)</sup> Few research regarding the impact of tobacco use on developing countries' economy has been

conducted.<sup>(13-15)</sup> In 2018, a study in Alexandria, Egypt reported that the smoking-attributable healthcare expenditure (SAE) of CVDs among male workers at a petroleum refinery was 109,005 Egyptian pounds.<sup>(16)</sup> The aim of the study was to estimate the inpatient SAE for CVDs and CRDs among adults aged 35 years and above in Alexandria, Egypt.

## METHODS

A household survey took place from the beginning of June to the end of August 2017. The target population was adults aged 35 years and above. The sample size was calculated using Epi-info version 7.1.2.0 software. Based on a prevalence of current smokers of 20.9% among adults in Egypt<sup>(7)</sup>, a 3% confidence limits and a design effect of 1.9, the minimum required sample size at 95% confidence level was estimated to be 1340 adults aged 35 years and above. A representative sample of households was drawn from the eight health districts of Alexandria taking into consideration the total size of the population in each region. Thirty clusters were randomly selected representing the different zones of each region using probability proportionate to size. Each cluster was composed of 48 households and all adults (35 years and above) who were present at the time of the interview were included. The total sample amounted to 1445 adults, but complete information were possible to be obtained from 1354 adults (93.7% response rate).

**Working definitions<sup>(2)</sup>:** Current smokers are those who reported smoking at least 100 cigarettes in their lifetime and who smoke cigarettes every day or some days at the time of the survey. Former smokers are those who had smoked at least 100 cigarettes in their lifetime but do not smoke cigarettes at the time of the survey. Ever smokers are current smokers and former smokers. Never smokers are those who have not smoked 100 cigarettes during their lifetime.

Cases are only those who were told by a physician that they have CVDs (ICD-10 Codes I20-I25, I60-I71, I73 and I74) or CRDs (ICD-10 Codes J41-J44) during the previous 12 months and had valid documents, such as a prescription from a physician or a hospital record. Inpatient care costs included hospital care costs provided in a hospital or other facility and requires at least one overnight stay.

A predesigned structured household interviewing questionnaire was used to collect data on the socio-demographic characteristics (age, sex), smoking status (never, current, former, and ever smokers), history of CVDs or CRDs in the previous 12 months and number of inpatient days of hospital admission due to CVDs and CRDs. To quantify the inpatient care costs, patients admitted to private hospitals were asked about their average expenditure per hospitalization, while the average hospitalization costs for patients admitted to Health Insurance Organization and Ministry of Health and Population hospitals was obtained through contacting the

Health Insurance Organization and Ministry of Health and Population to provide primary data needed for that part of the analysis. The collected data were reviewed for accuracy and completeness. Data entry and analysis were done using statistical package for social Sciences (SPSS), version 21 statistical software. Descriptive statistics were used for summarization of data .

**Estimation of the SAE<sup>(2)</sup>:** The SAE was calculated guided by the WHO economics of tobacco toolkit using the following steps:

- Determination of the smoking-related diseases and the type of healthcare services: In this regard, two smoking related diseases, namely, CVDs and CRDs and one healthcare service, namely, inpatient care were determined.
- Estimation of the smoking-attributable fraction (SAF) of health care expenditure: This was made using the epidemiological approach. In this regard, two data elements were calculated: the first was the smoking prevalence and the second was the relative risk (RR). The RR of developing a disease i was calculated by using disease incidence ratio approach (Incidence rate for disease i among smokers / incidence rate for a disease i among never smokers)

Calculation of SAF of healthcare cost for treating a disease is based on the RR of disease incidence rate for ever smokers relative to never smokers, using the following formula:  $(Pe*(RRie-1))/(Pe*(RRie-1)+1) \times 100$  where Pe= prevalence of ever smokers, RRie = RR for developing disease i for ever smokers compared to never smokers.

- Estimation of the total healthcare expenditure (THE) for treating a disease (CVDs and CRDs) on healthcare service (inpatient care) among the population (adults aged 35 years and above): The following formula was used:

THE = population size x average annual healthcare utilization per person for inpatient care for treating CVDs and CRDs X average expenditure per unit of utilization for inpatient care for treating CVDs and CRDs

- Estimation of the SAE was then carried out using the following formula:

SAE = SAF (for inpatient care for treating CVDs and CRDs among adults aged 35 years and above) x THE (for inpatient care for treating CVDs and CRDs among adults aged 35 years and above).

The SAE for CVD and CRD inpatient services among ever smokers in Alexandria was then estimated by the same steps using the adults aged 35 years and above in Alexandria as the population size.

## Ethical considerations

The study was approved by the Ethics Committee of the High Institute of Public Health. The researchers complied with the International guidelines for Research Ethics. Verbal consent was taken from the study participants after explanation of the purpose and benefits of research.

Anonymity and confidentiality were assured and maintained.

## RESULTS

More than half of the respondents (54.4%) were current smokers, 43.7% were never smokers while only 1.9% were former smokers. Ever smokers represented 56.3% of the sample. The respondents' age ranged from 35-95 years. More than one third (35.6%) were from 35 to less than 40 years and 56.6% were males. The prevalence of current smokers was higher among those aged 35 to less than 40 years (60.6%) compared to those aged 60 years and above (47.0%). This association was statistically significant ( $\chi^2=27.85$ ,  $p=0.000$ ). Most males (88.4%) were current smokers, while most females (89.8%) were never smokers with a statistically significant difference ( $\chi^2=900.57$ ,  $p=0.000$ ). It appears from table 1 that the highest incidence of CVDs and CRDs was among current smokers (861.6/1000 and 321.6/1000, respectively) followed by former smokers (423.1/1000 and 192.3/1000, respectively) while the least incidence was among never smokers (109.9/1000 and 157.4/1000, respectively). The incidence of CVDs among ever smokers was 846.7/1000 while the incidence of CRDs was 317.2/1000. Regarding the relative

risk for CVDs and CRDs, current smokers had 7.84 times and 2.04 times more risk for CVDs and CRDs respectively compared to never smokers. On the other hand, former smokers had 3.85 times and 1.22 times more risk for CVDs and CRDs, respectively, compared to never smokers. Table 2 presents the relative risk for CVDs and CRDs calculated for ever smokers in relation to never smokers. Ever smokers had 7.7 times more risk for CVDs and 2.015 times more risk for CRDs compared to never smokers. It appears from the table that 79.1% of CVDs and 36.4% of CRDs among ever smokers were attributed to smoking.

The study showed that the total expenditure / admission to hospital was 1177.1 Egyptian pounds for CVDs and 302.99 for CRDs. It also showed that the average number of admissions to hospital per year was 4.69 for CVDs and 1.59 for CRDs.

### Inpatient THE and SAE for CVDs and CRDs among ever smokers in the study population

The inpatient THE for CVDs and CRDs among ever smokers in the study sample was 4,212,217 Egyptian pounds for CVDs and 365,266 Egyptian pounds for CRDs. The inpatient SAE was 3,331,863 Egyptian pounds and 132,956 Egyptian pounds for CVDs and CRDs, respectively.

**Table (1): Incidence of CVD and CRD and smoking status among adults (Alexandria, 2017)**

Smoking status	Disease					
	CVDs			CRDs		
	No.	Per 1000	RR (95% CI)	No.	Per 1000	RR (95% CI)
Current (n=737)	635	861.6	7.84 (7.78-7.89)	237	321.6	2.04 (2.03-2.06)
Former (n=26)	11	423.1	3.85 (3.79-3.91)	5	192.3	1.22 (1.19-1.25)
Ever (n=763)	646	846.7	7.70 (7.64-7.76)	242	317.2	2.015 (2.001-2.029)
Never (n=591)	65	109.9		93	157.4	

CVDs: cardiovascular diseases

CRDs: chronic respiratory diseases

RR: relative risk

CI: confidence interval

### Inpatient THE and SAE for CVDs and CRDs among ever smokers in Alexandria

For estimating the inpatient THE for CVDs and CRDs among ever smokers in Alexandria, the following formula was used:

Prevalence of ever smokers x Adults (35 years and above) in Alexandria x Average annual inpatient admissions to hospital due to CVDs and CRDs x Average expenditure per admission for treating CVDs and CRDs.

For CVDs it was:

$0.564 \times 1,857,493 \times 4.69 \times 1177.1 = 5,783,523,335$  Egyptian pounds.

For CRDs it was:

$0.564 \times 1,857,493 \times 1.58 \times 302.99 = 501,523,944$  Egyptian pounds. The inpatient SAE for treating CVDs and CRDs in Alexandria was calculated as the product of THE X SAF.

For CVDs it was  $5,783,523,335 \times 0.791 = 4,574,766,958$  Egyptian pounds which is equivalent to US\$ 257,009,380 (Exchange rate= 17.8).

For CRDs it was  $501,523,944 \times 0.2364 = 182,554,716$  Egyptian pounds which is equivalent to US\$ 10,255,883.

The cost/ smoker for CVDs= 138.4 and for CRDs= 5.5 \$.

**Table (2): Smoking attributable expenditure on inpatient services for CVDs and CRDs among ever smoker adults aged 35 years and above (Alexandria, 2017)**

Smoking status	Disease	
	CVDs	CRDs
Smoking prevalence (ever smokers)	56.4%	
Relative risk (95% CI)	7.7 (7.64-7.76)	2.015 (2.001-2.029)
Smoking attributable fraction (SAF)	79.1%	36.4%
Total expenditure/admission (in Egyptian pounds)	1177.1	302.99
Average number of admissions/year	4.69	1.59
<b>Inpatient THE and SAE for the study population (in Egyptian pounds)</b>		
Inpatient THE	4,212,217	365,266
Inpatient SAE	3,331,863	132,956
<b>Inpatient THE and SAE for Alexandria population</b>		
Inpatient THE among ever smokers in Alexandria (in Egyptian pounds)	5,783,523,335	501,523,944
Inpatient SAE among ever smokers in Alexandria (in Egyptian pounds)	4,574,766,958	181,554,716
Inpatient SAE among ever smokers in Alexandria (in US\$)	257,009,380	10,255,883
Inpatient SAE per smoker in Alexandria (in US\$)	138.4	5.5

CVDs: cardiovascular diseases

CRDs: chronic respiratory diseases

SAE: smoking attributable expenditure

THE: total health care expenditure

## DISCUSSION

The detrimental impact of smoking on physical health and wellbeing has been widely documented throughout the world. Numerous studies in developed countries have quantified the economic cost of smoking on health and on the society in general but only few studies were carried out in developing countries.<sup>(2)</sup> That is why the present study was conducted to fill this gap.

The prevalence of current smokers in the present study (54.4%) was much higher than the Egyptian rate (20.9%) reported by the WHO in 2017.<sup>(7)</sup> This might be explained by the fact that the rate reported by the WHO represented Egypt with its various social, economic and environmental diversities, while the present rate was for Alexandria only, which is a metropolitan governorate, and does not represent Egypt. This rate in Alexandria may be higher than other governorates.

Tobacco use is one of the most important risk factors for CVDs and a well-established risk factor for CVD incidence.<sup>(17, 18)</sup> The present study showed higher incidence of CVDs among current and former smokers compared to never smokers. The RR for developing CVDs among current and ever smokers in the present study was 7.8 and 7.7, respectively. These estimates were much higher than those reported in a meta-analysis in 2018, where the RR of CVDs for smokers of one, five, or 20 cigarettes per day compared to never smokers was 1.65, 1.72, and 2.34, respectively.<sup>(19)</sup>

It is well known that smoking is the most important causative factor for COPD<sup>(20,21)</sup> and that smokers have higher risk to develop COPD compared to never smokers. Lifelong smokers have a 50% probability of developing COPD during their lifetime.<sup>(22)</sup> The present study showed that the incidence of CRDs were higher among current and

former smokers compared to never smokers. Similar results were reported from the Nederland in 2016.<sup>(23)</sup>

The current study, as all studies carried out in developing countries, highlighted the serious impact of smoking on the morbidity from diseases documented to be related to smoking. Comparison between the results of this study and other studies was difficult due to differences in the methodology used. Some studies concentrated on the impact on mortality<sup>(24)</sup>, others on morbidity<sup>(25-28)</sup> of an array of diseases linked to smoking. Some covered the direct cost of the disease in the form of costs of hospitalization, outpatient care and medicines. Others also covered the indirect costs such as costs to the patients themselves for their own care and absenteeism from work and loss of years of life (number of years of potential life lost).<sup>(29)</sup> In Europe, it has been calculated that on the average smokers live about eight years shorter than non-smokers.<sup>(30)</sup>

The present study, although related only to inpatient costs for two groups of diseases namely CVDs and CRDs, shows that smoking in Egypt costs the national health care services in Alexandria at least US\$ 267,265,263 annually. The burden estimated in this paper is a significant underestimation of the real cost of smoking. This estimate will be significantly more should the cost be calculated for all the array of diseases linked to smoking and for all other direct costs of care (outpatient). It will be further increased when the indirect costs of smoking are added not only on the smokers but also on the non-smokers exposed to second hand smoke.

Furthermore, when the present potential demand for inpatient health care is transferred to real demand as what is expected to happen in Egypt when the national health insurance system is implemented, the real cost will be much higher than what has been estimated in this study. Added to that, with the rapid economic growth, the

economic cost of smoking will escalate in future if the prevalence of smoking cannot be substantially reduced. The cost of inpatient treatment of CVDs per smoker aged 35 years and over per year in this study is equivalent to US\$ 138.4 and for CRDs US\$ 5.5. A study in China reported in 2006 that the costs were lower as they were equivalent to US\$ 56.2 for CVDs and US\$ 13.2 for CRDs.<sup>(13)</sup> The costs reported from Taiwan in 2005 were higher as they were equivalent to US\$ 269 for CVDs and US\$ 61 for CRDs per year.<sup>(29)</sup>

Another approach to estimate the cost of smoking is to calculate the cost per cigarettes smoked. The United States of America calculated that for each pack of cigarettes sold, the cost for the society would be US\$ 3.45 for medical care and US\$ 3.73 in productivity loss which means a total of US\$ 7.18 for pack.<sup>(31)</sup> In Egypt, on the average each smoker consumes one pack of cigarettes daily.<sup>(32)</sup> According to this fact and based on the current findings (prevalence of current smokers, population size, THE for CVDs and CRDs), it could be estimated that for every pack of 20 cigarettes sold, an inpatient cost of approximately 13 Egyptian pounds daily is incurred due to CVDs and CRDs. This fact means that the National authorities should realize that the burden of tobacco products outweighs any economic benefit from their manufacture and taxes on their sales.

In 2005, the government of Egypt has ratified the Framework Convention on Tobacco Control (FCTC)<sup>(33-35)</sup> which means a commitment to a national program for tobacco control which needs to be sustained for decades in an effort to reduce the current smoking prevalence and prevent acquisition of smoking particularly among young adults. This can be done through: more widespread enforcement of current legislations, reinforcing a school-based tobacco prevention intervention to reduce prevalence and prevent smoking initiation, and ensure that tobacco industry does not undermine the current and future legislation and implementation of the FCTC obligation. The government may also consider recovering funds spent on treating diseases linked to smoking from the tobacco industry.

The study had the following limitations: the economic cost was calculated for only inpatient care of cases of CVDs and CRDs. It did not include other diseases known to be linked to tobacco use. The study did not include mortalities due to tobacco use or years of potential life lost due to smoking and did not include the indirect costs such as absenteeism from work or decreased productivity or cost to others caring for the cases. The estimates of the study relate to direct exposure through smoking and do not include the harm from secondhand smoke. Adding these elements would substantially increase the cost.

## CONCLUSION & RECOMMENDATIONS

The study revealed that the cost of inpatient SAE for CVDs and CRDs is enormous. Tobacco control measures are considered very important in achieving the national

sustainable development goals. Further studies are required to estimate the cost of smoking in other Egyptian governorates with the aim of reducing the burden of NCDs in Egypt.

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**Conflict of Interest:** None to declare.

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