The Economic Cost of Smoking in South Africa, 2016

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Abstract

Chronic, non-communicable diseases are on the rise globally, and tobacco consumption is one of the important risk factors contributing to many of these diseases. The premature deaths and morbidity from tobacco account for about 4% of total disease burden globally, and 6.3% of disability-adjusted life-years lost.[1 2] In South Africa, chronic diseases such as COPD, ischaemic heart disease, hypertensive and other heart diseases are among the leading causes of mortality. Although smoking prevalence has seen a downward trend over the last three decades, South Africa still has a significant number of smokers. To make a case for tobacco control, we estimated the economic cost of tobacco use in South Africa from a societal perspective. Using 2016 data from death notification, direct healthcare cost and productivity losses due to illness and premature deaths were estimated using smoking attributable fraction method. Present value of lifetime earnings was used to estimate productivity losses from premature deaths. We estimate that 20 249 deaths among persons aged 35–74 in 2016 are smoking-attributed. The economic cost of smoking was R33 billion (US$2.27 billion) of which healthcare cost (i.e., outpatient care and inpatient care) was R11.4 billion. The economic cost of smoking amount to 0.77% of the South African GDP in 2016, while healthcare cost of smoking-related diseases was 3.24% of total healthcare expenditure. The costs are lower for women due to their low smoking prevalence. The economic burden of smoking calls for further scaling-up of tobacco control interventions in South Africa.

Keywords: Healthcare cost; productivity losses; chronic diseases; smoking

Introduction

The South African health system is markedly two-tiered, with a well-functioning but overly expensive private sector, and an under-capacitated and under-resourced public sector. This, along with a tumultuous history of political segregation of race groups, have resulted in large health inequalities across income groups, with the poor bearing the brunt of the burden.[3] Globally, there is a trend of higher smoking rates among lower socio-economic groups and South Africa is no different.[4] As a result, smoking related mortality and morbidity are disproportionately higher among the economically disadvantaged, which in turn results in higher costs for the public healthcare sector and perpetuate already existing health inequalities.

A quantification of the direct and indirect costs of smoking in South Africa is a useful tool for evidence-based policy making. They inform the true costs attributed to smoking and provide an evidence base for the extent of policy intervention required to deal with the negative externalities of smoking. For instance, in Brazil, the Attorney General's Office is suing cigarette manufacturers and their parent companies for costs incurred by the public health sector on treatments for 26 scientifically-linked smoking-related diseases over the past 5 years.[5] This quantification of the economic burden of smoking allows for a more detailed analyses of the consequences of tobacco consumption on the economy.

The economic costs of smoking in low- and middle-income countries (LMICs) are relatively low when compared to higher income countries, driven by lower costs of healthcare, labour and lower employment. A global analysis of the economic burden of smoking was performed by Goodchild, et al. [6] by applying a cost of illness approach to 2012 data. The authors find that the economic cost of smoking amounted to 1.8% of global GDP. Smoking-attributable diseases accounted for 5.7% of global health expenditures. The authors also find that the economic burden was higher in Europe (with some regional variation) and proportionally lower in Africa and the Eastern Mediterranean region, driven by lower smoking prevalence and intensity.[6]

There is a paucity of rigorous, country-level estimates of the economic cost of smoking studies from Sub-Saharan Africa. This has been partly due to the focus on communicable diseases and maternal and infant deaths which have shifted the attention away from smoking-related non-communicable diseases. To add to this, most African countries are in the early stages of the cigarette smoking epidemic, implying low rates of consumption.[7] However, the epidemic model predicts that smoking rates will be increasing in most of these countries[8], as will the economic costs attributable to smoking, making these estimates increasingly important. Another impediment to Sub-Saharan African costing studies is access to high quality, administrative or publicly available data.

Apart from studies in Uganda[9] and Tanzania[10], the most comprehensive analysis of the economic burden of smoking has been in South Africa. Compared to the rest of Sub-Saharan Africa, South Africa has experienced high rates of tobacco consumption. About 29.3% of all South Africans smoked in 1977[11], while the smoking rate for adults aged 16 and over was estimated to be 31% during 1989-1990.[12] A change in the political dispensation in 1994 lead to substantial changes in health policy, including the implementation of stricter tobacco control legislation. Although this contributed to a decline in smoking rates, rates remain consequentially high. The 2016 Demographic and Health Survey estimates that 8% of women and 37% of men aged 15 and older smoke tobacco products, the majority of which smoke daily.[13]

Given the high smoking rates, there have been several estimations of the costs of smoking in South Africa. It should be noted that economic costing studies are difficult to compare due to differing methodologies and analytical horizons. Older studies are often hampered by a missing data on premature death rates for multiple smoking-related diseases. In the seminal estimate by Yach [14] the mortality costs of heart diseases, cancer and bronchitis are considered. McIntyre and Taylor [15] update of Yach's [14] analysis includes circulatory, respiratory and neoplastic disease due to smoking. Later analyses included ischaemic heart disease, lung cancer, respiratory heart disease, chronic obstructive airways disease and aneurysm.[12]

McIntyre and Taylor [15] estimate the cost of smoking in 1985 to be between R362.3 and R396.9 million. If a broader assumption of employment is assumed (everyone, not just those employed in the formal sector, would experience a loss in productivity), the estimate increases to between R584.4 and R652 million. The higher estimate is more justifiable given the presence of a large informal sector in South Africa. Yach, et al. [12] estimated the economic cost of smoking in 1988 to reach 1.4 billion Rands, which included healthcare costs as well as lost productivity.

The most recent estimate of the economic burden of smoking in South Africa can be drawn from Goodchild, et al. [6] 2012 estimate. In their article, the economic burden of smoking is proportionally quite equal to global estimates. More specifically, the economic cost of smoking amounts to 1.8% of GDP and the cost of smoking attributable diseases accounted for 5.8% of total health expenditures. Pearce, et al. [16] find a much lower estimate of 0.49% of GDP, but these estimates are restricted to smoking-related cancer.

In this paper, we extract estimates from a wide range of recent data sources to estimate the 2016 cost of smoking for South Africa. Our analysis includes a large range of smoking-related disease categories, including tuberculosis, cerebrovascular diseases, hypertensive diseases, influenza and pneumonia, chronic lower respiratory diseases, ischaemic heart disease, malignant neoplasm of digestive organs and malignant neoplasms of respiratory and intrathoracic organs. Three costs relating to smoking were estimated. The costs are healthcare costs (i.e., hospitalization and outpatient department visits), cost of premature deaths, and the cost due to illness. Given the data availability, this is the most comprehensive analysis of the costs associated with smoking in South Africa yet.

Methods

Data Sources and Processing

Secondary data on mortality[17], healthcare expenditure and utilisation,[18 19] labour market statistics[20 21] and life table statistics[22] from 2016 were employed for this analysis. .

The cost estimation involved several steps. First, we extracted the mortality data by race and diseases from the mortality report and applied the pattern of deaths to calculate the number of deaths for persons aged 35-74.[17] For instance, 23 per cent of all deaths were below age 35 hence we dropped 23 per cent of all deaths that occurred in 2016 and extracted those between 35 and 74 years using their share in total deaths. Secondly, the gender distribution of deaths was applied to obtain female and male deaths. Per the mortality report, 52.7 per cent of all deaths were males. Deaths from hypertension and ischaemic heart, and COPD were restricted to older adults[17]. The reason is that deaths from these diseases were predominant among older adults. Finally, after estimating the total smoking-attributable deaths (SAD), age and gender disaggregated SADs were determined by multiplying each group's mortality share with total SAD.

All analyses are done in Microsoft Excel.

Diseases and Attributable Fraction

Based on previous literature,[23-26] 8 main disease categories (based on ICD10 codes) including tuberculosis, cerebrovascular diseases, hypertensive diseases (I10-I15), influenza and pneumonia (J09-J18), chronic lower respiratory diseases (J40-J47), ischaemic heart disease (I20-I25), malignant neoplasms of digestive organs (C15-C26), and malignant neoplasms of respiratory and intrathoracic organs (C30-C39) were considered. Other smoking-related

diseases not explicitly classified by race were assumed to be categorised under "other natural causes" of death in the mortality report. Thus, a certain proportion of deaths under "other natural causes" were attributed to smoking. Diseases of arteries, arterioles and capillaries and other neoplasms (e.g., lip, oral cavity and pharynx (C00-C14), lymphoid, haematopoietic and related tissue (C81-C96)) are some of the diseases in the "other natural causes" category. We estimated the smoking attributable fraction (SAF) for each smoking-related disease by race and gender using published South African relative risk of mortality from various smoking-related diseases.[23] Following Groenewald, et al. [24] and Chen, et al. [27] the SAF was determined as

$$SAF = \frac{p(RR-1)}{p(RR-1)+1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where p is the prevalence of smoking within the population and RR the Relative Risk of dying from smoking-related disease *i* among ever-smokers compared to never-smokers who die from the same disease. Since the death certificate asks *Was the deceased a regular smoker five years ago?*, smoking prevalence five years prior to the death is used.[28] A common smoking prevalence rate was applied to deaths from the same race and gender. To obtain the smoking-attributable deaths for each disease, the number of deaths from that disease for persons aged 35-74 was multiplied by the SAF. This was done by race and by gender. In the next stage, the attributable deaths were grouped by gender and age based on the pattern of deaths as per the mortality report.[17]

Costs

Three costs relating to smoking were estimated. The costs are healthcare costs (i.e., hospitalization and outpatient department visits), cost of premature deaths, and the cost due to illness. The costs are estimated using the prevalence-based, annual cost approach where costs are incurred due to the presence of smoking-related diseases in 2016 but caused by cumulative use of tobacco in the past.[26 27] The costing takes societal perspective irrespective of who bears it.

Cost of Premature deaths

To obtain the cost of premature deaths due to smoking, different procedures were followed. First, the years of potential life years lost (YPLL) at ages 35-39, 40-44, up to 60-64 was calculated using variables (i.e., probability of survival and life expectancy at different ages) from the life table.[22] Second, using the average monthly gross salary in May 2016,[20] the present value of output, represented by average life time earnings, for each death was calculated in line with previous studies.[9 29] The calculation takes into account the labour force participation and unemployment rates for men and women.[21] The real interest rate in 2016 (i.e., 3.45%) is used to discount all future output/earnings to present earnings, while an exchange rate of R14.71 per US$1 is used to obtain dollar equivalent.[30]

$$\sum_{i=1}^{n} FE = \frac{[Y(e)*E(e)\,][(1+p)^{n}]}{(1+r)^{n}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

In equation 2, FE is the sum of present value of all future earnings or output for persons who died in 2016. *Y* is the average annual earnings for those employed, *E* is the proportion of the population that is employed, *p* is the growth rate in output, *n* is the years of life lost at the time of death, and *r* is the discount rate (3.45%). Output/earnings was assumed to grow by 1 per cent annually, while older adults were assumed to earn 1 per cent more than young adults due to differences in experience. Another assumption is that people will be productive during their

lifetimes in accordance with the present earning trends and experience.[9 29] The total lost output for each person was calculated and multiplied by the number of smoking attributable deaths in each age category. Men and women were assumed to receive equal average monthly pay (R17 834) as of May 2016.[20]

Healthcare cost

First, healthcare utilisation due to smoking was determined based on the estimated smoking-attributable deaths and healthcare utilisation from all causes.[18] Since the private sector treats 27 per cent of all patients in South Africa[31], we multiplied the public healthcare utilisation in 2016 by (1+0.37) to obtain the total healthcare consumption for all sectors.

To estimate the smoking-attributed healthcare use, national population statistics by gender were used to distribute hospitalisation and outpatient visits for persons aged 35-74.[30] Afterwards, the percentage of smoking-related deaths (i.e., attributable fraction) in all deaths was multiplied by the total number of hospitalisation for males and females separately. The same procedure was repeated for outpatient department (OPD) visits. This gave us the smoking-attributed healthcare utilisation for OPD and hospitalisation.

To estimate the cost of hospitalisation due to smoking, the expenditure per patient day equivalent (PDE) for 2016 was multiplied by the total smoking-attributed inpatient days (the product of the average length of stay and separations/admissions) based on public and private sector market shares.[18 19] Per definition of the average length of stay, one third of expenditure per PDE was used as the cost per outpatient visit in both sectors.[15 18] This was then multiplied by the total smoking-related outpatient visits based on smoking-attributable deaths. Unlike productivity costs, healthcare cost was calculated for 35-74 age group.

Cost of lost output due to illness

For productivity losses due to illness, the total number of smoking-attributable work-days lost was estimated based on the labour force participation and unemployment rates. The daily wage rate, obtained by dividing the average monthly salary by 30, was multiplied by the work-days lost to ascertain the cost of productivity losses due to illness.

Although deaths were calculated by gender and race, we estimated the cost of smoking based on gender alone. The reason being the absence of disaggregated data on healthcare utilisation by race. The cost of second-hand smoking is not considered in this study.

Results

In 2012, nearly 21 percent of adult South Africans reported having ever-smoked.[28] There are clear racial and gender differences in the smoking rates among South Africans (Table 1). Among males, smoking prevalence was highest among Coloured men (51%) and lowest among White men (25%). Smoking rates among females are highest among Coloured women (39.7%) and lowest among African females (4.8%).

Table 1: Smoking Prevalence by Gender and Race in South Africa, 2012.

Group	**Male**	**Female**
Coloured	51	39.7
White	25.5	23.7
African	31.4	4.8
Asian/others	41.4	9.4

Source: Shisana O, et al. [28]

Deaths, Years of Life Lost

Overall, we estimated that 20 249 deaths among persons aged 35-74 in 2016 were due to smoking. This represents 7.94% of all deaths among persons aged 35-74. The proportion of deaths attributable to smoking was higher among men (10.3%) compared to women (4.8%). SADs constituted 22.4% of Coloured deaths, 15% of White deaths, 9.03% of African deaths and 7.03% deaths among other racial groups (Asians and others). Overall, the resulting years of potential life years lost (YPLL) for these deaths were 286 666 for men and 123 628 for women.

Table 2: Smoking Attributed Deaths by Gender and Disease, 2016

Causes of death (based on ICD Version 2010)	Male	Female	Both Sexes
Tuberculosis (A15-A19)	876	312	1188
Other forms of heart disease (I30-I52)	480	189	668
Cerebrovascular diseases (I60-I69)	358	163	522
Hypertensive diseases (I10-I15)	379	157	536
Influenza and pneumonia (J09-J18)	397	80	477
Chronic lower respiratory diseases (J40-J47)	940	563	1503
Ischaemic heart diseases (I20-I25)	374	372	746
Malignant neoplasms of digestive organs (C15-C26)	388	300	688
Malignant neoplasms of respiratory and intrathoracic organs (C30-C39)	404	346	750
All other diseases**	10421	2749	13170
Total	15017	5232	20249

** These diseases are those in Groenewald, et al. [24] and Sitas, et al. [25].

Table 2 summarises the number of deaths by gender and disease in 2016. Smokers died predominantly from COPD (1 503), Tuberculosis (1 188), lung cancer (750) and ischaemic heart disease (746).

Among men, there were 1 052 019 admissions and 22 million OPD visits in both public and private facilities. 108 863 admissions and 2.27 million OPD visits were attributed to smoking. For women, 56 116 out of 1.18 million admissions were attributed to smoking. Similarly, 1.17 million OPD visits were attributed smoking out of the 24.7 million OPD visits during the year. In all cases, smoking attributed healthcare use was higher among men.

Cost of Smoking

In 2016, economic cost of smoking to South Africa for persons aged 35-74 years was R33 billion (US$2.27 billion). Of this, healthcare cost was R11.4 billion, while the discounted cost of future output (i.e., cost of premature death) was R21.6 billion. The smoking-attributed healthcare cost consisting of outpatient department visits and hospitalisation represented 3.24% of total healthcare cost in 2016 (Table 3). A total of 489 167 workdays were lost due to illness from smoking. However, the cost of workdays contributed the least to the total costs. The value of productivity losses due to illness from smoking was R290.56 million, of which 74% occurred among men.

Table 3: Summary of costs due to smoking, 2016

	OPD	Inpatients	Productivity loss due to illness	Premature Deaths cost	Total	Total, USD
Male	3,986,980,083	3,543,405,659	215,292,565	17,186,369,095	24,932,047,401	1,694,904,650
Female	2,057,033,233	1,828,176,476	75,272,816	4,433,499,445	8,393,981,970	570,630,997
Total	6,044,013,316	5,371,582,135	290,565,381	21,619,868,540	33,326,029,371	2,265,535,647

All amounts are in South African Rand unless otherwise stated. US$1 = R14.71

Higher RR and smoking prevalence resulted in higher smoking attributed costs among men (R24.9 billion) compared to women (R8.4 billion). Disaggregation by race was impossible due to data limitations.

Sensitivity Analyses
Sensitivity analyses were performed by varying parameters of uncertainty.

- We allowed real output to grow by 1.5% per annum while using a discount rate of 3%. This productivity growth rate is the average growth rate of South Africa's GDP in the past five years. The total cost increases to R39 billion or 0.9% of 2016 GDP.
- We assumed that the rate at which smoking contributes to mortality would be the same rate at which it contributes to total healthcare expenditure. For this reason, we applied the Smoking Attributed Fraction of 7.94% to the total health expenditure in 2016 with the same discount rate of 3% and 1.5% productivity growth rate. This brings total health expenditure due to smoking to R28 billion and the cost of premature deaths to R27.2 billion. The total economic cost, i.e., healthcare expenditure, cost of premature deaths and the loss of productivity due to illness amount to R55.6 billion (US$3.8 billion) or 1.3% of GDP. This is closer to the earlier estimate.[6]
- We also used the individual's remaining years to retirement to calculate the cost of premature deaths. Applying the same 3% discount rate, 1.5% productivity growth rate and SAF for healthcare cost brings the total cost of smoking to R48 billion (1.1% of GDP). If healthcare cost in Table 3 is used, then the total cost of smoking is 0.72% of GDP.

The overall cost is between 0.72% and 1.3% of GDP depending on the assumptions, while healthcare cost due to smoking is between 3.24% and 7.94% of total healthcare spending.

Discussion

This study is not without its limitations. Firstly, although we calculated the smoking attributable deaths by race, we did not calculate cost using race due to race-age specific limitations in the data. Secondly, using life expectancy from the life table suggest that individuals do not retire, which is overly simplistic given that people retire. In the presence of retirement, our estimates from the cost of premature deaths would be lower. However, our study does not consider second-hand smoking (SHS), which also poses health risks to non-smokers and would increase our estimate.

Tobacco is a major contributor to mortality and morbidity in South Africa. In 2016, 20 249 adults died from smoking-related diseases. This represents 7.94 percent of all adult deaths in the 35-74 year age-group in the same year, which corresponds to previous South African estimates.[24 25] The total economic cost of smoking for 2016 was R33 billion (US$2.27 billion), or 0.77% of South Africa's 2016 GDP. This estimate reflects the average cost of smoking for adults in the 35-74 years age group. Previous estimates for South Africa have ranged between R250 million and R1.39 billion during the 1980s.[12 14 15 i] Recent estimates of the cost of smoking are US$138 million (0.49% of GDP) for cancer only[16] and US$12 billion (1.8% of GDP)[6] for all causes in 2012. At the same time, the total benefits from cigarette economy in

[i] This constitutes between 0.39% and 0.64% of GDP. In 2016 prices, the cost is between R6.5 and R10.6 billion. These estimates are based on different age distribution such as ≥16 years and/or 35-64 years.

2016 was R28.3 billion (US$1.92 billion) which represented 0.65% of GDP.[ii] Comparing these costs and benefits, the results show that smoking imposes a net cost on society. The total cost of smoking as a share of GDP is similar to the findings in other LMIC studies.[9 27]

Our findings (Table 2) show that COPD, tuberculosis, cancers and ischaemic heart disease impose the biggest costs on South Africa's healthcare system due to their high mortality rates. Smoking accounts for 3.24% of overall healthcare costs in South Africa. Given that the public health system serves about 70 percent of all patients, government bears a significant portion of these costs due to the subsidised care in the public sector. In low- and middle-income countries such as Uganda and Vietnam, respectively, 2.3% and 4.3% of total healthcare cost are due to smoking.[9 32] The estimates also compares closely with the smoking-attributed healthcare cost in Hong Kong,[27] China,[33 34] but lower than the 4.7% in India.[35] In Tanzania, households spend 35% of their income to treat smoking-induced cardiovascular diseases and this translates into US$136 million for the country.[10] The share of smoking-attributed healthcare cost as a portion of total health expenditure in South Africa is slightly higher than shares reported in certain high-income countries such as Sweden,[36] Australia[37] and the UK[38].

Our estimates of smoking-attributed healthcare cost should be considered as conservative given that many of these smoking-related diseases are chronic in nature and requires continuous treatment.

Despite the decline in smoking prevalence in South Africa, smoking still has substantial consequences for the economy. The economic benefits of smoking are lower than the cost incurred in treating and managing tobacco-related diseases as well as the productivity losses resulting from premature deaths. Thus, smoking imposes a net cost on society. Like Hong Kong,[27] the cost of smoking in South Africa has increased significantly despite the falling smoking prevalence. One reason for this is that the health consequences of smoking take longer to manifest.

The findings call for proactive measures to combat smoking. First, the government should raise tobacco taxes. Higher taxes are expected to raise cigarette prices and reduce affordability. This will consequently reduce cigarette smoking and the cost it imposes on society. A percentage of excise revenue from tobacco may be earmarked for smoking cessation and other public health interventions to help current smokers quit. Such taxes may also help smokers obtain healthcare for any smoking-induced disease they may be suffering from. Stringent tobacco control policies and legislation are needed.

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References

1. NCI/WHO. The Economics of Tobacco and Tobacco Control. National Cancer Institute Tobacco Control Monograph 21. . 2016;NIH Publication No. 16-CA-8029A.

[ii] This excludes tobacco exports. The contribution is obtained by multiplying the retail price of cigarette in 2016 by total cigarette consumption.

2. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The lancet* 2012;380(9859):2224-60.
3. Coovadia H, Jewkes R, Barron P, et al. The health and health system of South Africa: historical roots of current public health challenges. *The Lancet* 2009;374(9692):817-34.
4. Mukong AK, Van Walbeek C, Ross H. Lifestyle and income-related inequality in health in South Africa. *International journal for equity in health* 2017;16(1):103.
5. Alves L. Brazil sues cigarette manufacturers for public health costs. *The Lancet* 2019;393(10187):2187.
6. Goodchild M, Nargis N, d'Espaignet ET. Global economic cost of smoking-attributable diseases. *Tobacco Control* 2018;27(1):58-64.
7. Blecher E, Ross H. Tobacco use in Africa: tobacco control through prevention. *Atlanta, GA: American Cancer Society* 2013
8. Thun M, Peto R, Boreham J, et al. Stages of the cigarette epidemic on entering its second century. *Tobacco control* 2012;21(2):96-101.
9. Nargis N, Nyamurungi K, Baine SO, et al. The health cost of tobacco use in Uganda. *Health policy and planning* 2017;32(8):1153-60.
10. Kidane A, Hepelwa A, Ngeh ET, et al. Healthcare cost of smoking induced cardiovascular disease in Tanzania. *Journal of health science (El Monte)* 2015;3(3):117.
11. Coetzee A. Rook en gesondheid-feite en statistiek. *S Afr Med J* 1978;54:425.
12. Yach D, McIntyre D, Saloojee Y. Smoking in South Africa: the health and economic impact. *Tobacco Control* 1992;1(4):272.
13. National Department of Health (NDoH) SSASS, South African Medical Research Council (SAMRC), and ICF, . South Africa Demographic and Health Survey 2016. . Pretoria, South Africa, and Rockville, Maryland, USA: NDoH, Stats SA, SAMRC, and ICF., 2019.
14. Yach D. Economic aspects of smoking in South Africa. *South African Medical Journal* 1982;62(6):167-70.
15. McIntyre DE, Taylor SP. Economic aspects of smoking in South Africa. *South African Medical Journal* 1989;75(9):432-35.
16. Pearce A, Sharp L, Hanly P, et al. Productivity losses due to premature mortality from cancer in Brazil, Russia, India, China, and South Africa (BRICS): a population-based comparison. *Cancer epidemiology* 2018;53:27-34.
17. Statistics South Africa. Mortality and causes of death in South Africa, 2016: Findings from death notification. Pretoria, South Africa: Statistics South Africa 2018.
18. Rispel LC, Padarath A. South African Health Review 2018. Durban: Health Systems Trust 2018.
19. Competition Commission South Africa. Health Market Inquiry: Report on analysis of medical schemes claims data - initial cost attribution analysis. Pretoria: Competition Commission South Africa 2017.
20. Statistics South Africa. Quarterly Employment Statistics. Pretoria: Statistics South Africa, June 2016.
21. Statistics South Africa. Gender Series Volume IV: Economic Empowerment, 2001-2017. Pretoria: Statistics South Africa, 2018.
22. WHO. Life Table by Country, South Africa 20-04-2018 ed. Geneva WHO, 2018.
23. Sitas F, Egger S, Bradshaw D, et al. Differences among the coloured, white, black, and other South African populations in smoking-attributed mortality at ages 35–74 years: a case-control study of 481 640 deaths. *The Lancet* 2013;382(9893):685-93.
24. Groenewald P, Vos T, Norman R, et al. Estimating the burden of disease attributable to smoking in South Africa in 2000. *South African Medical Journal* 2007;97(8):674-81.
25. Sitas F, Urban M, Bradshaw D, et al. Tobacco attributable deaths in South Africa. *Tobacco control* 2004;13(4):396-99.

26. Max W, Sung H-Y, Shi Y, et al. The Cost of Smoking in California. *Nicotine & Tobacco Research* 2015;18(5):1222-29. doi: 10.1093/ntr/ntv123
27. Chen J, McGhee S, Lam TH. Economic Costs Attributable to Smoking in Hong Kong in 2011: A Possible Increase From 1998. *Nicotine & Tobacco Research* 2017;21(4):505-12. doi: 10.1093/ntr/ntx254
28. Shisana O LD, Rehle T, Simbayi L, Zuma K, Dhansay A, Reddy P,, Parker W HE, Naidoo P, Hongoro C, Mchiza Z, Steyn NP, Dwane N, Makoae M, Maluleke T,, Ramlagan S ZN, Evans MG, Jacobs L, Faber M, & SANHANES-1 Team. South African National Health and Nutrition Examination Survey (SANHANES-1). Cape Town: HSRC & SAMRC, , 2013.
29. Max W, Rice DP, Sung H-Y, et al. Valuing human life: estimating the present value of lifetime earnings, 2000. 2004
30. World Bank. World Development Indicators. 05 Feb 2019 ed. Washington DC: World Bank, 2019.
31. Statistics South Africa. General Household Survey 2016. Pretoria Statistics South Africa, 2017.
32. Ross H, Trung DV, Phu VX. The costs of smoking in Vietnam: the case of inpatient care. *Tobacco control* 2007;16(6):405-09.
33. Yang L, Sung H-Y, Mao Z, et al. Economic costs attributable to smoking in China: update and an 8-year comparison, 2000–2008. *Tobacco control* 2011;20(4):266-72.
34. Sung H-Y, Wang L, Jin S, et al. Economic burden of smoking in China, 2000. *Tobacco control* 2006;15(suppl 1):i5-i11.
35. John R, Sung H, Max W. Economic cost of tobacco use in India, 2004. *Tobacco control* 2009;18(2):138-43.
36. Bolin K, Borgman B, Gip C, et al. Current and future avoidable cost of smoking–Estimates for Sweden 2007. *Health Policy* 2011;103(1):83-91.
37. Collins D, Lapsley HM. The costs of tobacco, alcohol and illicit drug abuse to Australian society in 2004/05: Department of Health and Ageing Canberra 2008.
38. Callum C, Boyle S, Sandford A. Estimating the cost of smoking to the NHS in England and the impact of declining prevalence. *Health Economics, Policy and Law* 2011;6(4):489-508.