

RESEARCH ARTICLE

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Prevalence and Factors Associated with Tobacco Smoking in a National Representative Sample of Zambian Adults: Data from the 2017 STEPS – NCDs Survey

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Abstract

Background: There has been a reduction in tobacco smoking worldwide except in developing countries. Africa has the lowest prevalence of tobacco use in the world, however, the rising trends amidst the WHO FCTC implementation are worrisome as it is likely to increase the tobacco public health impact in the next decade. The study investigated factors associated with tobacco smoking among adults in Zambia. **Methods:** We used secondary data extracted from the 2017 STEPS – NCDs Survey. Logistic regression was used to obtain unadjusted (UOR) and adjusted odds ratios (AOR) at 95% confidence interval (CI). **Results:** Of the 4,301 adults who participated, 11.0% were current tobacco smokers (25.7% men and 2.27% women). Of these 75.6% and 11.9% drunk alcohol and had mental health problems, respectively. In multivariable analysis, factors significantly associated with increased odds of current tobacco smoking were older age groups of 45-59 years (AOR = 1.69; 95% CI: 1.17-2.43, $p = 0.005$) and 60-69 years (AOR = 2.22; 95% CI: 1.25-3.93, $p = 0.006$), alcohol consumption (AOR = 5.93; 95% CI: 4.44-7.91, $p < 0.001$), mental health problems (AOR = 2.08; 95% CI: 1.34-3.22, $p = 0.001$). On the other hand, female gender (AOR = 0.07; 95% CI: 0.05-0.10, $p < 0.001$), being diabetic (AOR = 0.52; 95% CI: 0.15-0.46, $p = 0.026$), education attainment; primary, secondary, and higher education (AOR = 0.65; 95% CI: 0.47-0.91, $p = 0.012$, AOR = 0.40; 95% CI: 0.29-0.55, $p < 0.001$ and AOR = 0.26; 95% CI: 0.15-0.46, $p < 0.001$), respectively, had reduced odds of tobacco smoking. **Conclusions:** Our findings underscore the high prevalence of tobacco smoking particularly in uneducated males who consume alcohol and have mental health problems. The mental health problems and alcohol consumption in this population need to be addressed in concert with smoking cessation strategies.

Keywords: Tobacco smoking- psychological- cardiovascular diseases- hypertension- diabetic mellitus- Zambia

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Introduction

Although, there has been a substantial reduction of tobacco use globally (Gravelly et al., 2017; Hoffman et al., 2019), the mortality due to smoking is still higher than those of diseases such as HIV, Malaria, and Tuberculosis, making tobacco use the largest preventable health risk factor (Mathers et al., 2006; Oberg et al., 2011). Tobacco use is a public health concern as it is a risk factor to six of the eight leading causes of death in the world (Mathers et al., 2006; Sumithrarachchi et al., 2021), and has been projected to kill over eight million people annually globally by 2030 with more than 80% of deaths occurring in the low and middle-income countries (LMICs) (GGT, 2017). More than 80% of the 1.3 billion people who use tobacco live in the LMIC (WHO, 2020),

which is apparently the target for the tobacco industry marketing (WHO, 2022). There are deliberate national and global strategies and efforts to regulate and control tobacco use; the World Health Organization (WHO) through the Framework Convention of Tobacco Control (WHO FCTC); set a goal of 30% reduction of tobacco smoking from a prevalence of 22.1% to 15.4% by the year 2025 (WHO, 2010). It is important to note that there has been a reduction in tobacco smoking and related deaths worldwide except in developing countries (Jha et al., 2014; Mathers et al., 2006). Africa has the lowest prevalence of tobacco use in the world (Jha et al., 2014; Mathers et al., 2006), however, the rising trend amidst the WHO FCTC implementation is worrisome as it is likely to increase the public health impact resulting in morbidities and mortalities in the next decade.

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The establishment of effective tobacco control policies depends on consistently assessing tobacco use in a country. In Zambia, three major national surveys collect information on tobacco use to evaluate the prevalence of tobacco use and these have shown different prevalence over time. The Zambia demographic health surveys (DHS) have shown overall prevalence ranging from 9.9% to 12.0% (Olowski, 2016), with males and rural areas smoking more than females and urban areas, respectively (Nyirenda et al., 2019; Olowski, 2016). The Global Youth Tobacco survey (GTYS) which tracks tobacco use in school-going adolescents has also indicated the overall prevalence range of 6.8% to 10.5% (Cosmas, 2022; S, 2009). Some authors have indicated boys and rural residence smoking more than girls and urban areas respectively (Cosmas, 2013b; S, 2009; Zulu, 2008). STEPS survey conducted by the WHO, shows the overall range from 8.7% to 10.7% (Cosmas, 2013b; Pengpid et al., 2020). Overall, all the surveys showed that there is a substantial increase in rural tobacco use as compared to urban areas (Olowski, 2016; Seter, 2011), with women having a reduced risk factor to tobacco use as compared to the men (Nyirenda et al., 2019; Olowski P, 2016; Seter 2011).

In the year 2008, Zambia ratified the WHO FCTC, since then several policies have been implemented to reduce tobacco smoking. Some of the restrictions imposed include among others, banning cigarette sales to minors who are less than 16 years; access to free products (GRZ, 1992), tobacco advertisement in the mass media, smoking in educational and health care facilities, including public transport and other public places (GRZ, 1992), and the Local government prohibiting smoking in public places (GRZ, 2008). Despite the implementation of the policies in Zambia, surveys have shown that overall, there has not been a significant reduction in the prevalence of tobacco use.

While some studies on tobacco smoking have been conducted in Zambia (Cosmas, 2022; Nyirenda et al., 2019; Olowski, 2016; S, 2009; Zulu R, 2008), we are not aware of a study that has included the behavioral and psychological factors (mental health problems and alcohol consumption) and comorbidities such as CVD (heart attack and hypertension); and metabolic disorders (diabetes and dyslipidemia) in their analysis. We, therefore, use a nationally represented survey to report the sociodemographic, behavioral, and psychological factors; and clinical characteristics associated with tobacco smoking. The aim is to investigate the psychological and socio-economic factors associated with tobacco smoking among adults in Zambia. The findings from this study will provide insight into the optimal design of targeted smoking cessation interventions in the general population in Zambia.

Materials and Methods

Data source

This study used secondary data from the Zambia STEP-wise survey for non-communicable diseases (NCD) prevalence and risk factors, mental and oral

health conducted in 2017. The Zambia STEPS survey was a cross-sectional national survey designed to obtain data representative of the adult population, aged 18 to 69, living in Zambia (WHO, 2017b). The STEPS survey used a multi-stage cluster sampling technique and utilized the household listing from the Zambia Population-Based HIV Impact Assessment (ZAMPHIA). The first stage of sampling was a selection of Standard Enumeration Areas (SEAs) from every 10 provinces using probability proportional to size (PPS); in the second stage, 15 households in each of the rural SEAs and 20 households in urban SEAs were selected systematically using appropriate sampling intervals which are based on the number of households in that SEA. Thirdly, one member of the household who was eligible was purposively selected for an interview. The questionnaire administered to survey participants included demographic data, as well as physical and biochemical measurements. Overall 4, 301 participants were included in the survey, with a response rate of 77.7%. Details of the WHO STEPS methodology can be found elsewhere (WHO, 2005; Zyaambo Cosmas; Babaniyi, 2012).

Variables and statistical analysis

This study included variables selected from the Zambia STEPS - NCD 2017 data set as identified in the literature as possible predictors for tobacco smoking such as socio-demographic characteristics (age, gender, residence, education, marital status, and employment), history of having mental health problems, heart attack, high blood pressure, alcohol consumption, and history of high blood sugar and cholesterol.

Primary outcome

The primary outcome was current tobacco smoking. From the questionnaire, the question “Do you currently smoke any tobacco products, such as cigarettes, Shisha, cigars, or pipes?” Those who answered YES were classified as current tobacco smokers and those who answered NO were classified as non-current tobacco smokers.

Independent variables

The independent variables included the following

Socio-demographic variables

Age, gender (male and females), residence (rural and urban), Education (non or less primary, primary, secondary school, and higher education) marital status (never married and married/cohabiting), Employment (Self-employed/Formally employed, Unemployed/Retired, Non-paid/Student/Homemaker

Behavioral and psychological variables

The participants were asked, “During the past 12 months, have you attempted suicide?” Those who answered YES were classified as having mental health problems otherwise they did not have mental health problems. The participants who responded YES to the question “Have you consumed any alcohol within the past 12 months?” were classified as alcohol consumers.

Clinical variables

Two specific questions were asked on the history of cardiovascular diseases (CVD). “Have you ever had a heart attack?” those who responded yes were classified as having had a heart attack. Anyone who answered yes to the question “have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?” was classified as being hypertensive. History of metabolic diseases (diabetes mellitus and dyslipidemia) were determined by asking a question “Have you ever been told by a doctor or other health worker that you have raised blood sugar or diabetes?” and “Have you ever been told by a doctor or other health worker that you have raised cholesterol?”. Those who answered yes to raised blood sugar or diabetes or raised cholesterol were classified as having diabetes mellitus and high cholesterol, respectively.

Statistical Analysis

Weighted analysis for complex surveys was conducted including descriptive statistics and logistic regression. Data was described using numbers and proportions of current smokers and non-smokers by their socio-demographic characteristics and other factors. The chi-square test of association was used to determine associations between selected predictor variables and tobacco smoking. Moreover, univariate analysis was performed and a multivariable logistic regression model was generated to examine the correlation between variables that may influence tobacco smoking and current smoking status among adults in Zambia. The covariates determined as significantly associated ($p < 0.05$) with tobacco smoking in the univariate analyses were included in the multivariable model. Data modeling was done using investigator-led stepwise backward regression as well as post-estimation analysis. The Wald test, AIC, and BIC methods were

used to assess model fit. Adjusted odds ratios, p-values, and the associated 95% confidence intervals (CIs) were estimated and used as measures of effect. All analyses were conducted using STATA version 15.

Ethical approval

The University of Zambia Research Ethics Committee (UNZABREC) approved the STEPS Survey and written informed consent was obtained from all the participants (WHO, 2017a).

Results

Population and distribution

This study involved 4,301 adults living in Zambia out of which 1,614 (37.5%) were men and 2,687 (62.5%) women. The largest proportion among adults who smoked was found in those aged 30-44 (36.8%), living in rural areas (71.0%), having none or less the primary education (42.6%). drinking alcohol (75.6%) and 11.9% of the smokers had mental health problems. Among the participants, current smokers who were told about having different clinical features were: high blood pressure (20.6%), heart attack (3.0%), raised blood sugar (4.2%) and cholesterol (0.4%) (Table 1).

Prevalence of tobacco smoking

Tobacco smoking prevalence was 11.0 %. (Men, 25.7% Vs Women 2.27%) (Table 1). By residence, the highest tobacco smoking prevalence was in Luapula province for both rural and urban areas (Figure 1).

Factors associated with tobacco smoking

Results from the univariate logistic regression analyses shows factors significantly associated with current tobacco smoking among adult Zambians: age, gender, residence,

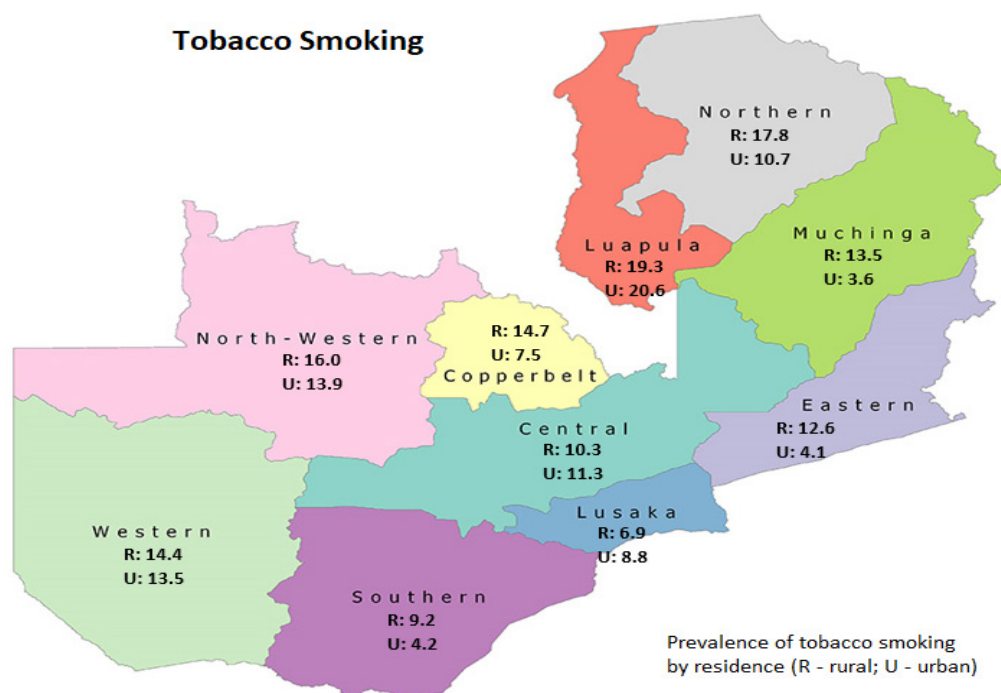


Figure 1. Tobacco Smoking

Table 1. The Characteristics of Adult Zambians According to Their Tobacco Smoking Status Using 2017 WHO-NCDs-STEPS Survey

Socio-demographics	Overall n (%) ^a 4301 (100.0)	Current Smokers n (%) ^a 475 (11.0)	Non-smokers n (%) ^a 3,826 (89.0)
Age group			
18-29	1,620 (37.7)	130 (27.4)	1,490 (38.9)
30-44	1,512 (35.2)	175 (36.8)	1,337 (35.0)
45-59	785 (18.2)	120 (25.3)	665 (17.4)
60-69	384 (8.9)	50 (10.5)	334 (8.7)
Gender			
Men	1,614 (37.5)	414 (87.2)	1,200 (31.4)
Women	2,687 (62.5)	61 (12.8)	2,626 (68.6)
Residence			
Rural	2,657 (61.8)	337 (71.0)	2,320 (60.6)
Urban	1,644 (38.2)	138 (29.0)	1,506 (39.4)
Education			
None or less primary	1,546 (36.0)	202 (42.6)	1,344 (35.1)
Primary	1,036 (24.1)	116 (24.5)	920 (24.1)
Secondary	1,390 (32.3)	134 (28.3)	1,256 (32.8)
Higher	327 (7.6)	22 (4.6)	305 (8.0)
Marital status			
Never married	934 (21.8)	89 (18.7)	845 (22.1)
Married/Cohabiting	2,627 (61.2)	327 (68.8)	2,300 (60.3)
Separated/Divorced/Widowed	731 (17.0)	59 (12.4)	672 (17.6)
Employment			
Self-employed/Formally employed	2,147 (55.0)	289 (61.0)	1,858 (48.6)
Unemployed/Retired	1,351 (31.4)	138 (29.1)	1,213 (31.8)
Non-paid/Student/Homemaker	797 (18.6)	47 (9.9)	750 (19.6)
Behavioral and Psychological			
Alcohol consumption			
Never drank alcohol	2,903 (67.5)	116 (24.4)	2,787 (72.8)
Drank alcohol	1,398 (32.5)	359 (75.6)	1,039 (27.2)
Mental health problem			
No	3,924 (91.9)	416 (88.1)	3,508 (92.3)
Yes	347 (8.1)	56 (11.9)	291 (7.7)
Clinical			
Heart attack			
No	4,141 (96.3)	461 (97.0)	3,680 (96.2)
Yes	160 (3.7)	14 (3.0)	146 (3.8)
Hypertensive			
No	1,781 (76.3)	123 (79.4)	1,658 (76.1)
Yes	554 (23.7)	32 (20.6)	522 (23.9)
Diabetes			
No	3,911 (91.0)	455 (95.8)	3,456 (90.4)
Yes	389 (9.0)	20 (4.2)	522 (9.6)
High cholesterol			
No	4,214 (98.0)	473 (99.6)	3,741 (97.8)
Yes	86 (2.0)	2 (0.4)	84 (2.2)

^aColumn percentages; All variables were significant at the p<0.05 level except for Heart attack and High blood pressure

Table 2. Factors Associated with Current Tobacco Smoking among Adults in the General Population in Zambia WHO-STEPs Cross-Sectional study 2017

Socio-demographics	UOR (95% CI)	P-value	AOR (95% CI)	P-value
Age group				
18-29	ref		ref	
30-44	1.39 (1.02-1.90)	0.035	1.12 (0.81-1.57)	0.484
45-59	1.93 (1.38-2.69)	<0.001	1.69 (1.17-2.43)	0.005
60-69	2.12 (1.36-3.33)	0.001	2.22 (1.25-3.93)	0.006
Gender				
Men	ref		ref	
Women	0.07 (0.05-0.10)	<0.001	0.07 (0.05-0.10)	<0.001
Residence				
Rural	ref		ref	
Urban	0.60 (0.47-0.78)	<0.001	0.87 (0.64-1.17)	0.357
Education				
None or less primary	ref		ref	
Primary	0.81 (0.61-1.06)	0.127	0.65 (0.47-0.91)	0.012
Secondary	0.60 (0.46-0.79)	<0.001	0.40 (0.29-0.55)	<0.001
Higher	0.49 (0.29-0.82)	0.007	0.26 (0.15-0.46)	<0.001
Marital status				
Never married	ref		ref	
Married/Cohabiting	1.55 (1.11-2.18)	0.011	1.10 (0.71-1.71)	0.654
Separated/Divorced/Widowed	0.93 (0.58-1.47)	0.75	1.31 (0.75-2.27)	0.341
Employment				
Self-employed/Formally employed	ref		Ref	
Unemployed/Retired	0.67 (0.51-0.88)	0.004	0.99 (0.73-1.35)	0.97
Non-paid/Student/Homemaker	0.38 (0.25-0.58)	<0.001	0.84 (0.50-1.40)	0.507
Behavioral and Psychological				
Alcohol consumption				
Never drank alcohol	ref		Ref	
Drank alcohol	8.50 (6.42-11.27)	<0.001	5.93 (4.44-7.91)	<0.001
Mental health problem				
No	ref		Ref	
Yes	1.46 (1.02-2.10)	0.041	2.08 (1.34-3.22)	0.001
Clinical				
Heart attack				
No	ref		NA	
Yes	0.86 (0.44-1.71)	0.678		
Hypertensive				
No	ref		NA	
Yes	0.77 (0.47-1.25)	0.288		
Diabetes				
No	ref		Ref	
Yes	0.41 (0.24-0.70)	0.001	0.52 (0.30-0.92)	0.026
High cholesterol				
No	ref		Ref	
Yes	0.16 (0.04-0.68)	0.013	0.26 (0.05-1.34)	0.107

Added due to clinical significance; - variables excluded from the multivariable analysis due to lack of statistical significance in univariate analysis: Heart attack, Hypertensive, Diabetes; UOR* Unadjusted odds ratio; AOR** Adjusted odds ratio; AOR (Age group, gender, education, employment, Alcohol consumption, mental health problems, High cholesterol)

education, alcohol, marital status, employment, mental health, diabetes mellitus, and high cholesterol (Table 2). Multivariable logistic regression analysis was used to obtain adjusted estimates for current tobacco smoking status given the different predictor variables. Adult Zambians in older age groups of 45-59 and 60-69 years were twice as likely to smoke as those in the youngest age group 18-29 (AOR=1.69; 95% CI: 1.17-2.43, $p = 0.005$ and AOR=2.22; 95% CI: 1.25-3.93, $p < 0.006$), respectively. Being a female reduced odds of smoking by 93.0% (AOR=0.07; 95% CI: 0.05-0.10, $p < 0.001$). Zambians who completed primary, secondary, and higher education were less likely to smoke tobacco products than those without any education or less than primary (AOR=0.65; 95% CI: 0.47-0.91, $p = 0.012$, AOR=0.40; 95% CI: 0.29-0.55, $p < 0.001$ and AOR=0.26; 95% CI: 0.15-0.46, $p < 0.001$), respectively. Drinking alcohol increased the odds of smoking almost six times (AOR=5.93; 95% CI: 4.44-7.91, $p < 0.001$), whereas having blood sugar measured reduced odds of smoking by nearly 50.0% (AOR=0.52; 95% CI: 0.15-0.46, $p = 0.026$). Adult Zambians with possible mental health problems who considered suicide during the past 12 months had higher odds of smoking tobacco (AOR=2.08; 95% CI: 1.34-3.22, $p = 0.001$).

Discussion

This study aimed to estimate the prevalence of tobacco smoking and examine the socio-demographic, behavior and psychological; and clinical characteristics associated with tobacco smoking among adults in Zambia. Overall 11.0 % reported smoking tobacco. Age, gender, educational attainment, alcohol consumption, mental health problems, and having blood sugar measured were associated with tobacco smoking.

This study shows that the prevalence of tobacco smoking in Zambia is of a public health concern and compared with previous national surveys; there has not been a significant overall reduction (Cosmas, 2022; Nyirenda et al., 2019; Olowski, 2016; S, 2009; Zulu, 2008) showing that there is need for implementation of interventions that impact behaviour change. As shown by the results of this study, of those who participated in the STEPS survey, 11.0% reported being current tobacco smokers. These findings are consistent with the previous surveys that have shown a national range of 6.8% to 11.89% (Cosmas, 2022; Nyirenda et al., 2019; Olowski P, 2016; S, 2009; Zulu R, 2008). Our estimate is slightly lower than what has been reported in other countries (Dickson et al., 2017), yet it remains notably higher than the tobacco smoking prevalence found in other sub-Saharan countries (Guliani et al., 2019; He et al., 2018). Overall, the prevalence of tobacco smokers was significantly higher in males than in females both in rural and urban areas. This is consistent with the previous studies conducted in Kitwe (Cosmas, 2013b), Lusaka (S, 2009; Seter, 2011); and Kaoma and Kasama (Mulenga, 2013). Our study also showed that the prevalence of tobacco smokers in rural areas was higher than the urban counterparts, this is in conformity with previous studies

(Nyirenda et al., 2019; Olowski, 2016; Seter, 2011).

Further, the results of this study have shown that the prevalence of tobacco smoking increases with age in both genders; and that the odds of tobacco smoking was found to increase among the older age group (45-59 and 60-69) as compared to the young group (18-29). This is consistent with studies in Zambia (Nyirenda et al., 2019; Olowski, 2016) Ghana (Doku et al., 2013), and Madagascar (Mamudu et al., 2013). The people who initiate smoking at an early stage in life are less likely to quit smoking later in life, the other plausible explanation is that older age may have had a long period of time of smoking hence developing habits towards it (Nash et al., 2017), as well as the ability to afford to buy tobacco products due to financial stability (Townsend et al., 1994). It could also be a lack of specific smoking cessation interventions that have targeted this segment of the population in Zambia.

In terms of the empirical literature, a plethora of studies have demonstrated an association between gender and tobacco smoking (Cosmas, 2022; Nyirenda et al., 2019; Olowski P, 2016; S, 2009; Zulu, 2008). Theilmann et al., (2022), examined household survey data from 82 low and middle income countries showed that women had less prevalence of tobacco smoking as compared to men in most of the countries. It's not surprising that women were less likely to smoke tobacco as compared to men, due to the presence of strong social norms and taboos that do not permit women to smoke tobacco (Yanaba et al., 2021). These social norms and taboos depict tobacco smoking among women as inappropriate while in men, it is acceptable and is a symbol of status and societal power (Lee et al., 2020). Not only did our study find a significant relationship between the level of education and tobacco smoking but also the odds of tobacco smoking was found to be decreasing with the level of education. This is consistent with previous studies both in developed and developing countries (Pampel, 2006; Ruokolainen et al., 2019) showing that social economic status might have a bearing on uptake of information and intervention to stop smoking. For instance, education equips an individual with knowledge and skills to make informed health behavior choices that have a positive effect on the individual's health (Nketiah-Amponsah et al., 2018). This entails that, an individual with higher education is less likely to make wrong health decisions regarding tobacco smoking.

After the multivariable adjustment, participants from the urban areas were less likely to smoke tobacco, although these findings were not statistically significant. Numerous studies have shown a significant relationship between residence and tobacco smoking (Cosmas, 2022; Nyirenda et al., 2019; Olowski P, 2016), although some review studies have not found consistency in this relationship (Garrusi et al., 2012). The plausible explanation could be that smokers in the rural areas were more likely to access tobacco and other products which are mostly grown in rural areas. Another explanation could be due to disparities in accessing health information in rural areas hence accounting for the residential differentials in tobacco smoking (Doku et al., 2013). Other factors could be at play but there is a need to investigate why there is an increase in use of tobacco products in rural

than urban areas.

In the context of numerous studies that have demonstrated an association between alcohol consumption and tobacco smoking (Cosmas, 2013a; Friedman et al., 1991), it's not surprising that more than three quarters (75%) of the tobacco smokers reported alcohol consumption. Our study showed that alcohol consumption was strongly associated with tobacco smoking, with those who consumed alcohol being six times more likely to smoke tobacco. Several mechanisms may contribute to the strong association between alcohol consumption and tobacco smoking. Swan et al., (1990) suggested that there is a genetic influence that explains a substantial portion of the covariance of both behaviors, while Niaura (1995) and others advance the stress-coping theory that suggests that alcohol and tobacco serve as a coping mechanism that helps an individual to regulate the emotions. On the other hand, Beard et al., (2017), showed that there was a positive association between prevalence of smoking and alcohol consumption that provides complimentary effect (Tauchmann, 2013), meaning that achieving a reduction in the smoking prevalence would yield health benefits that go beyond smoking such as a reduction in alcohol drinking as well. This implies that increasing prices taxes and laws on alcohol would have a complementary effect that will reduce the tobacco smoking prevalence as well.

We have further characterized the association of mental health problems and tobacco smoking (Cook et al., 2014; Zyambo et al., 2019), demonstrating that people who seriously considered suicide were twice more likely to smoke tobacco. The mechanisms that support persistently high rates of tobacco smoking among mentally ill individuals are complex and remain unstudied (Aubin et al., 2012), however, some theories suggest that individuals with mental illness may attribute greater benefit and reward value to tobacco smoking as compared to individuals without mental illness (Spring et al., 2003). Identifying specific interventions to address individuals with mental health problems should be a priority for the smoking cessation policy.

The strong relationship between tobacco smoking and NCDs such as cardiovascular diseases (Heart attack or Hypertension), diabetes mellitus, and high cholesterol has previously been documented (Freund et al., 1993), however in our study, after adjusting for socio-demographic, behavior and psychological and other clinical factors, only diabetes mellitus was associated with tobacco smoking in conformity with other studies (Willi et al., 2007). It was shown that diabetic individuals had a reduced odds of smoking nearly by 50.0%. The plausible explanation is that the individuals who were diagnosed with this disorder may be motivated to quit smoking or would have received more smoking cessation counseling from the health care providers (Twardella et al., 2006).

Strengths and limitations

Our study is not without some limitations. We were unable to assess changes in these factors over time. This being an observational design, we only were able to identify the factors associated with tobacco smoking and were unable to address causality. Although we adjusted

for known confounders in the multivariable model, the potential for the residual confounders inherent in observational studies still remains and might affect the interpretation of study outcomes. The data is based on the self-reported responses which might result in information bias related to misclassification of tobacco smoking. In addition, one cross-sectional study in Zambia has limited generalizability to other national or international settings. Our study however has the advantage of using the standardized questionnaire that enables evaluation of NCDs' risk factors including tobacco smoking in Zambia.

In conclusion, our study found that there are psychological and socio-economic factors that we can associate to tobacco smoking. This underscores the need to identify the determinants of smoking, thus informing health promotion and education interventions to improve tobacco smoking cessation and reduce tobacco-related comorbidities.

Author Contribution Statement

CZ: Conceptualization, Methodology, Analyzed the data, interpreted the findings, writing – original draft, writing – review & editing. PO: Data analysis, interpreted the findings, writing – review & editing. DM: writing – review & editing. PS: writing – review & editing. MM: writing – review & editing. AH: writing – review & editing. HH: writing – review & editing. SS: Conceptualization, Methodology, interpreted the findings, writing – review & editing. All authors read AND approved the final version of the manuscript.

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Ethical approval

The University of Zambia Research Ethics Committee (UNZABREC) approved the STEPS Survey and written informed consent was obtained from all the participants

Competing interest

The authors have no conflict of interest.

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