BMJ Open Association of smoking with direct medical expenditures of chronic diseases in north of Jordan: a retrospective cohort study

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ABSTRACT

Objective This study aimed to estimate the association of smoking with the direct medical expenditures for chronic disease management in north of Jordan.

Design, setting and participants Retrospective cohort study using hospital database. Patients who were diagnosed with at least one chronic disease, were aged 18 years or older and had attended King Abdullah University Hospital for disease management and procedures from 1 July 2015 through 30 June 2016 were included in the study.

Main outcome measures The outcome of interest was the direct medical expenditures for chronic disease management according to smoking status.

Results Data were collected from 845 patients having at least one chronic disease (mean age of 61 ± 10.7 years). Smokers formed 22% of total patients. The back transformed mean total expenditure per patient of smokers, former smokers and non-smokers was 875 JD, 928 JD and 774 JD, respectively. Drugs were the most expensive healthcare resource used, accounting for 43% of total expenditure, followed by inpatient-related and outpatient-related services (19%). Smokers and former smokers were associated with the highest inpatient expenditures and inpatient-related and outpatient-related services expenditures. However, smokers were associated with the lowest outpatient and medication expenditures.

Conclusions Smokers and former smokers presented with higher statistically significant inpatient-related and outpatient-related services expenditures and higher transformed mean total expenditures compared to non-smokers; highlighting this economic burden is useful for promoting tobacco control policies.

BACKGROUND

There are more than 1 billion smokers around the world.¹ During 2000–2015, there has been an evident rise in the estimated number of smokers in low-income and low middle-income countries on contrary to the decline in numbers of smokers in high and high middle income countries. For the period 2015–2025, the projected number of smokers' pattern is expected to remain similar.¹ Research indicates that both cigarette and water-pipe

Strengths and limitations of this study

- Compared with other Middle Eastern countries, cigarette and water-pipe smoking are highly prevalent in Jordan.
- The burden of smoking on healthcare expenditures among patients with chronic diseases in Jordan is not known.
- We estimated the direct medical expenditures for chronic diseases management in north of Jordan according to smoking status.
- Our study was limited to report healthcare utilisation and costs for patients with certain diseases; this is not the same as smoking-attributable costs.

smokers are exposed to several similar types of toxicants (water-pipe smokers are exposed to higher amounts of some of these toxicants), therefore they both involve comparable health risks.² In Jordan, cigarette smoking is the most frequent type of smoking, with water-pipe smoking being the second most common habit.³ In 2012, Jordan had the highest prevalence of smoking among Middle Eastern countries in terms of male smokers (43%) and ranked third for female smokers.⁴

Non-communicable diseases cause around 60% of global deaths, with nearly 80% of deaths occurring in low-income and middle-income countries.⁵ A number of diseases have been associated with smoking over the years, and tobacco can cause illness in both smokers and non-smokers exposed to secondhand smoke. Moreover, smoking is associated with cardiovascular disease and is the cause of nearly 25% of cardiovascular diseases.⁶ Based on the WHO Global Report of Mortality Attributable to Tobacco, the rate of mortality from non-communicable diseases was nearly five times that for communicable diseases worldwide. Globally, the percentage of tobacco attributable deaths was 12% in ischaemic heart disease (IHD) and

71% in cancer of the trachea, bronchus and the lung.⁷ According to the global estimate of the burden of disease from secondhand smoke, there are nearly 603 000 deaths worldwide attributable to secondhand smoking. Seventy-three per cent of these deaths are caused by IHD in adults, adult asthma and lung cancer.⁸

Jordan is experiencing an epidemiological transition in which chronic diseases are becoming more dominant.⁹ Sedentary lifestyle, unhealthy diet patterns and smoking have been shown to be frequent health risks among Jordanian youths.¹⁰ The prevalence of smoking in Jordanian patients with chronic diseases ranges between 21% and 27%,^{11 12} and more than 50% of all deaths in Jordan are caused by chronic diseases.¹³ Heart disease and stroke are the causes of more than 30% of deaths.¹² In Jordan, the rate of mortality from non-communicable diseases was nearly 15.5 times that for communicable diseases. The percentage of tobacco attributable deaths was 15% in IHD and 75% in cancer of the trachea, bronchus and the lung.⁷

As a country with limited natural resources, Jordan relies strongly on its highly educated human capital. Additionally, there is an elevated density of healthcare professionals in the region. Healthcare in Jordan is provided through the public sector and supplied by the government; the population is most often insured by the Ministry of Health (MOH) and the Royal Medical Services. The health sector in Jordan also involves medical services provided at universities and the private sector, wherein nearly one-third of total health expenditures were incurred in 2010.¹⁴ Jordan's total expenditure on health as a percentage of the gross domestic product (GDP) in 2014 was 7.5%.¹⁵ This is a growing expense: total health expenditures grew from 1.38 billion JD in 2008 to 1.67 billion JD in 2012.¹⁶ The cost of medications is also significant; drug expenditures accounted for 27% of total health costs in 2012, equal to 2% of GDP or about 445 million JD.¹⁶

Health risks associated with smoking have been illustrated in many research papers worldwide, showing potent links between smoking and morbidity and mortality.⁷ Costs assigned to chronic diseases have placed a massive burden on the budget of the Jordanian MOH. The motivation for this research emerged from the increasing tobacco epidemic and the burden of smoking-related diseases in Jordan as a middle-income developing country¹⁷ with a modest economy and resources.¹⁸ There is currently a knowledge gap regarding the burden of smoking on healthcare expenditures in patients with chronic diseases in this country. Observing healthcare utilisation and expenditures among patients with chronic diseases according to smoking status in Jordan will assist in improving resource allocation and policy development. Additionally, it will motivate the creation of youth educational programmes to raise awareness of the health risks and burden of smoking and promote tobacco control in Jordan. Thus, the objective of this study was to estimate the association of smoking with the direct medical

expenditures for chronic disease management in north of Jordan.

METHODS

Study design and setting

This study was a retrospective analysis of a cohort of patients treated for chronic diseases during the period of 1 July 2015 to 30 June 2016. The study was conducted using a prevalence-based, bottom-up cost-of-illness approach to accumulate the direct medical expenditures on chronic diseases based on smoking status over 1 year.

The study was performed at KAUH, located in Ar Ramtha, Irbid, Jordan.¹⁹

Study population and sampling procedure

Patients who visited the hospital's cardiology, endocrine and internal outpatient clinics were invited to participate. If they fit the inclusion criteria, they were given a brief explanation of the study, and each subject was asked to participate in the study by verbal consent.

Patients were included in the study if they were diagnosed with at least one chronic disease, were aged 18 years or older and had attended KAUH for disease management and procedures from 1 July 2015 through 30 June 2016. Patients were excluded if they participated in a recent clinical trial or had no data from this period.

Data collection

Sociodemographic, clinical, smoking status, economic and visit data were collected using a case record form. The form was piloted on 10 subjects to assess its content validity and determine the extent to which the information required within the case record form was relevant and representative of all patients' data about chronic diseases treatment.

Sociodemographic and clinical data were collected through patient interviews and electronic files. Data regarding smoking status (current, former, never) was obtained by patient interview. Participants were first asked if they considered themselves non-smokers, current smokers or former smokers. Those who described themselves as current smokers were asked about the types of tobacco they used. Participants were also asked about their duration of smoking and the amount of tobacco consumed (ie, number of times each type of tobacco product was smoked per day). Data on healthcare utilisations were collected through the hospital administration database at KAUH.

Expenditure resources and estimation

Information regarding participants' hospital fees on all service expenditures charged by the hospital during the annual period of 1 July 2015 through 30 June 2016 were extracted from the hospital administration database at KAUH. Expenditures were estimated using a bottom-up approach. The total annual expenditure of each service was obtained from outpatient expenditures, inpatient

Table 1 Sociodemographic and clinical characteristics of patients

	Smoking status			
Variable	Smokers (22%) n=187 N (%)	Former smokers (22%) n=189 N (%)	Non-smokers (56%) n=469 N (%)	Total n=845 N (%)
Gender				
Male	158 (85)	153 (81)	127 (27)	438 (52)
Female	29 (15)	36 (19)	342 (73)	407 (48)
Age mean (SD)	56 (10.7)	64 (10.5)	61 (10.2)	61 (10.7)
Marital status				
Married	176 (94)	176 (93)	430 (92)	782 (93)
Single	7 (4)	7 (4)	18 (4)	32 (4)
Divorced	1 (1)	1 (1)	5 (1)	7 (1)
Widowed	3 (1)	5 (2)	17 (3)	25 (2)
Education				
No formal schooling	7 (4)	13 (7)	70 (15)	90 (11)
Primary school	50 (27)	58 (31)	147 (31)	255 (30)
Secondary school	61 (32)	33 (17)	101 (22)	195 (23)
College/university	60 (32)	70 (37)	125 (27)	255 (30)
Graduate degree	9 (5)	15 (8)	26 (5)	50 (6)
Employment				
Public sector	37 (20)	18 (10)	28 (6)	83 (10)
Private sector	13 (7)	7 (4)	10 (2)	30 (4)
Own	33 (17)	27 (14)	19 (4)	79 (9)
Housewife	19 (10)	23 (12)	243 (51)	285 (34)
Retired	46 (25)	78 (41)	126 (26)	250 (29)
Unemployed	39 (21)	36 (19)	43 (9)	118 (14)
BMI kg/m²				
Underweight (<18.5)	3 (1)	3 (1)	2 (1)	8 (1)
Normal weight (18.5–24.9)	53 (29)	27 (14)	67 (14)	147 (18)
Overweight (25–29.9)	73 (39)	84 (45)	151 (32)	308 (36)
Obese (≥30)	58 (31)	75 (40)	249 (53)	382 (45)
Physical activity				
Yes	39 (21)	44 (23)	71 (15)	154 (18)
No	148 (79)	145 (77)	398 (85)	691 (82)
Number of comorbid conditions mean±SD	4±1.8	4±1.5	4±1.7	4±1.7

BMI, body mass index.

expenditures, operation and anaesthesia expenditures, labs expenditures, radiology expenditures, inpatient-related and outpatient-related services expenditures and drugs expenditures. These expenditures are higher than the actual costs to the hospital. Direct medical expenditures were presented using median annual expenditures. The total expenditures for each patient were calculated by summing the expenditures on all services used.^{20–23}

Data analysis

Descriptive statistics were calculated to present the results. The Kruskal-Wallis test was used to determine if there were statistically significant differences between the medians of more than two groups. Post-hoc analysis using the Mann-Whitney U test was conducted to determine if there were statistically significant differences between the medians in pairwise comparisons. Kruskal-Wallis and Mann-Whitney U tests were performed using SPSS

Figure 1 Distribution of patients according to smoking status.

for windows, V.22. Transformation, O'Brien test, Tukey-Kramer HSD test and ANOVA were performed using JMP software.

Patient and public involvement

Patients and the public were not involved in the design of this study.

RESULTS

A total of 845 patients met the inclusion criteria. Men (52%) comprised 85%, 81% and 27% of smokers, former smokers and non-smokers, respectively. The average age of smokers, former smokers and non-smokers was 56 (± 10.7) years, 64 (± 10.5) years and 61 (± 10.2) years, respectively. Age and body mass index (BMI) were tested using ANOVA and post-hoc Tukey-Kramer HSD test. Mean age for non-smokers was significantly higher than smokers ($p < 0.0001$). Moreover, the mean BMI of non-smokers was significantly higher than the other two group means (smokers, $p < 0.0001$ and former smokers, $p = 0.0386$, respectively). The sociodemographic and clinical characteristics of the patients are shown in [table 1](#).

Majority of current smokers (92%) indicated that they smoked cigarettes ([figure 1](#)). Of these, 40% consumed 11–20 cigarettes a day and almost the same percentage consumed more than 20 cigarettes a day. Smoking water pipes rated second (13%) and 5% reported that they smoked both cigarettes and water pipe. Among former smokers the average span of smoking was 23 ± 13.9 years ($n = 184$), while the average length of quitting was 16 ± 12.3 years ($n = 187$).

The vast majority of patients from all groups had hypertension (79%). The distribution of chronic diseases is shown in [figure 2](#) (note: some patients had more than one chronic condition). Smokers showed the highest percentage of IHD and dyslipidaemia (60% and 57%, respectively).

Direct medical expenditures and number of visits

For the whole sample ($n = 845$), the total annual direct medical expenditures were 1 895 197 JD. The annual total direct medical expenditures were 1 054 681 JD for non-smokers, 466 292 JD for former smokers and 374 224 JD for smokers; note that non-smokers also comprised the largest group in terms of sample size. The largest average expenditure comprised of medications (43%).

The median total annual direct medical expenditures per patient were 845 JD for smokers, 911 JD for former smokers and 714 JD for non-smokers. Former smokers had the highest total annual expenditure, with an average of 2467 JD per patient. Smokers and former smokers were associated with both the highest inpatient expenditures (214 JD and 191 JD, respectively) and highest inpatient-related and outpatient-related services expenditures (568 JD and 480 JD, respectively). However, smokers had the lowest outpatient visits expenditures (64 JD) and drug expenditures (468 JD) ([table 2](#)).

Figure 2 Distribution of chronic diseases among patients.

Table 2 Mean annual direct medical expenditures per person stratified by smoking status

Direct medical expenditure category (JD)	Smoking status				P value*
	Smokers (n=187) Mean (SD) (Median)	Former smokers (n=189) Mean (SD) (Median)	Non-smokers (n=469) Mean (SD) (Median)	Total n=845 Mean (SD) (Median)	
Drugs	468 (1103.7) (144)	1105 (6010.3) (170)	1087 (7229.6) (171)	954 (6112.7) (164)	0.759
Inpatient-related and outpatient-related services	568 (1032.9) (110)	480 (913.9) (110)	360 (842.3) (95)	433 (906.6) (102)	0.029
Labs	321 (679) (170)	351 (613.9) (169)	337 (567.5) (169)	337 (603.5) (169)	0.435
Radiology	284 (814.9) (10)	207 (499.6) (20)	164 (390.5) (20)	200 (537.4) (20)	0.862
Inpatient stays	214 (459.3) (13)	191 (387.5) (13)	146 (380.6) (0)	171 (401.4) (0)	0.062
Operations and anaesthesia	82 (288.3) (0)	55 (200.5) (0)	81 (456.6) (0)	75 (378.1) (0)	0.501
Outpatient visits	64 (49.2) (50)	78 (61.2) (60)	74 (55.6) (58)	73 (55.7) (56)	0.041
Total expenditures	2001 (3005.9) (845)	2467 (6966.5) (911)	2249 (7901.2) (714)	2243 (6887.9) (752)	0.23

*Kruskal-Wallis test.

Although, the difference in total annual direct medical expenditures between groups was not statistically significant ($p=0.23$). The difference in inpatient-related and outpatient-related services expenditures and the difference in the outpatient visits expenditures were statistically significant ($p=0.029$ and $p=0.041$, respectively). For both, to find out the differences, we conducted pairwise comparisons. For inpatient-related and outpatient-related services expenditures, a statistically significant difference appeared between smokers and non-smokers ($p=0.035$) and between non-smokers and former smokers ($p=0.031$), with higher medians in both smokers and former smokers than non-smokers. For outpatient visit expenditures, statistically significant difference also appeared between smokers and former smokers ($p=0.024$) and between smokers and non-smokers ($p=0.028$) (table 3).

For the total expenditures, and since it was skewed, we used log transformation which fixed the normality issue (figure 3). Moreover, we checked the unequal variances assumption depending on the O'Brien p value ($p=0.8170$). We do not have a problem with equal variances, so we can use ANOVA. Using ANOVA, we had insignificant results ($p=0.2164$). On the other hand, if we look at the mean of total expenditures of the three groups after transformation, smokers (6.77) and former smokers (6.83) have

higher means than non-smokers (6.65). We transformed back the means and the CI limits (table 4).

The total median annual number of visits per patient was 9. Smokers and former smokers had the highest emergency room (ER) visits (one visit annually per patient). Moreover, smokers had the longest average length of hospitalisation (inpatient days) at 4 days; however, they ranked lowest in outpatient visits (6). A statistically significant difference was detected between the number of outpatient visits of different groups ($p=0.001$) and between the number of admissions of different groups ($p=0.003$). Additionally, the difference in total median annual visits between groups was statistically significant ($p=0.006$) (table 5).

There was a statistically significant difference between smokers and former smokers ($p=0.004$) and between smokers and non-smokers ($p=0.005$) (table 6) with regards to the total number of annual visits.

DISCUSSION

This study adds to the growing body of knowledge in the developing world which presents evidence of the threats of tobacco use, with a focus on the association of smoking with the annual direct expenditures of chronic disease

Table 3 Difference in annual direct medical expenditures between groups

	Inpatient-related and outpatient-related services P value*	Outpatient visits P value*
Smokers and former smokers	0.987	0.024
Smokers and non-smokers	0.035	0.028
Non-smokers and former smokers	0.031	0.484

*Mann-Whitney test.

Figure 3 Q-Q plots of total expenditures before and after transformation.

management. Smoking impacts nearly every organ of the body.²⁴ The current research is one of the pioneer studies to observe the association between tobacco use and economic factors in Jordan, attempting to quantify the burden of tobacco use in a developing country to provide insights for promoting tobacco control policies.

In this study, smokers formed 22% of the total sample with at least one chronic disease. This percentage

corresponds to previous estimates in Jordan. In 2007, the rate of smoking in Jordan was 23% in heart disease patients, 21% in high cholesterol patients and 21% in diabetes mellitus patients.¹¹ The lower rate of current smoking in patients with heart disease and associated heart risk factors in Jordan may be explained by the fact that patients quit smoking after being diagnosed with these conditions.¹² Another explanation is that smokers with heart disease and its risk factors are less likely to survive.¹² In this study, smokers were the youngest in average age compared with the other groups (56 years). A study in Japan comparing life expectancy between male smokers and non-smokers using 11 years of data suggested that at age 40, non-smokers live 3.5 years longer than smokers.²⁵ Also, a study in Finland found that smokers had a 8.6 year shorter lifespan than non-smokers; the mortality rate was 71% (observed age at death, 68 years) among smokers, compared with 37% among non-smokers (observed age at death, 71 years).²⁶

Majority of current smokers in this study were men (85%). Male to female smoking prevalence ratios have reached 5:1 in recent years in certain regions around the world,²⁷ but this ratio varies across countries. In many low-income and middle-income countries, men smoke much more than women.²⁸ For instance, the male-to-female smoking ratio is 27 in Saudi Arabia, 5.33 in Syria and 9.53 in Jordan.^{29–31} Although women's smoking behaviour might be higher than reported here, they might deny smoking behaviour and/or underrate their smoking frequency.¹²

In this study, smoking participants reported using cigarette and water-pipe types of tobacco products. Majority of current smokers (92%) reported that they smoked cigarettes. Forty per cent of cigarette smokers consumed 11–20 cigarettes a day and almost the same percentage consumed more than 20 cigarettes a day. The water-pipe smoking rate was 13%, and 5% of smokers indicated that they smoked both cigarettes and water pipes. In a sample of daily habitual male smokers hospitalised with a diagnosis of cardiovascular disease in Jordan, 91% were cigarette smokers and 43% smoked more than 20 cigarettes per day.³² In considering the distribution of chronic diseases among patients, hypertension was the most prevalent, followed by diabetes and hyperlipidaemia. This is consistent with a previous study conducted on patients with chronic diseases in Jordan.³³

Table 4 Mean total expenditures and CI limits after transformation and back transformation

	Mean total expenditure*	Mean total expenditure†	CI lower*	CI lower†	CI upper*	CI upper†
Smokers	6.77	874.59	6.58	720.87	6.97	1061.10
Former smokers	6.83	927.46	6.65	771.54	7.02	1114.90
Non-smokers	6.65	773.53	6.53	688.31	6.77	869.30

*After transformation.

†After back transformation.

Table 5 Difference in total annual visits and admissions stratified by smoking status

Type of visit	Smoking status			Total n=845 Mean (SD) (Median)	P value*
	Smokers (n=187) Mean (SD) (Median)	Former smokers (n=189) Mean (SD) (Median)	Non-smokers (n=469) Mean (SD) (Median)		
Outpatient visits	8.3 (7.6) (6)	10.3 (8.3) (8)	10.5 (9.8) (7)	10 (9.1) (7)	0.001
ER visits	1.6 (2.2) (1)	2 (3.1) (1)	1.5 (2.3) (0)	1.6 (2.5) (1)	0.119
Admissions	0.8 (1.4) (0)	1.1 (2.6) (0)	0.6 (2.6) (0)	0.8 (1.7) (0)	0.003
Inpatient days	8.6 (14.8) (4)	6.1 (7.6) (3)	6.8 (9.3) (3)	7.1 (10.6) (3)	0.617
Total visits†	9.9 (9.4) (7)	12.3 (11) (9)	12 (11.4) (9)	11.6 (10.9) (9)	0.006

*Kruskal-Wallis test.

†Total of outpatient visits, ER visits.
ER, emergency room.

In Jordan, drug expenses made up 27% of total health expenditures in 2013.³⁴ In this study, the major healthcare expenditure was drugs (43%). Notably, in our study, 93% of patients had more than one chronic condition and 77% had three or more (with an average of four chronic conditions per patient) and 37% of patients were more than 65 years old. Thus, the higher percentage of drug expenditures might be explained via a previous study, which indicated that patients with at least three chronic conditions routinely consume an average of six prescription drugs at age 65 years or older.³⁵ Several studies have indicated that smokers (current and former) are associated with the highest total healthcare expenditures,^{36–38} a finding replicated in this study.

This study demonstrated that current smokers are associated with high rates of annual hospitalisation durations and inpatient expenditures. This is similar to a number of studies conducted on the association of smoking with hospitalisation. In the USA, it has been found that current smokers were more often hospitalised than non-smokers,³⁶ while another study found that smokers had the highest inpatient costs and subsequently higher overall medical costs, at least among men.³⁷ Furthermore, a number of studies in the Middle East (ie, Lebanon,³⁹ Iraq,⁴⁰ Iran⁴¹ and Egypt⁴²) had comparable results, associating smoking with hospitalisation and/or inpatient expenditures.

In a study comparing healthcare utilisation based on smoking status, smokers used outpatient care less often than non-smokers.³⁷ This may lead to poor prognosis of smokers—they may have a low concern for their health which leads to an aversion to seeking care at early stages

of illness. In addition, many smokers believe that smoking has no impact on their health, leading them to deny illness and delay seeking care.⁴³ Other factors that lead smokers to avoid seeking healthcare may include embarrassment and fear of discrimination,⁴⁴ as well as fear of health professionals blaming them for their conditions.^{45 46} They may also feel guilty about not having quit smoking.⁴⁷ This study was consistent with these theories, showing that smokers were the least likely to incur outpatient care expenditures compared with other groups. The present study also found that smokers had the lowest drug expenditures compared with former smokers and non-smokers. This may be explained via a US study on the association of smoking with medication adherence for chronic conditions in which smokers were found to be less adherent to medications than non-smokers.⁴⁸

Similar to the findings of other studies, former smokers in this study ranked the highest in total annual healthcare expenditures.^{36 38 49 50} Former smokers having elevated healthcare costs may be attributed to several factors: first, they may be prone to seek healthcare for additional medical and/or behavioural support to lower the opportunity of relapse. This motivation may arise following smoking cessation. Second, there is a possibility that smoking cessation is accompanied with a form of physiological disorder which results in a disease issue.⁵¹ Another study concluded that quitting smoking completely would result in a net increase in healthcare costs after 15 years of smoking cessation.⁵² These findings may explain the high healthcare expenditures among former smokers in this study, as the average length of smoking cessation in former smokers was 16 years.

There are some limitations to this study. First, the study design may introduce bias, as patient data were provided at the time of survey response, while the annual expenditures and visits were estimated retrospectively. In addition, the association of smoking with healthcare expenditures may be better captured by a longitudinal data set observing people over time. Second, smoking habits were estimated by self-report without biochemical test validity which may be associated with bias; however, these methods have

Table 6 Difference in total annual visits between groups

	P value*
Smokers and former smokers	0.004
Smokers and non-smokers	0.005
Non-smokers and former smokers	0.502

*Mann-Whitney test.

similar estimates of population prevalence.⁵³ Third, this study did not analyse the potential association of patients' sociodemographic status, type of chronic disease, second-hand smoking exposure or current smokers' smoking patterns (number per day, starting years and total years of smoking) with healthcare expenditures. Therefore, the association of smoking with expenditures may be overestimated or underestimated. Fourth, the study did not capture the monetary valuation of self-treatment or healthcare services administered by other sources nor factors that directly or indirectly contribute to expenditures (caregivers' time and expenses, pain, suffering and loss of life). This may underrate the total cost of smoking. Fifth, not all hospitalisations, visits and other services may be necessarily linked to a smoking-related disease, which may underestimate the magnitude of the association between smoking and healthcare expenditures. Sixth, expenditures on ER visits were included with the outpatient expenditures. However, the number of ER visits were much lower compared with the number of outpatient visits (one compared with seven per patient). Finally, interpreting the results of this study should be done with caution, especially when comparing the findings to those of other studies. In particular, studies may vary in their smoking status classification, the diseases included and the categories of healthcare expenditures estimated.

In addition, this study reports healthcare utilisation and costs for patients with certain diseases; this is not the same as smoking-attributable costs. The findings might reflect the fact that people with chronic illnesses who smoke experience worse health outcomes compared with non-smokers with chronic illnesses. While smokers are more likely to have certain diseases, this study perhaps did not reflect this reality because we enrolled patients who were already ill and being checked at the hospital.

Despite these limitations, this observation of a sample of patients with chronic diseases strengthens our understanding of the relationship between smoking and healthcare expenditures. Additionally, this study expanded the inclusion of smoking-related diseases compared with other research; most similar studies have primarily included IHD, chronic obstructive pulmonary disease and lung cancer. This research also included non-smokers to enable a comparison of healthcare expenditure per patient of smokers and non-smokers. Further strengths may be represented by the study's large sample size, inclusion of a range of KAUH departments and coverage of outpatient sections, which is a field that has scant literature in comparison with inpatient sections.

CONCLUSIONS

Smokers and former smokers presented with higher statistically significant inpatient-related and outpatient-related services expenditures compared with non-smokers. Although using ANOVA for transferred data resulted in insignificant results, the mean of transformed total expenditures was higher for smokers and former smokers than

for non-smokers, and hence the transformation solved the problem of outliers. The insignificance was a result from that the non-smoker group was significantly higher in mean age than smokers and mean BMI than the other two groups. This study is useful for promoting tobacco control efforts in that it suggests the value of increasing awareness of non-smoking and smoking cessation before health issues occur. This develops a health-conscious attitude throughout society that eventually reduces the burden of health problems and their accompanying expenditures.

Further research should examine the impact of the type of chronic disease and patients' smoking habits on healthcare expenditures. Moreover, expenditures from other healthcare sources and the association of second-hand smoking exposure with healthcare expenditures should be considered. This may offer a more thorough view on the distribution of healthcare burden associated with smoking.

Contributors QA is responsible for the study concept, design, reviewing, editing and approving the manuscript in its final form. ETA carried out data collection, analysis and interpretation of data, drafting the work and writing the manuscript. KHA contributed in the study design, patient recruitment and reviewed and approved the manuscript. HMH contributed in analysis and interpretation of data. All authors read and approved the final manuscript.

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