

Original Article

Tobacco smoking prevalent in Zambian males: Observations from the Zambia Demographic Health Survey 2013-2014

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ABSTRACT

Background: Tobacco smoking is one of the biggest public health threats causing poverty, several illnesses and death. Previous studies found that the lower the education, the higher the risk of smoking. This study assessed the association between education attainment and smoking among participants of the Zambia Demographic Health Survey 2013-2014.

Methodology: This was a population-based cross-sectional study. Secondary data was extracted from existing Zambia Demographic Health Survey 2013-2014 data sets, from ten provinces in comparison with different variables to constitute a resultant data set which this study used. All successfully interviewed male and female participants who answered the question, "Do you currently smoke cigarettes?" or "Do you currently smoke or use any other type of tobacco?" were included. The data extraction form was used to extract values of dependent and independent variables and imported into statistical analysis tool Stata version 13. Descriptive statistics of individual characteristics, testing for associations using the Pearson's Chi Square test and logistic regression were performed.

Results: Overall there were 14773 men and 16411 women with mean age of 15-19. Smoking prevalence was 9.9% overall and 20.4% in men, but 0.5% in women. The incidence of tobacco smoking

is steadily increasing with increase in age among both men and women. There was a significant increase in the incidence of smoking between 20-24 and 25-29 particularly in male smokers. Higher socioeconomic status seems to have a protective effect, consequently smoking remains highest among poor individuals and lowest among the rich. Higher education groups had a decreased likelihood to smoke with an odds ratio of 0.5 overall, 0.2 in men and 0.1 in women.

Conclusions: We report high and unchanging prevalence of smoking predominantly concentrated in rural adult populations with lower education attainment. This suggests past health promotion efforts that targeted whole population may not have been relevant to the most affected groups. This therefore calls for reshaping health promotion messages to target specific populations and settings with highest burden. Furthermore, this calls for additional explorative studies in order to examine reasons for smoking in lower educated groups including exploring how what has worked in reducing smoking in higher educated groups could be extrapolated to most affected low educated and rural populations.

INTRODUCTION

Tobacco smoking epidemic is one of the biggest public health threats the world has ever faced killing more than 7 million people a year. Around 80% of the 1.1 billion smokers worldwide live in low and

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middle-income countries, where the burden of tobacco-related illness and death is heaviest. Tobacco users who die prematurely deprive their families of income, raise the cost of health care and hinder economic development.¹ WHO, through the WHO Framework Convention on Tobacco Control (WHO FCTC) which entered into force in February 2005 is committed to fighting the global tobacco epidemic. It is an evidence-based treaty that reaffirms the right of people to the highest standard of health, provides legal dimensions for international health cooperation and sets high standards for compliance.² WHO introduced a package of six evidence-based tobacco control demand reduction measures that are proven to reduce tobacco use. These measures known as the MPOWER package reflect one or more provisions of the WHO FCTC. MPOWER refers to M: Monitoring tobacco use and prevention policies; P: Protecting people from tobacco smoke; O: Offering help to quit tobacco use; W: Warning about the dangers of tobacco; E: Enforcing bans on tobacco advertising, promotion and sponsorship, and R: Raising taxes on tobacco.³

“Smoking” term includes direct tobacco smoking, second hand tobacco smoking and exposure to environmental smoke (charcoal, fuels, etc.) Smokers are more likely than non-smokers to develop Cardiopulmonary disease (CPD), stroke and lung cancer.⁴ Smoking diminishes overall health as it harms nearly every organ of the body, increased absenteeism from work, and increased health care utilization and cost. The prevalence of smoking in patients with Cardiopulmonary disease is high among patients with a lower education. Many studies find that better educated individuals indeed have a better health and a lower risk of mortality.⁵ Lower education was associated with more pack-years of smoking, fewer quit attempts and a lower likelihood of cessation. The effect of education was characterized by a higher risk of smoking frequency/intensity among participants without high school degrees compared to those who had

graduated college.⁶ Kandel *et al.*, found that the lower the level of education, the greater the risk of being a current smoker, smoking daily, smoking heavily, being nicotine dependent, starting to smoke at an early age, having higher levels of circulating cotinine per cigarettes smoked, and continuing to smoke in pregnancy.⁷ The educational gradient is especially strong in pregnancy. Educational level and smoking in pregnancy independently increase the risk of offspring smoking and antisocial and anxious/depressed behaviour problems. The negative socioeconomic status-smoking association persists irrespective of the measure of SES used, although it is stronger for education than income.⁸ Health education and structural interventions to promote healthier lifestyles should be encouraged taking into account the observed associations of the modifiable risk factors.⁹

Smokers are at greater risk for diseases that affect the heart and blood vessels. Nicotine contained in smoke affects cardiovascular function mainly by activating the sympathetic nervous system, leading to increased heart rate and, possibly, constriction of peripheral blood vessels. Nicotine was shown to cause dysfunction of endothelial cells, a key trigger of thrombotic events leading to serious cardiovascular events.¹⁰ Atherosclerosis is a chief contributor to the high number of deaths from smoking, which leads to myocardial infarction and stroke.¹¹ The mechanisms for changes in the respiratory system may be attributed to tobacco smoke containing toxic gases which when inhaled into the lungs might induce both local and systemic inflammatory responses by stimulating alveolar macrophages to release inflammatory mediators and protease to break down connective tissue in the lung parenchyma and also stimulate mucus hypersecretion around damaged tissue leading to conditions like chronic obstructive pulmonary disease and lung cancers. Lung cancers associated with smoking have a 10-fold higher mutational burden on average than lung cancers in nonsmokers.¹² Smoking can cause cancer anywhere in the body by damaging our DNA, including key

genes that protect us against cancer.⁴ Many of the chemicals found in cigarettes have been shown to cause DNA damage, including benzene, polonium-210, benzopyrene and nitrosamines. Chemical carcinogens have highly reactive electrophile groups that directly damage DNA, leading to mutations and eventually cancer.¹² Education attainment can help reduce the burden of smoking and thus reduce its impact and mortality. People require knowledge to identify and address the problems associated with smoking. This could focus on the specific subgroups at highest risk putting more effort and priority on this subgroup and designing effective preventive smoking programs as per their level of understanding.

Although previous studies found that the lower the education, the higher the risk of smoking, information regarding this relationship is limited in this setting. This study therefore aimed to assess the association between education attainment and smoking among participants of the Zambia Demographic Health Survey 2013-2014

MATERIALS AND METHODS

ZDHS design

The Zambia Demographic and Health Survey (2013-14 ZDHS) is a nationally representative sample of women aged 15-49 and men aged 15-59 who were usual residents of the selected households, or who slept in the households the night before the survey. The main objectives of the 2013-14 ZDHS were to provide up-to-date information on fertility and childhood mortality levels; fertility preferences; awareness, approval, and use of family planning methods; maternal and child health; adult and maternal mortality; and knowledge and attitudes toward HIV/AIDS and other sexually transmitted infections (STIs). The survey produced representative results for the country as a whole, for the urban and the rural areas separately, and for each of the ten provinces. The Zambian population according to census data in 2010 was reported to be 13.1 million.¹³

Tobacco smoking design

This was a population-based cross-sectional study. Secondary data was extracted from the ZDHS 2013-2014. The data was extracted from ten provinces in comparison with different variables to constitute a resultant data set which the study of smoking and education used. This study's sample size was based on the available data of 16,411 women and 14,993 men that were interviewed. This study followed the ZDHS sampling method described above, used the same population and size for our study. Answers to questions relevant to the smoking and education study obtained from all randomly selected and successfully interviewed men and women were included in this study. All successfully interviewed male and female participants who met eligibility criteria of age 15-49 for women and 15-59 for men and household presence were included unless they failed to give an answer to the question, "Do you currently smoke cigarettes?", or "Do you currently smoke or use any other type of tobacco?" The outcome variable in this study was "smoking," which constituted different methods of smoking, such as cigarettes, pipes, and other. The background or exposure factors for this study included gender, age, residence, education level, and wealth index. The wealth index served as a proxy of participant's wealth and derived from data collected on the ownership of consumer goods, source of drinking, toilet facilities, dwelling characteristics and other household characteristics related to a socio-economic status.¹⁴

Data analysis

The data extracted was imported into statistical analysis tool Stata version 13.¹⁵ Descriptive statistics of individual characteristics and testing for associations using the Pearson' Chi Square test were performed. Multivariate logistic regression was used to examine if smoking was associated with education attainment whilst controlling for other variables. The p value 0.05 was considered statistically significant in all analyses.

Ethical considerations

This study was based on secondary analysis of publicly available ZDHS data which was de-identified to protect participant's privacy and confidentiality of data. Therefore, no study data at any point led to disclosure of personal information or person's identification. Permission was sought from the Central Statistics Office on the usage of the Zambia Demographic Health Survey data sets for this study. Due to the fact that ethical approval in the past was most likely given to ZDHS survey, a waiver was sought from the Research Ethics Committee of the University of Zambia, School of Medicine to proceed with this project. A waiver was sought for secondary use of data; (i) To make sure the research involved no more than minimal risk to the subjects. (ii) The waiver was unlikely to adversely affect the rights of the subject. (iii) The research was held confidential and not shared with others, unless the participant consented or unless other limited exceptions applied.

RESULTS

Population and distribution

Results are summarized in Table 1. Among the respondents (n=31184), with complete data there were 16411 (52.6%) women and 14773 (47.4%) men. The highest number of women respondents were in the 3686 (11.8%) in the 15-19-year age group which was similar in the men 3344 (10.7%). Most of the respondents reside in the rural areas 16485 (52.9%), 8540 (27.4%) of these are women and 7945 (25.5%) are men. The highest level of education attained in both sexes is primary at 13632 (43.8%) with women being more educated in this group at 7651 (24.6%) than men at 5981 (19.2%). Generally, the highest number of men attained Secondary at 7023 (22.5%). The highest number of respondents are in the richest wealth category at 6900 (22.2%) with women generally richer in this category at 3640 (11.7%) than men at 3260 (10.5%)

Table 1: Showing the socio-demographic characteristics of the respondents.

	Women n (%)	Men n (%)	All n (%)
Total	16411(52.6)	14773(47.4)	31184(100)
Age in 5-year groups			
15-19	3686(11.8)	3344(10.7)	7030(22.5)
20-24	3040(9.8)	2306(7.4)	5346(17.2)
25-29	2789(9.0)	1934(6.2)	4723(15.2)
30-34	2435(7.8)	1894(6.1)	4329(13.9)
35-39	1975(6.3)	1671(5.4)	3646(11.7)
40-44	1466(4.7)	1387(4.5)	2853(9.2)
45+	1020(3.3)	2237(7.2)	3257(10.5)
Residence			
Urban	7871(25.2)	6828(21.9)	14699(47.1)
Rural	8540(27.4)	7945(25.5)	16485(52.9)
Education level			
No education	1360(4.4)	554(1.8)	1914(6.2)
Primary	7651(24.6)	5981(19.2)	13632(43.8)
Secondary	6543(21.0)	7023(22.5)	13566(43.5)
Higher	847(2.7)	1205(3.9)	2052(6.6)
Wealth			
Poorest	2838(9.1)	2292(7.4)	5130(16.5)
Poorer	3000(9.6)	2878(9.2)	5878(18.8)
Middle	3491(11.2)	3102(10.0)	6593(21.2)
Richer	3442(11.0)	3241(10.4)	6683(21.4)
Richest	3640(11.7)	3260(10.5)	6900(22.2)

Determinants of tobacco smoking Multivariate analysis shows that the risk of smoking generally increases with increase in age, with the risk for 45+ females being 18 times that of those in the 15-19 subgroup in both sexes. Female rural residents are

90% more likely to smoke than urban residents, while male rural residents are 40% more likely to smoke. Education is generally protective with the degree of protection gradually increasing with increase in the level of education. Females with a higher education are 90% less likely to smoke, whereas males having a higher education are 80%

less likely to smoke. Wealth also has a protective effect with the degree of protection increasing with increase in wealth. Among the "Richest" subgroup, females are 70% less likely to smoke while males are more protected and 80% less likely to smoke. The highest prevalence of smoking was in the 45+ age group at 2.1% in women and 33.3% in men.

Table 2: Determinants of tobacco smoking in Zambia Demographic and Health Surveys (2013-2014)

	Women		Men		All	
	Prevalence n (%)	aOR (95% CI)	Prevalence n (%)	aOR (95% CI)	Prevalence n (%)	aOR (95% CI)
Age						
15-19	6(0.2)	Reference	98(2.9)	Reference	104(3.1)	Reference
20-24	8(0.3)	2.4(7.0 - 8.1)	306(13.3)	4.9(3.7 - 6.5)	314(13.6)	4.1(3.1 - 5.4)
25-29	11(0.4)	3.1(1.0 - 9.3)	496(25.7)	10.4(7.8 - 13.9)	507(26.1)	7.4(5.7 - 9.7)
30-34	10(0.4)	4.3(1.4 - 13.3)	499(26.3)	11.0(8.4 - 14.6)	509(26.7)	8.5(6.5 - 11.1)
35-39	8(0.4)	3.5(1.0 - 12.1)	441(26.4)	10.4(7.7 - 14.0)	449(26.8)	8.3(6.2 - 11.1)
40-44	11(0.7)	7.8(2.6 - 23.7)	430(31.0)	13.8(10.2 - 18.6)	441(31.7)	11.5(8.7 - 15.3)
45+	21(2.1)	18.4(6.5 - 52.6)	744(33.3)	15.1(11.3 - 20.2)	765(35.4)	18.9(14.4 - 24.9)
Residence						
Urban	28(0.4)	Reference	1155(16.9)	Reference	1183(17.3)	Reference
Rural	47(0.5)	1.9(1.0 - 3.4)	1859(23.4)	1.4(1.3 - 1.6)	1906(23.9)	1.4(1.3 - 1.6)
Education level						
No education	17(1.2)	Reference	200(36.1)	Reference	217(37.3)	Reference
Primary	36(0.5)	0.3(0.2 - 0.6)	1614(26.9)	0.7(0.6 - 0.9)	1646(27.4)	1.1(1.0 - 1.3)
Secondary	19(0.3)	0.2(0.8 - 1.4)	1086(15.5)	0.4(0.3 - 0.5)	1105(15.8)	0.8(0.6 - 0.9)
Higher	3(0.3)	0.1(0.4 - 0.5)	115(9.5)	0.2(0.1 - 0.3)	118(9.8)	0.5(0.4 - 0.6)
Wealth						
Poorest	28(1.0)	Reference	833(36.3)	Reference	861(37.3)	Reference
Poorer	12(0.4)	0.3(0.2 - 0.7)	734(25.5)	0.6(0.5 - 0.7)	746(25.9)	0.7(0.6 - 0.8)
Middle	14(0.4)	0.4(0.2 - 0.8)	594(19.2)	0.4(0.4 - 0.5)	608(19.6)	0.5(0.5 - 0.6)
Richer	10(0.3)	0.3(0.1 - 0.6)	538(16.6)	0.4(0.3 - 0.5)	548(16.9)	0.5(0.4 - 0.6)
Richest	11(0.3)	0.3(0.1 - 0.6)	315(9.7)	0.2(0.2 - 0.3)	326(10.0)	0.3(0.3 - 0.6)

Comparing smoking proportion by educational level and sex

Results of tobacco smoking prevalence are summarized in Table 3. Results show that tobacco smoking prevalence was higher in men than women (20.4% vs. 0.5%, $P < 0.001$) but overall it was 9.9% (95%CI 9, 10)

Education level	Women n=75		Men n=3014		All n=3089	
	Proportion %(n)	OR (95% CI)	Proportion %(n)	OR (95% CI)	Proportion %(n)	OR (95% CI)
Low education	70.7(53)	0.3(0.2 – 0.6)	60.1(1814)	0.7(0.6 – 0.9)	60.3(1863)	1.1(1.0 – 1.3)
High education	29.3(22)	0.2(0.1 – 0.3)	39.9(1200)	0.1(0.4 – 0.5)	39.7(1222)	0.5(0.4 – 0.6)

Notes: 1. *Low education= No education and Primary*High education= Secondary and Higher 2. Overall prevalence of smoking was 9.9% but it was only 0.5% in women whereas it was 20.4% in men

DISCUSSION

There is evidence of high tobacco smoking prevalence in this population. This burden is most notably seen in older males residing in rural areas of the country in contrast to females who seem to have a smaller burden among those residing in the rural areas. We also find evidence indicating that the rate of tobacco smoking is steadily increasing with increase in age among both men and women.¹⁶ The reasons for this association are unclear, but we hypothesize that this could be attributable to higher rates of smoking initiation among the older men and women in this population as well as lower or insignificant rates of smoking cessation in the general population. Finding that the prevalence of smoking and the risk of smoking increased with age in both men and women was an interesting observation given the fact that age continues to be a strong determinant of tobacco smoking. This finding is supported by the fact that Non-communicable diseases are much more associated with individuals in the older age groups.¹⁷ This finding gives us an opening to follow these individuals as a health promotional intervention by promoting early

screening and detection of associated NCDs and encouragement of smoking cessation to reduce the impact of smoking on NCDs or general prognosis of the existing NCDs.¹⁸

In this population, we observed that smoking rose with the highest surge between consecutive age groups in male tobacco smokers particularly between 20-24 and 25-29 age groups compared to the highest surge seen between the 15-19 year and 20-24-year age groups seen over the period of 2002-2007 suggesting that a significant number of young men is increasingly starting to smoke in the 20's.¹⁹ This is still consistent with available evidence that shows initiation of tobacco use during late adolescence and early adulthood among young male adults in sub-Saharan countries. The presence of advertisements that show the availability of cigarettes could possibly be one of the explanations.²⁰ These subtle marketing approaches together with peer pressure dynamics and lack of knowledge of health risks associated with smoking could thus make them prone to the habit. It highlights the importance of targeting the younger population in overall efforts to control tobacco smoking. Educating adolescents in the school environment is effective in increasing self-efficacy skills as a preventive measure of smoking in adolescents.²¹

We also found that sex, education and wealth were associated with tobacco smoking.²² We therefore state that, smoking tobacco appears to be driven by socio-economic factors, such as wealth and education. Higher socio-economic status seems to have a protective effect. Consequently, tobacco smoking remains highest among poor individuals and lowest among the rich.⁴ This distinct division between the poor and the rich may confer risk for persistent smoking as a mechanism to cope with stress. The strong effect that education attainment has on tobacco smoking did not change in this study

as higher education groups had a decreased likelihood to smoke overall. A previous study, although economic and lifestyle changes that follow education attainment may have been associated with behaviour that increased the risk of smoking in young people particularly, this relationship seems to be dissolving with increasing number of years in school in this population. Highly educated people maybe the first to respond positively to preventive information on smoking, have more quit attempts and a higher likelihood of cessation.²³ Lower education may also confer risk for persistent smoking due to lower occupational status and financial strains and be a more frequent mechanism for coping with stress among individuals with lower levels of education.⁶ The association of education and smoking may be mediated by health knowledge. It is well known that education is a robust determinant of health awareness. Exposure to health education improves the understanding of the association between health behaviours and outcomes, positively contributing to health behaviours. Furthermore, less educated may be less responsive to health promotion, receive less information about the consequences of smoking, and have limited access to cessation services.²⁴

Across sectional analysis of national surveys showed that men and women display different patterns by education.⁸ Men generally smoked more than women in this population.²⁵ The Zambian socio-cultural characteristics might be a major factor in the large discrepancy between men and women. Although the Zambian society has been influenced by the western culture during the past decades, it remains quite conservative and rooted into the traditional culture especially when it comes to women. The Zambian society is quite tolerant to men smoking but not to women smoking. Women with higher socio-economic status may be more sensitive to social norms against smoking, and more likely to be exposed to smoking restrictions and social pressures at their workplace.²⁶

We also find that geographical contrasts associated with smoking exist in this population. The highest number of smokers reside in the rural areas as compared to urban areas. This finding is similar to results in the previous study where there was an increasing popularity and consumption of cigarettes in rural settings.²² This could mean a failure or low effectiveness in rural Zambia. These differential smoking patterns may also be due to the educational background among rural or urban residents. Cigarettes could have been more accessible and affordable to rural residents.²⁷ This could be dictated by increased market penetration and more aggressive promotion of cigarettes.

Overall, our findings highlight the need of comprehensive approaches to smoking reduction and cessation. Due to the negative association between individual smoking behaviours and education, tobacco control policies should pay more attention to populations with a low level of education in Zambia.²⁸ To break the link between educational disadvantage and smoking status, tobacco control policies should pay more attention on enhancing health literacy and anti-smoking education initiatives.²⁴ The tailored interventions should target smoking characteristics of different socio-economic status groups.²⁹ The tailored interventions may include the improvement of awareness regarding social norms of tobacco smoking for low income females, and offering social support for rural residents. Therefore, tobacco control policies should not only address individual behaviours, but also mitigate broader inequalities in educational opportunities and cultural backgrounds. Men and women could be reached through a radio and television and the message could be packaged in such a way that they would be able to understand the message irrespective of education level.²² Health education changes attitude of young generation through knowledge, which is influenced by several elements, such as delivered information, manner or props used, and language.³⁰

CONCLUSION

These findings of educational differentials and smoking in this population provide strong evidence and are consistent with prior studies showing strong protective effects of schooling on smoking behaviours. Our findings revealed a similar pattern of tobacco smoking concentrated predominantly in rural adult populations with lower educational attainment. It remains unresolved whether low education is a risk factor for smoking, or whether educational disparities in smoking are attributable to factors that confer risk for both low education and smoking. Evidence that smokers have shortened educational careers raises the possibility of a reciprocal effect of educational achievements and smoking behaviours overtime. Education appeared to be an effective preventive factor in reducing the likelihood of smoking with increasing level of education attained. Increased prevalence of smoking in the older individuals should lead to new approaches of repackaging health promotional and life changing messages to both sexes. Tobacco smoking prevalence could remain a huge burden, thereby justifying the need for continuous tobacco smoking preventative approaches. These responses together with regulatory frameworks implemented by the WHO Framework Convention on Tobacco Control by Zambia in 2008 could contribute significantly in the fight against smoking. We conclude with an urgent call for a public health action targeting the specific risk groups.

Author's contributions

FN took part in the analysis, interpretation of the data and drafted the manuscript. PO took part in the extraction, analysis and interpretation of the data. CM participated in interpreting results and revising the manuscript. The final manuscript was reviewed by all authors.

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REFERENCES

1. WHO. *Tobacco*. 2018; Available from: <https://www.who.int/news-room/fact-sheets/detail/tobacco>.
2. WHO. *WHO Framework Convention on Tobacco Control*. 2003; Available from: https://www.who.int/fctc/text_download/en/.
3. WHO. *Tobacco Free Initiative (TFI)*. 2008; Available from: <https://www.who.int/tobacco/mpower/2008/en/>.
4. CDC. *Cigarette Smoking and Tobacco Use Among People of Low Socioeconomic Status*. 2018; Available from: <https://www.cdc.gov/tobacco/disparities/low-ses/index.htm>.
5. Cutler, D.M. and A. Lleras-Muney, *Education and health: evaluating theories and evidence*. 2006, National bureau of economic research.
6. Gilman, S.E., et al., *Educational attainment and cigarette smoking: a causal association?* International Journal of Epidemiology, 2008. **37**(3): p. 615-624.
7. Kandel, D.B., P.C. Griesler, and C. Schaffran, *Educational attainment and smoking among women: risk factors and consequences for offspring*. Drug and alcohol dependence, 2009. **104**: p. S24-S33.
8. Abdulrahim, S. and M. Jawad, *Socioeconomic differences in smoking in Jordan, Lebanon, Syria, and Palestine: A cross-sectional analysis of national surveys*. PloS one, 2018. **13**(1): p. e0189829.
9. Goma, F.M., et al., *Prevalence of hypertension and its correlates in Lusaka urban district of Zambia: a population based survey*. International archives of medicine, 2011. **4**(1): p. 34.
10. Chalon, S., et al., *Nicotine impairs endothelium-dependent dilatation in human veins in vivo*. Clinical Pharmacology & Therapeutics, 2000. **67**(4): p. 391-397.

11. CDC. *Health effects of cigarette smoking - smoking & tobacco use*. 2018, August 1; Available from: https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/effects_cig_smoking/index.htm.
12. Kumar , V., Abbas, A, and Aster, J., *Robbins and Cotran pathologic basis of disease*. . 9th ed. 2014: Elsevier Saunders.
13. CSO, *2010 Census of Population and Housing : National Analytical Report*. 2012.
14. Central Statistical Office, M.o.H., and ICF International, *Zambia Demographic Health Survey 2013-2014*. 2014.
15. Stata, S., *Release 13. statistical software*. StataCorp LP, College Station, TX, 2013.
16. CDC. *Current Cigarette Smoking Among Adults - United States 2005 - 2014*. 2014; Available from: <https://www.cdc.gov/mmwr/preview/mmwrhtml/m6444a2.htm>.
17. Munday, D., et al., *The prevalence of non-communicable disease in older people in prison: a systematic review and meta-analysis*. Age and ageing, 2019. **48**(2): p. 204-212.
18. Kruk, M.E., G. Nigenda, and F.M. Knaul, *Redesigning primary care to tackle the global epidemic of noncommunicable disease*. American journal of public health, 2015. **105**(3): p. 431-437.
19. Townsend, L., et al., *A systematic literature review of tobacco use among adults 15 years and older in sub-Saharan Africa*. Drug and alcohol dependence, 2006. **84**(1): p. 14-27.
20. Vasiljevic, M., D.C. Petrescu, and T.M. Marteau, *Impact of advertisements promoting candy-like flavoured e-cigarettes on appeal of tobacco smoking among children: an experimental study*. Tobacco Control, 2016. **25**(e2): p. e107-e112.
21. Bagherinia, M., et al., *Effectiveness school-based educational interventions in preventing smoking in Iranian adolescents: A Systematic Review*. International Journal of Pediatrics, 2020.
22. Olowski, P. and C. Michelo, *Differential burden and determinants of tobacco smoking: population-based observations from the Zambia demographic and health survey (2002 and 2007)*. J Health Commun, 2015. **1**: p. 2472-1654.
23. Lynch, B.S. and R.J. Bonnie, *PREVENTION AND CESSATION OF TOBACCO USE RESEARCH-BASED PROGRAMS*, in *Growing up Tobacco Free: Preventing Nicotine Addiction in Children and Youths*. 1994, National Academies Press (US).
24. Wang, Q., et al., *Income, occupation and education: Are they related to smoking behaviours in China?* PloS one, 2018. **13**(2): p. e0192571.
25. Tsai, Y.-W., et al., *Gender differences in smoking behaviours in an Asian population*. Journal of Women's Health, 2008. **17**(6): p. 971-978.
26. Greaves, L.J. and N.J. Hemsing, *Sex, gender, and secondhand smoke policies: implications for disadvantaged women*. American journal of preventive medicine, 2009. **37**(2): p. S131-S137.
27. Wang, J., et al., *Smoking, smoking cessation and tobacco control in rural China: a qualitative study in Shandong Province*. BMC Public Health, 2014. **14**(1): p. 916.
28. Huisman, M., A. Kunst, and J. Mackenbach, *Educational inequalities in smoking among men and women aged 16 years and older in 11 European countries*. Tobacco control, 2005. **14**(2): p. 106-113.
29. Christiansen, B.A., et al., *Motivating low socioeconomic status smokers to accept evidence-based smoking cessation treatment: a brief intervention for the community agency setting*. Nicotine & Tobacco Research, 2015. **17**(8): p. 1002-1011.
30. Abdullah, A., et al., *Health Education; The Comparison Between With Leaflet and Video Using Local Language In Improving Teenager's Knowledge of Adverse Health Effect of Smoking*. Faletahan Health Journal, 2020. **7**(1): p. 48-51