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Research Article

Smoking cessation economic benefits in a human capital approach: emerging evidence in Jordan

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Abstract

Background: Smoking is a major cause globally of morbidity and mortality hence life years lost, this issue manifested in 399 Million Jordanian dinars (JD)($562.3 million USD) lost yearly due to productivity lost as a consequence of smoking in Jordan[1]. It is no surprise that quitting smoking will reduce the loss in life years and hence productivity. In this study, using cohort simulation, we want to quantify the gains in productivity from smoking cessation aids usage for one course of smoking cessation aid varenicline or nicotine replacement therapy in comparison to physician counseling only without pharmacological therapy, in the population that intends to quit at a point of time, through campaigns nationwide, among the working-age population followed up until retirement.

Methodology: We present a transparent, generic model based on accepted analytic methods that allow users to assess the present value of lifetime earnings gained (PVLE) in smokers who intend to quit. It is shown in previous studies that smoking cessation aids are cost-effective in Jordan (Madae'en et al. 2020), yet the benefit of using smoking cessation aids goes further to reduce productivity loss by reducing life years lost. Our model incorporates life-years gained from the Markov Model in Madae'en et al. (2020), simulation of Jordanian male smokers' cohort in three scenarios of either using varenicline or nicotine replacement therapy or only physician consultation, to estimate life-years gained and hence reduction in lost productivity costs.

Results: We found productivity loss was reduced in males who attempted to quit in their productive years. Using Varenicline, the researchers calculated the expected future payments (wages) count for years gained due to varenicline use for a wage average of 507 JDs ($714.5 USD) per month discounted by 8% for the rest of their productive life. As well as for the other two scenarios, the gained productivity from one course of varenicline to the male adults over 30 who intend to quit will reduce loss by more than 72 billion JDs ($101.42 billion USD) among the working-age population followed up until retirement.

Conclusion: policy change must be approached to reimbursement of smoking cessation aid in the Jordanian formulary.

1 Jordan strategy Forum, JSF February 2022

Keywords

smoking cessation, Pharmacoeconomics, economic benefit

Introduction

The indirect cost of tobacco pandemic in the year 2022 was 399 Million Jordanian dinars ($562.3 million USD)/ year (JSF 2022).

Jordan has shown to be one of the highest prevalence of smoking worldwide counting up to 70% in the middle age male population, according to the Tobacco Atlas[2]. Many campaigns have been launched to raise awareness of smoking risks and provide clinics and smoking cessation assistance to help smokers who seek to quit smoking, but the number of smokers is still on the rise. Keeping in mind, smoking cessation aid programs are a well-documented health policy that is both clinically effective and cost-effective (Song et al. 2002; Feenstra et al. 2005). Moreover, the consequences of smoking are still not only a health risk, but also there is an economic burden. Tobacco use touches the whole society economically, private individuals, families, employers, and taxpayers.

There are two different kinds of productivity losses. The first is potential years of potential life lost (YPLL) caused by pre-mature deaths in the population that can be linked to smoking. The second is lost workday productivity, which is time lost on the job due to smoking cigarettes. In the current study, we only did the loss due to years of potential life lost (YPLL) (Ekpu and Brown 2015). While we challenge the hypotheses of productivity lost due to (YPLL) the lost workday productivity lost is not of less importance. A meta-analysis done by Sirgid et al. (2020), on sickness and absence because of smoking that included over a million participants showed a statistically significant increase in risk of sickness and absence up to 31% with adjustment to relevant confounders (Sigrid et al. 2020).

We are not the first to study the effect of smoking cessation aids benefit in reducing productivity loss. Notably, a study conducted in the USA studied the indirect cost of smoking as well as the benefit of smoking cessation aids, it revealed work productivity losses of approximately USD $ 67.5 billion, premature death losses of USD $117 billion, while smoking cessation aids use revealed substantial benefits on the indirect costs (Rumberger et al. 2010). Furthermore, studies went further into the benefit of smoking cessation programs in the workplace showing benefit on productivity, hence a net profit to society and enterprise alike. each of the four areas of economic benefit-medical care, absenteeism, on-the-job productivity, and life insurance-eventually yields financial returns that are more than to cover program cost by enterprise (Warner et al. 1996; Baker et al. 2018).

As for the effect of quitting smoking on productivity loss a systematic review and meta-analysis of 29 longitudinal and cohort studies of working adults found that the increased risk of absenteeism was 33% higher for current smokers than non-smokers and 19% higher than for former smokers. Current smokers took an average of 2–3 days more absenteeism per year than non-smokers (Skillgate et al. 2009; Holmberg et al. 2010). Another study reported that US smokers miss work about 6.5 more days per year than non-smokers and that they they are more likely to visit a public health center per year (Cahill et al. 2014).

Literature review

Attempts to measure smoking cessation on lifetime direct costs and consequences of smokers who make a one-time attempt to quit smoking were in Madae'en et al. (2020), where the cost per life year gained was $1,696 USD. In addition, a $1,890 USD for varenicline and Nicotine Replacement Therapy (NRT), respectively. In addition, a 103,970 life years were gained using the varenicline regimen, while 64,030 life years were gained using (NRT) for the whole male smoker population in Jordan who intended to quit at one moment of time. The intervention model used by Virtanen et al. (2017) has estimated the cost per quitter was USD $522 using 'usual care' condition. Calculated net saving for Swedish population during 10 years, using population-based model was USD $17.3 million for intervention and USD $49.9 million in 'usual care', with gains in quality-adjusted life-years of 1,428 and 2,369 respectively, for the whole Swedish population during 10 years.

Ruger and Lazar (2012) tested smoking cessation from two perspectives, pharmaco- and behavioural therapies, through literature review of PubMed and the British National Health Service Economic Evaluation Database. Results showed methodology and standardization of current economic evaluations, had remarkable deficits. Productivity and decreased costs associated with loss of work impairment showed by Suwa et al. (2017) tested the association of smoking status with the Work Productivity and Activity Impairment questionnaire and configured indirect costs. The results showed that current smokers and former smokers had greater activity impairment than never smokers and Current smokers has the highest indirect costs (work impairment); but after taking into account covariates, there were no significant differences between former smokers and never smokers on indirect costs. In Berenbaum et al. (2019), interventions were made to study

2 The Tobacco Atlas. https://tobaccoatlas.org/country/jordan/.

the economic benefits of smoking cessation. The systematic reviews model has shown economic gains in terms of cost per successful quit attempt, cost per additional quitter, and cost per quality adjusted life year (QALY).

Baker et al. (2018) decreased work productivity between current and former smokers was quantified in terms of indirect costs. The US National Health and Wellness Survey showed that total indirect costs for current smokers were USD $1327.53, USD $1560.18, and USD $1839.87 annually higher than for those who quit 0–4 years, 5–10 years, and more than or equal to 11 years earlier, respectively. Whereas, Baker et al. (2017), showed that quitting benefits extend to work productivity rapidly after cessation, serving to further encourage and promote the implementation of workplace cessation programs.

In Leung et al. (2017) and using Markov model in smokers facing increased risks of lung cancer and cardiovascular disease. The counselling intervention will only be cost-effective if adherence is in a range of 7 or more intervention calls, which then leads to the required a sufficient number of health gains for quitters. Orme et al. (2001) outlined that China has a health risk, in terms of smoking in the workplace. The authors encourage having smoking bans, effective cessation programs accessibility, and vocal leadership of doctors. Warner et al. (1996) utilized simulation model that embed long-term and short-term implications and evaluation employee turnover effects on benefits derived by both the firm and the broader community. They reached out to say that half of program-generated benefits are attributed by the community outside the firm. Smoking cessation is profitable when long-term benefits are considered. The study reached out that the program is more cost-effective than most of the conventional medical care covered by the firm's insurance. Rather the intervention focus on only a fraction of the costs that smoking imposes on the firm.

Huicochea-Bartelt et al. (2013) evaluated in a 250 employees -medium size Mexican-Corporate setting the economic impact of a twelve-week smoking cessation program with varenicline from an employer perspective, taking into account shared proportion of 50% of the costs of the program between both employees and employers. Results showed that companies would have to invest USD $178 per employee only at the first year, and have potential savings of USD $228 for each of them after the elapse of three years. The net productivity gains per-program participant would be in a range of 70.8 hours. Being said that, then productivity gains and savings can be archived in a three-year time-horizon.

Menzin et al. (2012) has calculated lifetime earnings (PVLE) lost due to premature mortality. using the human capital approach. productivity loss has a considerable share of the total cost burden of premature mortality due to smoking, accounting for over 75% of total lifetime costs in the US and 67% of total lifetime costs in Brazil. Troelstra et al. (2020) reviewed evidence on the relation between smoking and sickness absence and whether any differences exist. Results showed that smoking increases risk and number of sickness absence days in working populations, regardless of study location, gender, age, and occupational class. Encouraging smoking cessation at the workplace could therefore be beneficial for the firms, both, for employers and employees.

Lightwood et al. (1999) went to calculate excess direct medical costs of low birth weight from maternal smoking and short-term cost savings from smoking cessation programs before or during the first trimester of pregnancy. They found that mean average excess direct medical cost per live birth for each pregnant smoker (in 1995 dollars) was USD $511; total cost was USD $263 million (in 1995 USD$). A drop of 1 percentage point-yearly - in smoking prevalence would prevent 1,300 low birth weight live births and save $21 million in direct medical costs in the first year of the program; it would prevent 57 200 low birth weight infants and save USD$572 million in direct medical costs in 7 years.

In Cohen et al. (2013), they showed results of smoking cessation are modelled for different European countries, and concluded that disease rates fall when smoking cessation occurs. The economic impact of smoking prevalence effectiveness of smoking cessation measures was evidenced in UK and globally in Ekpu and Brown (2015). They reached out that cessation measures have not only proved effective but cost effective in attaining the desired cost savings and net gains to individuals and health care providers. In a recent study by Satyana et al. (2020), the smoking impact in the working-age Indonesian population showed that having an effective tobacco control strategy at both macro and micro levels can benefit the country, in terms of deaths, life lost, QALYs and total cost of productivity.

In our study we will focus on the lost productivity due to lost life years and compare it to productivity increased in smokers due to the use of smoking cessation aids in Jordanian male smokers who intend to quit. Many studies have shown that smokers have higher productivity loss than former smokers.

Methodology

A previous study demonstrated through a cost-effectiveness study the benefit of offering smoking cessation aids to male smokers who intend to quit in Jordan for one course and the gained life years for the smokers who intended to quit population (Madaeʾen et al. 2020).

There is a consensus that researchers should work on health economics analysis from a societal perspective as much as possible as this is the most comprehensive. Moreover, the cost of productivity lost is to be taken into account for true societal analysis. For example, an illness can affect society not only through financial transactions related to the exchange of goods and services to treat the illness but also by losing an individual's contribution to society throughout life due to the illness or premature death.

The Markov model was conducted for a population of 8 age groups (30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, and 65–70) under three scenarios:

- Varenicline: if the population was given a course of varenicline for three months once;
- Nicotine Replacement Therapy NRT (e.g., Nicotine gum, nicotine patches, etc.) for three months once;
- Placebo: No medication was given; smokers were advised to have visits to a physician for 3 months.

The results of the Markov model are presented in Table 1 and Fig. 1. The numbers of smokers decreased as age increased (Fig. 1). The population of age 30–34 had the most smokers (N = 123476) and the population of age 65–70 had the least smokers (N = 7770) (Table 1).

For each age group, present values for lifetime earnings are different for the three scenarios (Varenicline, NRT, and Placebo). Notice that within each age group, the present value for lifetime earnings seemed to be highest for Varenicline, in comparison to the other two scenarios (NRT and Placebo). Presents on value for lifetime earnings decreased as age increased. Under the scenario Varenicline, the population of age 30–34 had the highest present value for lifetime earnings gained (PVLE = 63097.52) due to longer life expectancy and benefit from smoking cessation at a younger age, and the population of age 65–70 had the lowest present value for lifetime earnings gained (PVLE = 9657.3) (Table 1).

Using this data, we will analyze the productivity lost. An analysis was conducted to determine the present value for lifetime earnings (PVLE) of future payment using the human capital approach. In particular, the formula used to compute PVLE was:

$$PVLE(W_{ij}) = \sum_{i=S_j}^{N_j} \frac{L_{ij} * W_{ij}}{(1+R)^{i-S_j}}$$

Note that j represents gender, j = 1 for male and j = 2 for female; i represents age. Additionally,

- S_j = the starting age for gender j
- N_j = life expectancy for starting age for gender j
- L_{ij} = economic activity rate for age i and gender j
- W_{ij} = annual wages for age i and gender j
- R = discount rate

To our knowledge, there are no existing models that provide estimates of productivity costs for such a wide array of countries or that utilize a methodology that can be modified to estimate productivity costs of specific subgroups of interest (Menzin et al. 2012).

We present a transparent, generic model based on accepted analytic methods that allow users to assess the present value of lifetime earnings (PVLE) for Jordan. Our model incorporates mortality rates from the Markov Model in order to estimate smoking-related lost productivity costs. In Madae'en et al. (2020) study it was done up to a 70-year cycle so the years occur in a productive period in an attempt to study the indirect cost of not using varenicline.

We found productivity gains in males who attempted to quit in their productive years. Further, for a treatment cohort of 527,118 Jordanian male smokers who intended to quit with varenicline, the total life-years gained by males was calculated as 103970 years by the average wage of 507 JDs ($714.5 USD) per month for the year 2016. we used our reference year 2016 because the Markov model used data of 2016 making it more accurate, we used average wage from the same year as well as the unemployment percentage for males in the same period. We add a discount rate of 8% because the future payment discount rate for developing countries is higher than in developed countries (Valentin, et al. 2010), hence, the discount rate considers the market risk premium and the tax rate. For the NRT are 64,030 life years were gained using the NRT regimen (compared to the no-intervention and same variables and methodology as varenicline was used to calculate present value of lost earning.

Results

The results of the Markov model are presented in Table 1 and Fig. 1. Numbers of smokers decreased as age increased (Fig. 1). The population of age 30–34 had the most smokers (N = 123476) and the population of age 65–70 had the least smokers (N = 7770) (Table 1). For each age group, present values for lifetime earnings are similar for the three scenarios (Varenicline, NRT, and Placebo). Notice that within each age group, present value for lifetime earnings seemed to be highest for Varenicline, in comparisons to the other two scenarios (NRT and Placebo). Present value for lifetime earnings decreased as age increased . Under the scenario Varenicline, the population of age 30–34 had the highest present value for lifetime earnings (PVLE = 63097.52) in JDs and the population of age 65–70 had the lowest present value for lifetime earnings (PVLE = 9657.3) in JDs (Table 1).

For each age group, Notice that within each age group, life years expected for every smoker seemed to be highest for Varenicline, in comparisons to the other two scenarios (NRT and Placebo). Present value for lifetime earnings decreased as age increased .Under the scenario Varenicline, the population of age 30–34 had the longest life years expected for every smoker (Life-years/Person = 23.00) and the population of age 65–70 had the shortest life years expected for every smoker (Life-years/Person = 1.71) (Table 1).

From the group using Varenicline the expected future payments (wages) count for productive years for a wage average of 507 JDs ($714.5 USD) per month discounted by 8% for the rest of their productive life. While for the same group were offered only physician counselling, the total 103,970 productive years will be lost, and we used the same average wage and discount rate. The gained productivity from one course of varenicline was 72760406228

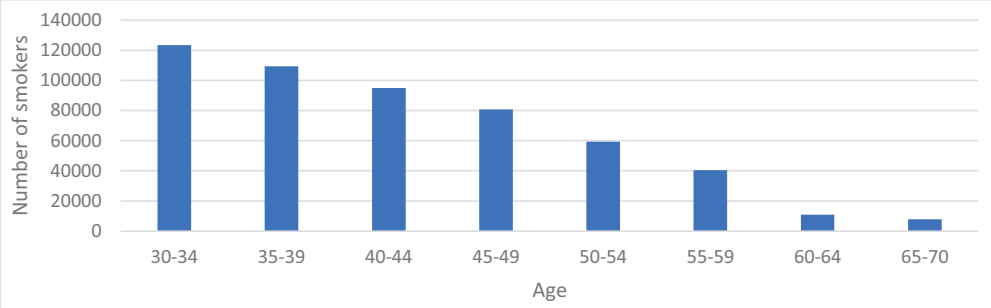

Figure 1. Number of smokers for each age group.

Table 1. Present value for lifetime earnings for each age group under the three scenarios.

	Number of smokers	PVLE	Life-years/Person
Age 30–34	123.476		
Varenicline		63097.52	23.00
NRT		63004.26	22.91
Placebo		62858.09	22.76
Age 35–39	109.453		
Varenicline		57728.5	18.49
NRT		57567.8	18.39
Placebo		57421.42	18.28
Age 40–44	95.062		
Varenicline		50316.9	14.08
NRT		50157.9	13.99
Placebo		49837.14	13.85
Age 45–49	80.768		
Varenicline		41776.2	10.36
NRT		41528.7	10.27
Placebo		41282.01	10.17
Age 50–54	59.340		
Varenicline		31845.8	7.05
NRT		31675.56	6.99
Placebo		31370.57	6.91
Age 55–59	40.366		
Varenicline		22919.4	4.66
NRT		22676.8	4.61
Placebo		22647.73	4.56
Age 60–64	10.883		
Varenicline		15586.1	2.99
NRT		15469.5	2.96
Placebo		15352.95	2.93
Age 65–70	7.770		
Varenicline		9357.3	1.71
NRT		9232.4	1.69
Placebo		9228.86	1.68

Note: PVLE = Present value for lifetime earnings gained in JDs; Life-years/Person = The life years expected for every smoker, if he was given the medicine.

JDs,($102538475601 USD) compared to physician counseling only. Nearly a 73 billion Jordanian dinars ($102 billion USD) for the productive lifetime of smokers intended to quit who are offered a course of varenicline.In sensitivity analysis the results were shown to be significant on a wide range of life years gained per age group.

Additional costs to employers include lost productivity resulting from illness and smoking breaks, increased accidents and workers' compensation costs, early retirement for disability, increased facility costs for ventilation systems. Most importantly is the healthcare costs for diseases caused by smoking, such as cardiovascular disease, stroke, chronic obstructive lung disease, and preterm birth, but we couldn't do this now for the lack of data in the Jordanian population, but it is a near-future plan.

Discussion

Our results are much similar to studies conducted in other countries where the benefits of quitting smoking on work productivity were comparable to the United State, European Union Five (France, Germany, Italy, Spain, United Kingdom), and China. The results suggest that quitting benefits extend to work productivity rapidly after cessation, serving to further encourage and promote the implementation of workplace cessation programs (Baker et al. 2017).

Other studies in third world countries such as Indonesia estimated that smoking caused 846 123 excess deaths, 2.9 million years of life lost, 41.6 million Quality Adjusted Life Years (QALYs) lost and 15.6 million productivity adjusted life years (PALYs) lost. The total cost of productivity loss due to smoking amounted to USD $183.7 billion among the working-age population followed up until retirement (Satyana et al. 2020). In a research conducted in China, it was revealed that use of smoking cessation aids saves lives and consequently money and productivity, and the WHO in 2014 declared that productivity lost counted to USD $48 billion in china (Xue 2020).

The benefit is studied worldwide as declared in a research paper done by Suwa et al. (2017) in Japan. Given the improvement after quitting smoking in work productivity loss and associated costs, smoking cessation can not only lessen the risk of many of the leading causes of death but, for employers, it has also been associated with improved workplace performance and reduced indirect costs. Results suggest that former smokers appear statistically indistinguishable from never smokers in terms of their work productivity loss and the associated indirect costs, smoking cessation programs may be important considerations for the workplace setting (Suwa et al. 2017).

In another continent a study conducted in Mexico Assuming a 250 employees company and a shared proportion of 50% of the costs of the program between employees

and employers, the simulation showed a rapid profit to the company in the first 3 years, companies would have to invest USD $178 per employee only at the first year, and have potential savings of USD $228 for each of them after 3 years. In the same circumstances, the net productivity gains per program participant would be in an amount of 70.8 hours (Huicochea-Bartelt et al. 2013).

Other relevant studies have showed a cost-saving effect of smoking cessation aids use in a systematic review of 15 articles on nicotine-based pharmacotherapies, 12 articles on non-nicotine-based pharmacotherapies, no articles on selegiline, and 10 articles on brief counselling for smoking cessation treatment. Results show that both pharmaco- and behavioral therapies for smoking cessation are cost-effective or even cost-saving (Ruger and Lazar 2012).

On the contrary, other researchers extended their economic model to include aging and costs of medical care for the aging former smokers to conclude that short term economic benefits are not the whole picture. The effects of reduced smoking on overall health care costs i.e. accounting for the long term health care costs of an increase in the elderly population are by 2030, savings become negative in all countries apart from Romania, Switzerland, Portugal and Austria due to the cost of caring for a greater number of older people (Cohen et al. 2013). These models should include productivity to give a clearer picture.

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