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## BMJ Open

## The Spatial Distribution and Correlates of Smoking in Zambia

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## SCHOLARONE ${ }^{\text {m }}$ <br> Manuscripts

## Title: The Spatial Distribution and Correlates of Smoking in Zambia

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#### Abstract

Objective: The objective of the paper was to investigate the spatial distribution and correlates of tobacco smoking in various regions of Zambia including provincial, Rural as well as urbans variations.

Design: This paper adopts a cross sectional study design Setting: The study used data from the 2013/2014 Zambia Demographic Health Survey (ZDHS) which is a National wide health survey conducted in all the 10 provinces. Participants: A random sample of 18,052 households across Zambia were selected from 722 clusters, of which 16,258 were occupied at the time of the fieldwork. Garbles

Results: The results show that $8.2 \%$ and $11 \%$ of Zambians in urban and rural areas smoke. In urban areas, the risk of being a cigarette smoker was 2.31 (CI: 1.69-3.16) and 2.03 (CI: 1.36-3.02) times higher for the divorced and separated while as in rural areas the risk was lower for the married (RRR: $0.69, \mathrm{CI}: 0.55-0.86$ ). The risk of being a cigarette smoker in urban and rural areas was lower for those with an education. Similarly, in rural areas, the risk of being a pipe \& other smoker was higher for those who were self-employed (RRR: 8.46, CI: 2.95 24.20) and with an occupation (RRR: 2.37, CI: 1.39-4.02) but was lower among women.


Conclusion: Tobacco smoking is a widely known modifiable risk factor for a number of non-communicable diseases and its association with a number of diseases has been clearly demonstrated. Therefore, interventions to curb smoking should target specific demographic, socio-economic and cultural factors and how they are spatially distributed.

Keywords: Smoking, Correlates, Urban, Rural, Tobacco, Relative Risk Ratios (RRR), spatial distribution

## Strengths and limitations of this study

- The paper used multinomial logistic regression and spatial distribution analysis to a measure the factors associated with smoking focusing on the various forms of smoking and regional differences.
- This paper assesses the status of forms or types (cigarette and other forms) of smoking fundamental to regions of Zambia.
- The paper builds a body of knowledge on the variations in smoking hence enhancing decision making on public health surveillance on smoking behaviour and the evaluation of policy and program development at regional level.
- The study is limited to the available data hence could not associate there correlates of smoking to health outcomes.


## Introduction

Smoking and other forms of tobacco use can cause a wide variety of diseases and can lead to death and is one of the common causes of preventable morbidity and mortality globally [1, 2]. Smoking is a risk factor for cardiovascular disease, lung cancer, and other forms of cancer, and it contributes to the severity of pneumonia, emphysema, and chronic bronchitis symptoms. The prevalence of smoking differs widely between populations in different localities which results in disparities at national, regional and global levels [3].

Studies in Zambia and elsewhere have had varied findings on rural and urban disparities on the influences of demographic characteristics on tobacco smoking [4]. In Zambia, having primary education decreased chances of female smoking and women living in rural areas had three-fold increase in likelihood of smoking compared to those in urban areas [5]. In Cameroon, Proctor et al reported no significant differences in smoking between children in rural and urban areas, but Finau et al reported significantly higher tobacco consumption in Tongan [6, 7]. Notably, in a report on Sub-Saharan African Countries, the greatest difference in current smoking prevalence between urban and rural areas was observed in Zambia were $22.4 \%$ in rural Zambia, compared to $6.8 \%$ in urban were tobacco smokers. Further, with regard to urban/rural differences, urban dwellers were more likely to be cigarette smokers while subjects living in rural areas were more often consumers of other forms of tobacco that are more accessible in these settings [8].

Age and Socioeconomic status in Zambia were influential determinants of tobacco smoking. According to the 2007 ZDHS, smoking prevalence among females aged 15-49 years old living in rural areas is three times higher than among females living in urban areas. Lower education and lower socioeconomic status were also found to be a significant predictor of smoking prevalence [9].

The paper was aimed at estimating correlates of tobacco smoking among Rural and urbans Zambians. The social demographic correlates included; age, province, region, years lived in place of residence, highest educational level, religion, wealth index, marital status, gender, occupation, sex of the household head, frequency of listening to radio and television and relationship to the household head. Understanding the correlates of smoking in rural and urban areas can contribute to filling the gap on how to deal with noncommunicable diseases such as smoking which generally develop over a long period and, if addressed at an early stage, are often preventable [10].

## Methods

Population characteristics and setting

Zambia covers a land area of 752,612 square kilometres. This study was conducted in Zambia's 10 provinces. The provinces include Central, Copperbelt, Eastern, Lusaka, Southern, Luapula, Muchinga, Northern, North-Western and Western Provinces.

Data source

This paper used data from the 2013/2014 Zambia Demographic Health Survey (ZDHS) which is a nationally representative sample survey of women and men of reproductive age designed to provide up-to-date information on health status and behaviour. This study adopted a cross sectional study design. The study was purely quantitative and was conducted through structured interviews. Three questionnaires were used and these
include; the Household Questionnaire, the Woman's Questionnaire, and the Man's Questionnaire. The three instruments were based on the questionnaires developed by the Demographic and Health Surveys Program and adapted to Zambia's specific data needs.

The 2013-14 ZDHS used an updated list of enumeration areas (EAs) for the 2010 Population and Housing Census as the sampling frame for the survey. The frame comprised 25,631 EAs and 2,815,897 households. An EA is a convenient geographical area with an average size of 130 households or 600 people. For each EA, information is available on its location, type of residence (rural or urban), number of households, and total population. Each EA has a cartographical map with delimited boundaries and main landmarks of the area. A 2013-14 ZDHS cluster is essentially representative of an EA. A representative sample of 18,052 households was drawn for the 2013-14 ZDHS to provide estimates at the national, provincial and regional (Rural/Urban) levels.

The survey used a two-stage stratified cluster sample design, with EAs (or clusters) selected during the first stage and households selected during the second stage. In the first stage, 722 EAs ( 305 in urban areas and 417 in rural areas) were selected with probability proportional to the size. The 10 provinces were stratified into 20 sampling strata and a complete list of households served as the sampling frame in the selection of households for enumeration with an average of 25 households being selected in each EA. Therefore, a random sample of 18,052 households across Zambia were selected were selected from 722 clusters, of which 16,258 were occupied at the time of the fieldwork. Of the occupied households, 15,920 were successfully interviewed, yielding a household response rate of 98 percent. "All women aged 15-49 and men aged 15-59 who were either permanent residents of the households or visitors present in the households on the night before the survey were eligible to be interviewed.

Measurement and definition

Dependent variable

Smoking in this paper refers to the act or habit of inhaling and exhaling the smoke of tobacco by men and women in rural and urban Zambia.

Independent variables

The independent variables include respondents; Age, Province, Region, Years lived in place of residence, Highest educational level, Religion, Wealth index, marital status, gender, occupation, sex of the household head, frequency of listening to radio and television and relationship to the household head.

Data analysis

Data analysis was done using Stata version 13 and the data was survey weighted to factor in population estimates. Bivariate analysis or Chi-square analysis was conducted in an attempt to describe and establish the relationship between smoking and socio-economic and demographic factors. A multivariate analysis involving multinomial logistic regression was conducted to ascertain the risk associated with smoking. Therefore, Relative Risk Ratios associated with smoking were generated for the socio-economic and demographic factors that were significant at bivariate analysis (Chi-square). The study also conducted a spatial distribution analysis indicating the regional differences in tobacco smoking.

## Patient and Public Involvement

This was a household survey which involved the participation of the general public. Participants are made aware of the study results through publication and statistical bulletins. There were no patients involved in the study.

Ethical Consideration

The paper used secondary data hence posed no risk or harm to the respondents. The data did not contain any of the respondent's names nor traces of the respondents. This paper, therefore holds respondents information with the highest confidentiality. Permission to use the data was sought from Central Statistics Office (CSO) Zambia and approval to use the data was granted. However, in the parent study, participants gave informed consent and participation was voluntary.

## Results

## Socio-economic and Demographic Characteristics

In the interviewed households, a total of 17,064 women aged 15-49 were identified as eligible for individual interviews, and 96 percent of these women were successfully interviewed. A total of 16,209 men aged 15-59 were identified as eligible for interviews, and 91 percent were successfully interviewed. The results reveal that $46.1 \%$ of Zambians live in urban areas while $53.9 \%$ live in rural areas. In the urban area, $22.6 \%$ of the study participants were aged between 15 to 19 years. Almost half ( $49.1 \%$ ) were married, about 6 in $10(59.2 \%)$ had a secondary school education, over half ( $52.7 \%$ ) were females, over three quarters $(78.4 \%)$ were protestants, $85.8 \%$ were rich (upper wealth quintile), 4 in $10(40.6 \%)$ were not working, $45.4 \%$ listened to the radio almost every day and 6 in $10(60.4 \%)$ watched television almost every day, $31 \%$ were the household heads and over three quarters ( $78.1 \%$ ) of the households were male headed households.

In the rural area, $22.1 \%$ of the study participants were aged between 15 to19 years. Close to two thirds ( $64 \%$ ) were married, over half ( $58.2 \%$ ) had a primary school education, slightly over half ( $52.5 \%$ ) were females, about 8 in $10(80.3 \%)$ were protestants, $61.1 \%$ were poor, over one third $(36.5 \%)$ were employed in the agriculture sector, $36.5 \%$ never listened to the radio and almost three quarters $(72.4 \%)$ never watched television, over one third were ( $35.5 \%$ ) were household heads and eight in ten $(81.1 \%)$ of the households were male headed households.

Prevalence of smoking
The results show that only $8.2 \%$ of Zambians in urban areas smoke. However, $8.1 \%$ were cigarette smokers and only $0.1 \%$ smoked pipe and other. With regards to gender, $16.7 \%$ of the males smoked cigarette compared to only $0.3 \%$ of females. Results also showed that $11 \%$ of Zambians in rural areas smoke. All the same, $10.7 \%$ were cigarette smokers and only $0.3 \%$ smoked pipe and other. With regards to gender, $21.8 \%$ of the males smoked cigarette compared to only $0.6 \%$ of females

Spatial distribution of cigarette smoking
The figure below shows the spatial distribution of cigarette smoking in Zambia. The prevalence of cigarette smoking was highest in Eastern and Luapula provinces and Lowest in Western and Muchinga Province in Zambia, (Figure 1).

Figure 1: Spatial distribution of cigarette smoking by province
Cigarette Smoking


Chi-square: Association between smoking and socio-economic and demographic factors
The chi-square results indicate that there was a statistical significant association between smoking status and the following factors; age, marital status, province, education status, sex, religion, wealth index, occupation, frequency of listening to the radio and watching television, respondents relationship to the household head and sex of the household head for both rural and urban areas, (Table 1 and Table 2).

Table1: Percentage distribution and association between smoking, socio-economic and demographic factors in urban Zambia

| Urban |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Smoking status |  |  |  |  |  |  |  |
|  | NonSmokers | NonSmokers | Cigarette Smokers | Cigarette Smokers | Pipe \& Other Smokers | Pipe \& Other Smokers | Population estimates |
|  | \% | 95\% CI | \% | 95\% CI | \% | 95\% CI |  |
| age in 5-year groups |  |  |  |  |  |  |  |
| 15-19 | 98.2 | [97.4-98.8] | 1.8 | [1.2-2.6] |  |  | 3,258 |
| 20-24 | 93.5 | [92.3-94.5] | 6.5 | [5.4-7.7] |  |  | 2,748 |
| 25-29 | 90.4 | [88.4-92.1] | 9.6 | [7.9-11.6] |  |  | 2,281 |
| 30-34 | 89.1 | [87.3-90.6] | 10.7 | [9.2-12.5] | 0.2 | [0.1-0.7] | 2,066 |
| 35-39 | 90.7 | [88.4-92.5] | 9 | [7.1-11.3] | 0.3 | [0.1-0.9] | 1,626 |


| $40-44$ | 87.1 | $[84.2-89.6]$ | 12.8 | $[10.4-15.8]$ | 0.1 | $[0.0-0.3]$ | 1,157 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $45-49$ | 88.1 | $[84.7-90.8]$ | 11.9 | $[9.2-15.2]$ |  | 777 |  |
| $50-54$ | 77.5 | $[70.0-83.5]$ | 22.5 | $[16.5-30.0]$ |  | 286 |  |
| $55-59$ | 81.5 | $[73.6-87.4]$ | 18.5 | $[12.6-26.4]$ |  | 191 |  |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,388 |

Pearson: Uncorrected chi2(16) $=405.5742$
Design-based $\mathrm{F}(12.31,3631.48)=16.2815$ P-value $<0.001$

| Marital Status |  |  |  |  |  |  | 5,888 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Never in union | 94 | $[93.0-94.8]$ | 6 | $[5.2-7.0]$ |  |  |  |
| Married | 90.7 | $[89.7-91.5]$ | 9.2 | $[8.3-10.2]$ | 0.1 | $[0.1-0.3]$ | 7,064 |
| Living with partner | 91.2 | $[80.9-96.2]$ | 8.8 | $[3.8-19.1]$ |  |  | 87 |
| Widowed | 95.2 | $[90.6-97.6]$ | 4.8 | $[2.4-9.4]$ |  | 385 |  |
| Divorced | 87.4 | $[83.7-90.3]$ | 12.5 | $[9.6-16.2]$ | 0.1 | $[0.0-0.3]$ | 668 |
| No longer living |  |  |  |  |  |  |  |
| Together $/$ separated | 84.4 | $[78.1-89.1]$ | 15.5 | $[10.8-21.7]$ | 0.1 | $[0.0-0.8]$ | 296 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,388 |

Pearson: Uncorrected chi2(10) $=100.3434$
Design-based F(6.95, 2051.56) $=7.1598$ P-value $<0.001$

| Province |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Central | 92.8 | $[90.3-94.7]$ | 7.1 | $[5.2-9.6]$ | 0.1 | $[0.0-0.9]$ | 742 |
| Copperbelt | 90.2 | $[88.5-91.7]$ | 9.7 | $[8.2-11.5]$ | 0.1 | $[0.0-0.4]$ | 4,572 |
| Eastern | 93.2 | $[91.1-94.9]$ | 6.7 | $[5.1-8.8]$ | 0.1 | $[0.0-0.4]$ | 524 |
| Luapula | 90.4 | $[88.0-92.4]$ | 9.5 | $[7.5-11.9]$ | 0.1 | $[0.0-0.6]$ | 462 |
| Lusaka | 93 | $[91.9-93.9]$ | 7 | $[6.0-8.1]$ |  |  | 5,545 |
| Muchinga | 92.5 | $[90.1-94.3]$ | 7.2 | $[5.5-9.4]$ | 0.3 | $[0.1-0.9]$ | 350 |
| Northern | 89.3 | $[86.8-91.4]$ | 10.7 | $[8.6-13.2]$ |  |  | 473 |
| North western | 93.7 | $[92.0-95.0]$ | 5.7 | $[4.4-7.5]$ | 0.6 | $[0.3-1.3]$ | 363 |
| Southern | 93.1 | $[91.3-94.5]$ | 6.9 | $[5.5-8.7]$ |  |  | 986 |
| Western | 90.7 | $[88.0-92.9]$ | 8.9 | $[6.8-11.6]$ | 0.4 | $[0.1-1.0]$ | 371 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,388 |
|  |  |  |  |  |  |  |  |
| Pearson: Uncorrected chi2(18) $=59.9506$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(9.62,2838.63)=$ | $=2.7270$ P-value $=0.003$ |  |  |  |  |  |  |

Education Status

| No education | 93.4 | $[89.6-95.9]$ | 6.6 | $[4.1-10.4]$ |  | 335 |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Primary | 89.3 | $[88.0-90.5]$ | 10.6 | $[9.4-11.8]$ | 0.2 | $[0.1-0.4]$ | 3,853 |
| Secondary | 92.4 | $[91.6-93.1]$ | 7.6 | $[6.8-8.4]$ | 0.1 | $[0.0-0.2]$ | 8,510 |
| Higher | 94.8 | $[93.2-96.0]$ | 5.2 | $[4.0-6.7]$ |  |  | 1,686 |
| Total | 91.9 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,384 |

Pearson: Uncorrected chi2(6) $=60.3249$
Design-based F(5.20, 1534.67) $=7.7282$ P-value $<0.001$

| Sex |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Male | 83.1 | $[81.6-84.5]$ | 16.7 | $[15.3-18.2]$ | 0.2 | $[0.1-0.3]$ | 6,803 |


| Female | 99.7 | [99.5-99.8] | 0.3 | [0.2-0.5] |  |  | 7,585 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |
| Pearson: Uncorrected chi2 2 ) $=1340.6624$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(1.95,574.01)=571.3623$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Religion |  |  |  |  |  |  |  |
| Catholic | 88.5 | [86.7-90.1] | 11.5 | [9.8-13.3] | 0.1 | [0.0-0.1] | 2,830 |
| Protestant | 92.9 | [92.2-93.6] | 7 | [6.4-7.7] | 0.1 | [0.0-0.2] | 11,249 |
| Muslim | 86.8 | [76.2-93.1] | 13.2 | [6.9-23.8] |  |  | 194 |
| Other | 70.9 | [53.8-83.6] | 29.1 | [16.4-46.2] |  |  | 82 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,356 |
| Pearson: Uncorrected chi2(6) $=119.4077$ |  |  |  |  |  |  |  |
| Design-based F $(2.89,851.69)=6.5833$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Wealth Index |  |  |  |  |  |  |  |
| Poor | 82 | [78.5-85.0] | 17.8 | [14.8-21.3] | 0.2 | [0.1-0.6] | 384 |
| Middle | 86.2 | [84.1-88.0] | 13.7 | [11.9-15.8] | 0.1 | [0.0-0.3] | 1,667 |
| Rich | 92.9 | [92.2-93.6] | 7 | [6.3-7.7] | 0.1 | [0.0-0.2] | 12,338 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |
| Pearson: Uncorrected chi2(4) $=143.9332$ <br> Design-based F $(2.90,855.70)=41.9643$ P-value $<0.001$ |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Occupation |  |  |  |  |  |  |  |
| Not working | 98.1 | [97.4-98.6] | 1.9 | [1.4-2.6] |  |  | 5,815 |
| Professional/technical | 95.9 | [94.1-97.2] | 4.1 | [2.8-5.9] |  |  | 881 |
| Clerical | 92.4 | [90.9-93.6] | 7.5 | [6.3-8.9] | 0.1 | [0.0-0.4] | 3,560 |
| Agricultural - self employed | 81.7 | [74.0-87.5] | 18.2 | [12.4-25.9] | 0.1 | [0.0-0.8] | 165 |
| Agricultural - employee | 84.6 | [81.5-87.2] | 15.3 | [12.7-18.4] | 0.1 | [0.0-0.4] | 752 |
| Services | 86.4 | [82.3-89.7] | 13.6 | [10.3-17.7] |  |  | 655 |
| Skilled manual | 79.6 | [76.6-82.3] | 20.2 | [17.5-23.2] | 0.2 | [0.1-0.4] | 1,354 |
| Unskilled manual | 77.5 | [71.9-82.3] | 22.3 | [17.6-27.9] | 0.2 | [0.0-0.6] | 540 |
| Other | 82 | [76.8-86.3] | 17.5 | [13.2-22.8] | 0.5 | [0.1-2.7] | 615 |
| Total | 91.9 | [91.2-92.6] | 8 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,336 |

Pearson: Uncorrected chi2(16) $=956.0431$
Design-based $\mathrm{F}(9.70,2862.46)=36.6685 \mathrm{P}$-value $<0.001$

Frequency of listening to radio

| Not at all | 94.7 | $[93.3-95.8]$ | 5.3 | $[4.2-6.7]$ |  | 2,944 |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Less than once a week | 91.3 | $[89.1-93.1]$ | 8.5 | $[6.8-10.7]$ | 0.1 | $[0.1-0.4]$ | 1,682 |
| At least once a week | 90.3 | $[88.7-91.7]$ | 9.7 | $[8.3-11.2]$ |  | $[0.0-0.1]$ | 3,220 |
| Almost every day | 91.4 | $[90.3-92.5]$ | 8.4 | $[7.4-9.6]$ | 0.1 | $[0.1-0.3]$ | 6,529 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,375 |

Pearson: Uncorrected chi2(6) $=51.3026$

Frequency of watching television

| Not at all | 90.4 | $[88.8-91.7]$ | 9.5 | $[8.2-11.1]$ | 0.1 | $[0.0-0.2]$ | 2,805 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Less than once a week | 83.4 | $[80.5-86.0]$ | 16.5 | $[13.9-19.4]$ | 0.1 | $[0.0-0.4]$ | 1,118 |
| At least once a week | 88.8 | $[86.2-90.9]$ | 11.2 | $[9.1-13.8]$ |  | $[0.0-0.1]$ | 1,763 |
| Almost every day | 94 | $[93.2-94.8]$ | 5.9 | $[5.1-6.8]$ | 0.1 | $[0.0-0.2]$ | 8,689 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,375 |

Pearson: Uncorrected chi2(6) $=198.0866$
Design-based $\mathrm{F}(4.21,1241.79)=22.6512 \mathrm{P}$-value $<0.001$

Relationship to household head

| Head | 84.6 | [82.9-86.1] | 15.2 | [13.7-16.8] | 0.2 | [0.1-0.5] | 4,463 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Spouse | 99.1 | [98.6-99.5] | 0.8 | [0.5-1.4] | 0.1 | [0.0-0.2] | 3,448 |
| Son/Daughter | 99.6 | [98.9-99.8] | 0.4 | [0.2-1.1] |  |  | 1,568 |
| Daughter-in-law | 87 | [84.6-89.0] | 13 | [11.0-15.4] |  |  | 1,748 |
| Granddaughter/son | 97.9 | [94.1-99.3] | 2.1 | [0.7-5.9] |  |  | 252 |
| Father/Mother | 90.5 | [84.8-94.3] | 9.2 | [5.5-14.9] | 0.3 | [0.1-1.1] | 228 |
| Father/Mother-in-law | 69.3 | [25.0-93.9] | 30.7 | [6.1-75.0] |  |  | 7 |
| Brother/Sister | 100 |  |  |  |  |  | 330 |
| Co-spouse | 82.6 | [75.2-88.2] | 17.2 | [11.7-24.6] | 0.1 | [0.0-0.7] | 328 |
| Other relative | 94.4 | [91.4-96.4] | 5.6 | [3.6-8.6] |  |  | 813 |
| Adopted/foster child | 93.5 | [87.0-96.9] | 6.5 | [3.1-13.0] |  |  | 176 |
| Not related | 88.5 | [83.8-92.0] | 11.4 | [8.0-16.1] | 0.1 | [0.0-0.5] | 371 |
| Niece/nephew by blood | 96.2 | [92.8-98.1] | 3.8 | [1.9-7.2] |  |  | 400 |
| Niece/nephew by marriage | 92.4 | [87.8-95.3] | 7.6 | [4.7-12.2] |  |  | 254 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,385 |
| Pearson: Uncorrected chi2(26) $=872.7312$ |  |  |  |  |  |  |  |
| Design-based F(16.59, 4893.34) $=20.5155$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Sex of household head |  |  |  |  |  |  |  |
| Male | 91.3 | [90.5-92.1] | 8.6 | [7.8-9.4] | 0.1 | [0.0-0.2] | 11,233 |
| Female | 93.8 | [92.4-95.0] | 6.2 | [5.0-7.6] |  |  | 3,155 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |

Pearson: Uncorrected chi2(2) $=21.3809$
Design-based F(1.37, 402.84) $=7.7563$ P-value $=0.002$

Table2: Percentage distribution and association between smoking, socio-economic and demographic factors in rural Zambia

| Rural |
| :---: | :---: |
| smoking |


|  | Non- <br> Smokers | Non- <br> Smokers | Cigarette <br> Smokers | Cigarette <br> Smokers |  <br> Other <br> Smokers |  <br> Other <br> Smokers | Population <br> estimates |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| age in 5-year groups | \% | $\mathbf{9 5 \%} \mathbf{C I}$ | $\boldsymbol{\%}$ | $\mathbf{9 5 \%} \mathbf{C I}$ | $\mathbf{\%}$ | $\mathbf{9 5 \%} \mathbf{\text { CI }}$ |  |
| $\mathbf{1 5 - 1 9}$ |  |  |  |  |  |  |  |
| $20-24$ | 98.7 | $[98.2-99.0]$ | 1.3 | $[1.0-1.8]$ |  |  | 3,705 |
| $25-29$ | 94.5 | $[93.4-95.4]$ | 5.4 | $[4.5-6.5]$ | 0.1 | $[0.0-0.3]$ | 2,591 |
| $30-34$ | 88.9 | $[87.6-90.1]$ | 10.7 | $[9.5-12.1]$ | 0.4 | $[0.2-0.7]$ | 2,477 |
| $35-39$ | 87.6 | $[85.9-89.0]$ | 11.9 | $[10.5-13.5]$ | 0.5 | $[0.3-1.0]$ | 2,337 |
| $40-44$ | 86.8 | $[84.9-88.5]$ | 12.7 | $[11.1-14.6]$ | 0.5 | $[0.2-0.9]$ | 2,047 |
| $45-49$ | 83.1 | $[81.1-84.9]$ | 16.3 | $[14.5-18.3]$ | 0.6 | $[0.3-1.2]$ | 1,691 |
| $50-54$ | 77.5 | $[74.8-79.9]$ | 21.8 | $[19.4-24.4]$ | 0.7 | $[0.4-1.3]$ | 1,210 |
| $55-59$ | 65 | $[59.5-70.1]$ | 33.8 | $[28.6-39.3]$ | 1.3 | $[0.5-3.4]$ | 415 |
| Total | 62.7 | $[56.7-68.3]$ | 37.1 | $[31.5-43.1]$ | 0.2 | $[0.0-1.4]$ | 319 |
|  | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2(16) $=1130.6582$
Design-based F(13.80, 5601.60) $=67.4280$ P-value $<0.001$

| Marital Status |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| never in union | 95.4 | $[94.7-96.1]$ | 4.5 | $[3.8-5.2]$ | 0.1 | $[0.0-0.2]$ | 4,683 |
| married | 86.2 | $[85.4-86.9]$ | 13.4 | $[12.7-14.1]$ | 0.4 | $[0.3-0.6]$ | 10,744 |
| living with partner | 87 | $[77.8-92.8]$ | 11.5 | $[5.8-21.6]$ | 1.4 | $[0.4-5.2]$ | 99 |
| widowed | 92.6 | $[88.5-95.4]$ | 6.6 | $[4.0-10.7]$ | 0.8 | $[0.2-3.1]$ | 280 |
| divorced | 87 | $[84.3-89.3]$ | 12.5 | $[10.2-15.3]$ | 0.5 | $[0.2-1.3]$ | 733 |
|  |  |  |  |  |  |  |  |
| No longer living together/separated | 90.1 | $[86.0-93.1]$ | 9.9 | $[6.9-14.0]$ |  |  | 254 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2(10) $=290.4825$
Design-based $\mathrm{F}(9.16,3720.36)=27.5671 \mathrm{P}$-value $<0.001$

| Region | 91.6 | $[89.6-93.2]$ | 8.3 | $[6.7-10.3]$ | 0.1 | $[0.0-0.4]$ | 1,985 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Central | 87.4 | $[84.7-89.7]$ | 12.4 | $[10.1-15.1]$ | 0.2 | $[0.0-0.9]$ | 876 |
| Copperbelt | 88.8 | $[87.6-89.9]$ | 11 | $[10.0-12.2]$ | 0.2 | $[0.0-0.6]$ | 3,266 |
| Eastern | 85 | $[83.3-86.6]$ | 14.9 | $[13.3-16.7]$ | 0.1 | $[0.0-0.3]$ | 1,610 |
| Luapula | 90.4 | $[88.4-92.0]$ | 9.4 | $[7.8-11.4]$ | 0.2 | $[0.1-0.8]$ | 765 |
| Lusaka | 86.9 | $[84.6-88.9]$ | 12.7 | $[10.7-15.1]$ | 0.4 | $[0.2-0.8]$ | 1,280 |
| Muchinga | 87.6 | $[85.9-89.0]$ | 12.3 | $[10.8-13.9]$ | 0.1 | $[0.0-0.6]$ | 1,774 |
| Northern | 90.5 | $[88.6-92.2]$ | 7.5 | $[5.9-9.4]$ | 2 | $[1.4-2.8]$ | 958 |
| North-Western | 92.9 | $[91.1-94.3]$ | 6.9 | $[5.6-8.5]$ | 0.2 | $[0.0-0.9]$ | 2,932 |
| Southern | 84.7 | $[82.2-86.9]$ | 14.1 | $[12.0-16.5]$ | 1.2 | $[0.7-2.2]$ | 1,346 |
| Western | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2(18) $=239.2696$
Design-based F(13.85, 5624.85) $=9.9583$ P-value $<0.001$

## Educational status

| No education | 88.7 | $[87.0-90.3]$ | 10.9 | $[9.4-12.7]$ | 0.4 | $[0.2-0.7]$ | 1,599 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Primary | 87.8 | $[87.0-88.6]$ | 11.9 | $[11.1-12.6]$ | 0.3 | $[0.2-0.5]$ | 9,770 |
| Secondary | 90.9 | $[90.0-91.8]$ | 8.7 | $[7.8-9.6]$ | 0.4 | $[0.3-0.6]$ | 5,077 |
| Higher | 94.9 | $[92.2-96.7]$ | 5.1 | $[3.3-7.8]$ |  |  | 330 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,776 |
|  |  |  |  |  |  |  |  |
| Pearson: Uncorrected chi2(6) $=48.0492$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(5.41,2198.19)=7.1355$ | P-value $<0.001$ |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Sex | 77.4 | $[76.2-78.6]$ | 21.8 | $[20.7-23.1]$ | 0.7 | $[0.5-1.0]$ | 7,969 |
| Male | 99.4 | $[99.1-99.6]$ | 0.6 | $[0.4-0.8]$ |  |  | 8,823 |
| Female | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |
| Total |  |  |  |  |  |  |  |

Pearson: Uncorrected chi2(2) $=2024.5843$
Design-based F(1.59, 645.90) $=866.1712$ P-value $<0.001$

## Religion

| Catholic | 86.7 | $[85.2-88.1]$ | 13 | $[11.7-14.5]$ | 0.3 | $[0.1-0.5]$ | 3,103 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Protestant | 89.8 | $[89.2-90.4]$ | 9.8 | $[9.3-10.5]$ | 0.4 | $[0.3-0.5]$ | 13,438 |
| Muslim | 72.2 | $[49.8-87.1]$ | 23.6 | $[10.4-45.2]$ | 4.2 | $[0.6-25.7]$ | 30 |
| Other | 71.4 | $[63.3-78.3]$ | 28.6 | $[21.7-36.7]$ |  |  | 166 |
| Total | 89 | $[88.4-89.6]$ | 10.6 | $[10.1-11.2]$ | 0.4 | $[0.3-0.5]$ | 16,736 |

Pearson: Uncorrected chi2(6) $=100.7914$
Design-based F(5.62, 2281.12) $=13.6607$ P-value $<0.001$

| Wealth index | 86.3 | $[85.5-87.0]$ | 13.2 | $[12.5-14.0]$ | 0.5 | $[0.4-0.7]$ | 10,253 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Poor | 93 | $[92.0-93.8]$ | 6.9 | $[6.1-7.8]$ | 0.1 | $[0.1-0.3]$ | 4,197 |
| Middle | 93.7 | $[92.4-94.7]$ | 6.3 | $[5.2-7.5]$ | 0.1 | $[0.0-0.3]$ | 2,342 |
| Rich | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2(4) $=196.4984$
Design-based F(3.88, 1573.92) $=48.2620$ P-value $<0.001$

| Occupation <br> Not working | 97.5 | $[96.9-98.1]$ | 2.4 | $[1.9-3.1]$ | 0.1 | $[0.0-0.2]$ | 4,855 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |
| Professional/technical | 89.1 | $[82.9-93.3]$ | 10.9 | $[6.7-17.1]$ |  |  | 289 |
| Clerical | 93.4 | $[91.7-94.7]$ | 6.5 | $[5.1-8.1]$ | 0.2 | $[0.1-0.6]$ | 1,444 |
|  |  |  |  |  |  |  |  |
| Agricultural - self employed | 83.6 | $[81.6-85.5]$ | 15.5 | $[13.6-17.5]$ | 0.9 | $[0.6-1.3]$ | 2,942 |
|  |  |  |  |  |  |  |  |
| Agricultural - employee | 85.3 | $[84.2-86.4]$ | 14.4 | $[13.3-15.5]$ | 0.3 | $[0.1-0.5]$ | 6,112 |
| Services | 80.2 | $[72.1-86.4]$ | 18.3 | $[12.4-26.2]$ | 1.5 | $[0.3-7.1]$ | 129 |
| Skilled manual | 77.7 | $[73.3-81.5]$ | 21.9 | $[18.1-26.3]$ | 0.4 | $[0.1-1.3]$ | 582 |
| Unskilled manual | 80.1 | $[72.2-86.2]$ | 18.6 | $[12.7-26.4]$ | 1.3 | $[0.3-5.4]$ | 144 |
| Other | 85.5 | $[79.9-89.7]$ | 12.7 | $[8.7-18.1]$ | 1.9 | $[0.8-4.5]$ | 240 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,737 |

Pearson: Uncorrected chi2(16) $=688.4888$
Design-based F(11.23, 4559.07) $=32.9800$ P-value $<0.001$

| Frequency of listening to radio |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Not at all | 91.6 | $[90.7-92.4]$ | 8.2 | $[7.4-9.1]$ | 0.2 | $[0.1-0.4]$ | 6,119 |
| Less than once a week | 84.8 | $[83.0-86.4]$ | 14.7 | $[13.1-16.4]$ | 0.5 | $[0.3-0.9]$ | 2,100 |
| At least once a week | 87.7 | $[86.3-89.1]$ | 11.9 | $[10.6-13.3]$ | 0.4 | $[0.2-0.7]$ | 3,143 |
| Almost every day | 88.4 | $[87.4-89.3]$ | 11.2 | $[10.3-12.1]$ | 0.4 | $[0.3-0.7]$ | 5,415 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,778 |

Pearson: Uncorrected chi2(6) $=87.1177$
Design-based F(5.56, 2255.47) $=13.0440$ P-value $<0.001$

## Frequency of watching television

| Not at all | 89.2 | $[88.5-89.9]$ | 10.4 | $[9.7-11.1]$ | 0.4 | $[0.3-0.5]$ | 12,140 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Less than once a week | 82.4 | $[80.2-84.4]$ | 17.3 | $[15.3-19.5]$ | 0.3 | $[0.1-0.7]$ | 1,764 |
| At least once a week | 90.2 | $[88.2-91.9]$ | 9.4 | $[7.8-11.4]$ | 0.4 | $[0.1-1.0]$ | 1,320 |
| Almost every day | 93.1 | $[91.6-94.4]$ | 6.7 | $[5.5-8.2]$ | 0.1 | $[0.0-0.4]$ | 1,553 |
| Total | 89 | $[88.4-89.5]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,778 |

Pearson: Uncorrected chi2(6) $=110.4672$
Design-based F(5.55, 2251.39) $=16.6299$ P-value $<0.001$

| Relationship to household head |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Head | 75.4 | [74.0-76.7] | 23.8 | [22.5-25.1] | 0.8 | [0.6-1.1] | 5,953 |
| Spouse | 98.3 | [97.8-98.7] | 1.6 | [1.3-2.2] | 0.1 | [0.0-0.2] | 5,115 |
| Son/Daughter | 99.5 | [98.8-99.8] | 0.5 | [0.2-1.2] |  |  | 1,695 |
| Daughter-in-law | 93.5 | [92.1-94.6] | 6.4 | [5.2-7.7] | 0.1 | [0.1-0.4] | 2,027 |
| Granddaughter/son | 94.9 | [91.3-97.0] | 5.1 | [3.0-8.7] | 0 |  | 304 |
| Father/Mother | 89.2 | [84.3-92.7] | 10.3 | [6.8-15.1] | 0.6 | [0.1-2.3] | 262 |
| Father/Mother-in-law |  |  | 100 |  |  |  | 2 |
| Brother/Sister | 100 |  |  |  |  |  | 107 |
| Co-spouse | 80.1 | [72.3-86.2] | 19.9 | [13.8-27.7] |  |  | 174 |
| Other relative | 96.8 | [94.8-98.0] | 2.6 | [1.5-4.5] | 0.6 | [0.2-1.9] | 400 |
| Adopted/foster child | 98.7 | [94.6-99.7] | 1.3 | [0.3-5.4] |  |  | 151 |
| Not related | 83.2 | [77.1-87.9] | 16.2 | [11.6-22.3] |  | [0.1-4.1] | 251 |
| Niece/nephew by blood | 96 | [91.7-98.1] | 3.8 | [1.7-8.0] | 0.3 | [0.0-1.8] | 220 |
| Niece/nephew by marriage | 88.6 | [81.1-93.3] | 11.4 | [6.7-18.9] |  |  | 131 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |
| Pearson: Uncorrected chi2(26) $=1885.3640$ |  |  |  |  |  |  |  |
| Design-based F $(20.98,8518.16)=56.9133$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Sex of household head |  |  |  |  |  |  |  |
| Male | 87.9 | [87.2-88.6] | 11.7 | [11.1-12.4] | 0.4 | [0.3-0.5] | 13,733 |
| Female | 93.8 | [92.7-94.7] | 6 | [5.1-7.1] | 0.2 | [0.1-0.4] | 3,059 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |

Multinomial Logistic regression: Correlates of smoking in rural and urban Zambia- (Relative Risk Ratios(RRR))

After conducting a multinomial logistic regression and controlling for predictor variables, results shows that the relative risk of being a cigarette smoker vs a non-smoker increases with each additional age group in both urban and rural areas. In urban areas, the risk of being a cigarette smoker was 3.44 (CI: 1.48-7.96), 1.55 (CI: $1.25-1.93$ ) and 2.08 (CI: 1.24-3.49) times higher for sons/daughters, Son/Daughter-in-Law and Niece/Nephew by Marriage to the household head relative to the head of the household respectively compared to rural areas were the risk was 0.66 (CI: $0.51-0.85$ ) and 0.49 (CI: $0.26-0.89$ ) lower for Son/Daughter-in-Law and other related to the household head respectively. Similarly in urban areas, the risk of being a cigarette smoker vs a non-smoker was 2.31 (CI: 1.69-3.16) and 2.03 (CI: 1.36-3.02) times higher for the divorced and separated relative to the never married respectively were as in rural areas the risk was lower for the married (RRR: $0.69, \mathrm{CI}: 0.55-0.86$ ) and those living with a partner (RRR: $0.45, \mathrm{CI}: 0.23-0.90$ ) relative to the never married. Further, the risk of being a cigarette smoker vs a non-smoker for urban residents was higher for those working or with an occupation relative to those who were not doing anything. On the contrary, the risk of being a cigarette smoker vs a non-smoker in both urban and rural was lower for the following; those with an education relative to those with no form of education; Protestants relative to Catholics and lastly the middle income class as well as the rich relative to the poor, (Table 3).

Table3: Correlates of smoking in rural and urban Zambia-Multinomial logistic regression (Relative Risk Ratios-(RRR))

|  |  | Urban | Rural |
| :---: | :---: | :---: | :---: |
|  |  | Relative Risk Ratio (RRR) |  |
| Base outcome | Non Smokers |  |  |
|  | Cigarette Smokers |  |  |
| Age |  |  |  |
|  | 15-19 | 1 | 1 |
|  | 20-24 | 4.33*** | 5.77*** |
|  |  | (3.08-6.09) | (4.08-8.15) |
|  | 25-29 | 9.27*** | $12.97^{* * *}$ |
|  |  | (6.51-13.22) | (9.00-18.68) |
|  | 30-34 | 9.16 *** | 13.82*** |
|  |  | (6.3-13.2) | (9.47-20.16) |
|  | 35-39 | 7.71*** | 15.21*** |
|  |  | (5.28-11.25) | (10.38-22.28) |
|  | 40-44 | 9.95*** | 19.96*** |
|  |  | (6.75-14.67) | (13.63-29.25) |
|  | 45-49 | 10.96*** | 28.52*** |
|  |  | (7.28-16.51) | (19.31-42.13) |
|  | 50-54 | $8.96 * * *$ | $22.00 * * *$ |



[^0]

Confidence Interval (CI) in parentheses
${ }^{* * *} \mathrm{p}<0.01,{ }^{* *} \mathrm{p}<0.05,{ }^{*} \mathrm{p}<0.1$

On the other hand, table 4 shows that the risk of being a pipe $\&$ other smoker vs a non-smoker increases with each additional age in rural areas. In urban areas, the risk of being a pipe \& other smoker was higher for fathers/mothers to the household head (RRR: 14.29, CI: 1.66-122.79) relative to the head of the household. Similarly, in rural areas, the risk of being a pipe \& other smoker was higher for those who were selfemployed (RRR: 8.46, CI: 2.95-24.20) or with an occupation (RRR: 2.37, CI: 1.39-4.02) relative to those who were not doing anything and was higher for Muslims (RRR: 18.55, CI: 1.81-189.77) relatives to Catholics. Conversely, in urban areas, the risk of being a pipe \& other smoker was lower for those with a primary education (RRR: 0.36, CI: 0.11 - 1.16) relative to those without any form of education; and for protestants (RRR: 0.39, CI: 0.14 - 1.11) relative to Catholics. Similarly, in rural areas, the risk of being a pipe $\&$ other smoker was lower for those in the middle income (RRR: 0.31, CI: $0.14-0.67$ ) and rich (RRR: 0.16, CI: 0.04-0.73) relative to the poor. However, in both urban and rural, the risk of being a pipe \& other smoker was lower for women relative to men, (Table 4).

Table 4: Correlates of smoking in rural and urban Zambia-Multinomial logistic regression (Relative Risk Ratios-(RRR))

|  |  | Urban |
| :--- | :--- | :---: |
|  |  | Rural |
| Base outcome | Non Smokers |  |
| Pipe \& Other Smokers |  |  |
|  | $15-19$ | $14.71^{* * *}$ |



[^1]${ }^{* * *} \mathrm{p}<0.01,{ }^{* *} \mathrm{p}<0.05,{ }^{*} \mathrm{p}<0.1$

## Discussion

The findings of our current study indicate that the prevalence of smoking in Zambia is a notable public health problem and it is consistent with the prevailing prevalence in Sub-Saharan Africa [11]. The overall prevalence of smoking in our current study is slightly higher in the overall urban Zambia compared to the prevalence obtained in Lusaka alone, the capital city of Zambia by Siziya et al [12]. The prevalence of male cigarette smokers in our study was high compared to that of females both in the rural and urban areas. This is consistent with the findings of Siziya et al in Lusaka [12] and of Zyaambo et al in Kitwe, the mining city of Zambia (13) and of Mulenga et al in Kaoma and Kasama, rural towns in Zambia [14]. To the best of our knowledge, the current study is the first of its kind to evaluate and compare smoking between rural and urban in the same study in Zambia, the other studies only focused on either rural or urban areas alone.

In many previous studies, the risk of cigarette smoking has been correlated to various demographic, socio-economic and cultural factors by different researchers. Our study found age, gender, education, occupation, marital status, religion, wealth index, relationship to head of household, frequency of watching television and listening to the radio as significantly associated with the risk of being a cigarette smoker. This study documents a significant association between age and risk of cigarette smoking both in the rural and urban areas of Zambia. The observation by our study is that the risk of being a cigarette smoker in both rural and urban area increases with the increase in age. This stands in contrast with the finding by Townsend and colleagues who relates age to ability to afford the cost of cigarette as opposed to simply increase in age [15].

Gender showed significant association with the risk of cigarette smoking in our study, females presented a reduced risk of cigarette smoking compared to males and this is in accord with what is obtaining in sub-Saharan Africa where the estimated prevalence of tobacco consumption is $14 \%$ in males and $2 \%$ in females in 2010 [16]. Similarly, another study conducted in the rural parts of Zambia, Kaoma and Kasama by Mulenga et al indicate a high prevalence of smoking at $39.6 \%$ among males and $10.8 \%$ among female and $40.4 \%$ among males and $7.2 \%$ among females respectively [14].

In our study religion was significantly associated with cigarette smoking. Non Catholics were at low risk of cigarette smoking compared to catholic participants. This is supported by the religion-based public health interventions: relevance for tobacco control by Jabbour and Fouad [17].

Compared with the poor, according to the wealth index, the middle class and the rich were at a reduced risk of cigarette smoking. This finding is incomparable with the finding of Townsend and colleagues [15]. that individuals in lower socio-economic groups are more responsive than are those in higher socioeconomic groups to changes in price of cigarettes. On the other hand, individuals with an occupation in our study were at an increased risk of being cigarette smokers compared to those not having job. This aspect agrees with Townsend who states that those with an income are less responsive to the health information and promotion regarding tobacco smoking.

Individuals in this study from the rural areas were at an increased risk of cigarette smoking compared to those from the urban areas. This finding is comparable with the findings in Tunisia by Fakhfakf et al [18] who also observed a higher prevalence of smoking in the rural area compared to the urban areas. It is also
important to note that the prevalence of cigarette smoking in 2014 [19] is consistent with the prevalence obtained in previous Zambia Demographic Health Survey cigarette smoking statistics.

Our findings show that those with primary and secondary education were at a lower risk of cigarette smoking compared to those who had never been educated, similarly, individuals who watched television or listened to the radio at least once a week were at a reduced risk of cigarette smoking compared to those who never watched television or listened to radio at all. This observation correlates with the statement documented by Chapman [20] stating that evidence that health information and promotion, advertising, and smoking restrictions can be effective interventions of cigarette smoking exists and education, television and radio are cardinal in this regard.

Relatives to head of household in the urban area were at a higher risk of smoking cigarette compared to the head of household. This finding agrees with the results in Chongwe, Zambia and Nigeria where the aadolescents whose parents were smokers were more likely to start smoking [21,22] compare to individuals whose parents were not smokers. However, in the rural areas, our results indicate that relatives to head of household are at reduced risk of smoking compared to the head of household and this can be attributed to local customs, implying some form of respect for the head of household. The married/living with a partner were at a lower risk of cigarette smoking compared to those never been in union before. On the contrally, the divorced/separated were at a higher risk of smoking cigarette compared to the never been in union both in rural and urban area. This is more likely to be attributed to ways of reducing stress and feeling loneliness.

## Conclusion

Tobacco smoking is a widely known modifiable risk factor for a number of non-communicable diseases including cancers, cardiovascular diseases and its association with a number of diseases has been clearly demonstrated. Therefore, interventions to curb smoking should target specific demographic, socio-economic and cultural factors.

## Declarations

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Availability of data and materials
The data is available in soft copy in different formats and can be accessed from the Zambia Central Statistics Office, P.O. Box 31908, Lusaka, Zambia; Telephone: (260-211) 251377/85 257604/05; Fax: (260-211) 1253468; E-mail: Info@zamstats.gov.zm; Internet: http:www.zamstats gov.zm; Data Portal: http://zambia.africadata.org.

## Authors' contributions

All authors were responsible for facets of the study. However, Herbert Tato Nyirenda was responsible for the formulation, methods, data analysis, results and discussion of the study. David Mulenga \& Tambulani Nyirenda contributed to the design, formulation and study discussion. Herbert B.C Nyirenda \& Moono

Silitongo contributed to all facets of this research including writing, proof reading, and discussion. The paper was read and reviewed by all authors read.

## Competing interests

The authors declare that they have no competing interests.

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|  | $\begin{gathered} \text { Item } \\ \text { No } \\ \hline \end{gathered}$ | Recommendation | Page No |
| :---: | :---: | :---: | :---: |
| Title and abstract | 1 | (a) Indicate the study's design with a commonly used term in the title or the abstract | 2 |
|  |  | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| Introduction |  |  |  |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 3 |
| Methods |  |  |  |
| Study design | 4 | Present key elements of study design early in the paper | 3 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 3 |
| Participants | 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants | 4 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 4 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 4 |
| Study size | 10 | Explain how the study size was arrived at | 4 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 4 |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding | 4 |
|  |  | (b) Describe any methods used to examine subgroups and interactions | 4 |
|  |  | (c) Explain how missing data were addressed | 4 |
|  |  | (d) If applicable, describe analytical methods taking account of sampling strategy | 4 |
|  |  | (e) Describe any sensitivity analyses |  |
| Results |  |  |  |
| Participants | 13* | (a) Report numbers of individuals at each stage of study-eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 5 |
|  |  | (b) Give reasons for non-participation at each stage | 5 |
|  |  | (c) Consider use of a flow diagram |  |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 5 |
|  |  | (b) Indicate number of participants with missing data for each variable of interest | 5 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 5 |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, $95 \%$ confidence interval). Make clear which confounders were adjusted for and why they were included | 6 |


|  |  | (b) Report category boundaries when continuous variables were <br> categorized | (c) If relevant, consider translating estimates of relative risk into absolute <br> risk for a meaningful time period | 6 |
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| Other analyses | 17 | Report other analyses done-eg analyses of subgroups and interactions, <br> and sensitivity analyses | 6 |  |
| Discussion | 18 | Summarise key results with reference to study objectives | 7 |  |
| Key results | 19 | Discuss limitations of the study, taking into account sources of potential <br> bias or imprecision. Discuss both direction and magnitude of any potential <br> bias | 7 |  |
| Limitations | 20 | Give a cautious overall interpretation of results considering objectives, <br> limitations, multiplicity of analyses, results from similar studies, and other <br> relevant evidence | 7 |  |
| 7 Interpretation | 21 | Discuss the generalisability (external validity) of the study results | 7 |  |
| Generalisability | 22 | Give the source of funding and the role of the funders for the present study <br> and, if applicable, for the original study on which the present article is <br> based | 9 |  |
| Other information |  |  |  |  |

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

## BMJ Open

## The Spatial Distribution and Correlates of Smoking in Zambia

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Manuscripts

## Title: The Spatial Distribution and Correlates of Smoking in Zambia

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#### Abstract

Objective: The objective of the paper was to investigate the spatial distribution and correlates of tobacco smoking in various regions of Zambia including provincial, Rural as well as urbans variations.

Methods: This paper adopts a cross sectional study design. The study used data from the 2013/2014 Zambia Demographic Health Survey (ZDHS) which is a nationwide health survey conducted in all the 10 provinces. A random sample of men and women from 15,920 households were successfully interviewed. All women aged 15-49 and men age 15-59 who were either permanent residents of the households or visitors present in the households on the night before the survey were eligible to be interviewed.

Results: The results show that $8.2 \%$ and $11 \%$ of Zambians in urban and rural areas smoke, respectively. In urban areas, the risk of being a cigarette smoker was 2.31 (CI: 1.69-3.16) and 2.03 (CI: 1.36-3.02) times higher for the divorced and separated. However, the risk was lower for those with a form of education. In rural areas, the risk of being a cigarette smoker was lower for the married (RRR: $0.69, \mathrm{CI}: 0.55-0.86$ ) and those with a form of education. Nevertheless, in rural areas, the risk of being a pipe \& other smoker was higher for those who were self-employed (RRR: 8.46, CI: 2.95-24.20) and with an occupation (RRR: 2.37, CI: 1.39-4.02) but was lower among women.


Conclusion: Tobacco smoking varies between and within regions as well as provinces. . Therefore, interventions to curb smoking should target specific demographic, socio-economic and cultural factors and how they are spatially distributed.

Keywords: Smoking, Correlates, Urban, Rural, Tobacco, Relative Risk Ratios (RRR), spatial distribution

## Strengths and limitations of this study

- The paper uses a large sample size and is nationally representative providing depths for generalization and making inferences.
- This paper assesses the status of forms or types (cigarette, pipe and other forms) of smoking fundamental to regions of Zambia.
- The paper builds a body of knowledge on the variations in smoking hence enhancing decision making on public health surveillance on smoking behaviour and the evaluation of policy and program development at regional level.
- The study is limited to the available indicators hence could not associate there correlates of smoking to health outcomes such the effect of tobacco smoking on Non Communicable diseases. The data could not provide other indicators/variables such as reasons for smoking as it is limited to available data.


## Introduction

Smoking and other forms of tobacco use can cause a wide variety of diseases and can lead to death and is one of the common causes of preventable morbidity and mortality globally [1, 2]. Smoking is a risk factor for cardiovascular disease, lung cancer, and other forms of cancer, and it contributes to the severity of pneumonia, emphysema, and chronic bronchitis symptoms. The prevalence of smoking differs widely between populations in different localities which results in disparities at national, regional and global levels [3].

Studies in Zambia and elsewhere have had varied findings on rural and urban disparities on the influences of demographic characteristics on tobacco smoking [4]. In Zambia, having a primary education decreased chances of female smoking and women living in rural areas had three-fold increase in likelihood of smoking compared to those in urban areas [5]. In Cameroon, Proctor et al reported no significant differences in smoking between children in rural and urban areas, but Finau et al reported significantly higher tobacco consumption in Tongan [6, 7]. Notably, in a report on Sub-Saharan African Countries, the greatest difference in current smoking prevalence between urban and rural areas was observed in Zambia were $22.4 \%$ in rural Zambia, compared to $6.8 \%$ in urban were tobacco smokers. Further, with regard to urban/rural differences, urban dwellers were more likely to be cigarette smokers while subjects living in rural areas were more often consumers of other forms of tobacco that are more accessible in these settings [8].

Various Demographic Health Surveys (DHS) have shown regional variations in tobacco use. High cigarette use was reported among men in several nations of east central Africa and Madagascar and lowest use in nations of west central Africa, and medium use in nations of southern Africa. However, Global estimates indicate that high rates of tobacco use and tobacco-related deaths are in America and lowest in Africa [9]. The burden of tobacco-related deaths in Africa revealed an increase of about $70 \%$ highest in Eastern Africa and the lowest in Central Africa [10]. Findings also show that among men, the prevalence of smoking was high in Sierra Leone, Lesotho, and Madagascar and low $(<10 \%)$ in Ethiopia, Benin, Ghana, Nigeria, and Sao Tome \& Principe while among women, the prevalence rates were $<5 \%$ in most countries except for Burundi, Sierra Leone [11]. In Ghana and Lesotho, tobacco use was lower among men in urban areas compared to rural areas [12]. Variations of tobacco use among men in Indonesia and among women in Nepal were also observed [13]. Despite the existence of differences in tobacco use in Sub Sahara Africa (SSA), Madagascar has exceptionally higher prevalence rates almost 5 times higher in males than females [14]. Another study indicates that's tobacco use varies significantly globally for men and women as it exceeds 40 percent for men in all the countries examined in North Africa/West Asia/Europe, Central Asia, and South and Southeast Asia [15]. Age and Socioeconomic status in Zambia were influential determinants of tobacco smoking. According to the 2007 Zambia Demographic Health Survey (ZDHS), smoking prevalence among females aged 15-49 years old living in rural areas is three times higher than among females living in urban areas. Lower education and lower socioeconomic status were also found to be a significant predictor of smoking prevalence [1].

It's vital to assess rural-urban differentials in tobacco smoking as Zambia is a land-locked country that has administratively been divided into 10 provinces of which two are predominantly urban and the remaining 8 are predominantly rural. The country has a mixed economy consisting of a rural agricultural sector and a modern urban sector that, geographically, follows the rail line. Poverty continued to be more prevalent among rural than urban residents (1). The paper was aimed at estimating correlates of tobacco smoking among Rural and urbans Zambians. Understanding the correlates of smoking in rural and urban areas can contribute to filling the gap on how to deal with non-communicable diseaseswhich generally develop over a long period and, if addressed at an early stage, are often preventable [10].

## Methods

Population characteristics and setting

Zambia covers a land area of 752,612 square kilometres. This study was conducted in Zambia's 10 provinces. The provinces include Central, Copperbelt, Eastern, Lusaka, Southern, Luapula, Muchinga, Northern, North-Western and Western Provinces.

Data source

This paper used data from the 2013/2014 Zambia Demographic Health Survey (ZDHS), which is a nationally representative sample survey of women and men of reproductive age designed to provide up-to-date information on health status and behaviour. This study adopted a cross sectional study design. The study was purely quantitative and was conducted through structured interviews. Three questionnaires were used and these include; the Household Questionnaire, the Woman's Questionnaire, and the Man's Questionnaire. The three instruments were based on the questionnaires developed by the Demographic and Health Surveys Program and adapted to Zambia's specific data needs.

The 2013-14 ZDHS used an updated list of enumeration areas (EAs) for the 2010 Population and Housing Census as the sampling frame for the survey. The frame comprised 25,631 EAs and 2,815,897 households. An EA is a convenient geographical area with an average size of 130 households or 600 people. For each EA, information is available on its location, type of residence (rural or urban), number of households, and total population. Each EA has a cartographical map with delimited boundaries and main landmarks of the area. A 2013-14 ZDHS cluster is essentially representative of an EA.

The survey used a two-stage stratified cluster sample design, with EAs (or clusters) selected during the first stage and households selected during the second stage. In the first stage, 722 EAs ( 305 in urban areas and 417 in rural areas) were selected with probability proportional to the size. The 10 provinces were stratified into 20 sampling strata and a complete list of households served as the sampling frame in the selection of households for enumeration with an average of 25 households being selected in each EA. Therefore, a random sample of 18,052 households across Zambia were selected from 722 clusters, of which only 16,258 were occupied at the time of the fieldwork. Of the occupied households, 15,920 were successfully interviewed, yielding a household response rate of 98 percent. "All women aged 15-49 and men aged 15-59 who were either permanent residents of the households or visitors present in the households on the night before the survey were eligible to be interviewed.

Measurement and definition

Dependent variable

Smoking in this paper refers to the act or habit of inhaling and exhaling the smoke of tobacco by men and women in rural and urban Zambia. Therefore, tobacco use status is a composite variable from the various questions on the mode of tobacco smoking and was classified into three categories namely; Non-smoker, Cigarette smoker and lastly pipe and other smokers. The variable was thus measured on a nominal scale.

## Independent variables

The independent variables include respondents; Age, Province, Region, Years lived in place of residence, Highest educational level, Religion, Wealth index, marital status, gender, occupation, sex of the household head, frequency of listening to radio and television and relationship to the household head.

The wealth index is a composite measure of a household's cumulative living standard and was calculated using easy-to-collect data on a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities. The wealth index was thus generated with a statistical procedure known as principal components analysis, the wealth index places individual households on a continuous scale of relative wealth. DHS classified households into five wealth quintiles which are lowest, second, middle, fourth and Highest. This study classified the wealth index into three categories as follows: lowest and second as low, middle as middle, fourth and highest as high.

Data analysis

Data analysis was done using Stata version 13 and the data was survey weighted to factor in population estimates. Bivariate analysis or Chi-square analysis was conducted in an attempt to describe and establish the relationship between smoking and socio-economic and demographic factors. A multivariate analysis involving multinomial logistic regression was conducted to ascertain the risk associated with smoking. Therefore, Relative Risk Ratios associated with smoking were generated for the socio-economic and demographic factors that were significant at bivariate analysis (Chi-square). The study also conducted a spatial distribution analysis indicating the regional differences in tobacco smoking and Moran's 1 to ascertain autocorrelation

Patient and Public Involvement

This was a household survey which involved the participation of the general public. Participants are made aware of the study results through publication and statistical bulletins. There were no patients involved in the study.

## Ethical Consideration

The paper used secondary data hence posed no risk or harm to the respondents. The data did not contain any of the respondent's names nor traces of the respondents. This paper, therefore holds respondents information with the highest confidentiality. Permission to use the data was sought from Central Statistics Office (CSO) Zambia and approval to use the data was granted. However, in the parent study, participants gave informed consent and participation was voluntary.

## Results

Socio-economic and Demographic Characteristics
The results reveal that $46.1 \%$ of Zambians live in urban areas while $53.9 \%$ live in rural areas. In the urban area, $22.6 \%$ of the study participants were aged between 15 to 19 years. Almost half ( $49.1 \%$ ) were married, about 6 in $10(59.2 \%)$ had a secondary school education, over half ( $52.7 \%$ ) were females, over three quarters ( $78.4 \%$ ) were protestants, $85.8 \%$ were in the high wealth quintile, 4 in $10(40.6 \%)$ were not working, $45.4 \%$ listened to the radio almost every day and 6 in $10(60.4 \%)$ watched television almost every day, $31 \%$ were the household heads and over three quarters $(78.1 \%)$ of the households were male headed households.

In the rural area, $22.1 \%$ of the study participants were aged between 15 to19 years. Close to two thirds ( $64 \%$ ) were married, over half $(58.2 \%)$ had a primary school education, slightly over half ( $52.5 \%$ ) were females, about 8 in $10(80.3 \%)$ were protestants, $61.1 \%$ were in the low wealth quintile, over one third ( $36.5 \%$ ) were employed in the agriculture sector, $36.5 \%$ never listened to the radio and almost three quarters ( $72.4 \%$ ) never watched television, over one third were ( $35.5 \%$ ) were household heads and eight in ten ( $81.1 \%$ ) of the households were male headed households.

Prevalence of smoking
The results show that only $8.2 \%$ of Zambians in urban areas smoke. However, $8.1 \%$ were cigarette smokers and only $0.1 \%$ smoked pipe and other. With regards to gender, $16.7 \%$ of the males smoked cigarette compared to only $0.3 \%$ of females. Results also showed that $11 \%$ of Zambians in rural areas smoke. All the same, $10.7 \%$ were cigarette smokers and only $0.3 \%$ smoked pipe and other. With regards to gender, $21.8 \%$ of the males smoked cigarette compared to only $0.6 \%$ of females

Spatial distribution of cigarette smoking
Figure 1 shows the spatial distribution of cigarette smoking in Zambia. The prevalence of cigarette smoking was highest in Eastern and Luapula provinces and Lowest in Western and Muchinga Province in Zambia. After running the Moran's I to assess for autocorrelation, the results show that there was clustering of dissimilar values in tobacco use among province. However the results were not statistically significant (p value $=0.152$ )

Chi-square: Association between smoking and socio-economic and demographic factors
The chi-square results indicate that among residents in urban areas, a statistical significant association existed between smoking status and the following factors; age ( p -value $<0.001$ ), marital status ( p -value $<0.001$ ), province ( p -value $=0.003$ ), education status ( p -value $<0.001$ ), sex ( p -value $<0.001$ ), religion ( p -value $<0.001$ ), wealth index ( p -value $<0.001$ ), occupation ( p -value $<0.001$ ), frequency of listening to the radio ( p -value $<0.001$ ) and watching television ( p -value $<0.001$ ), respondents relationship to the household head ( p -value $<0.001$ ) and sex of the household head $(p-v a l u e=0.002),($ Table 1)

Table1: Percentage distribution and association between smoking, socio-economic and demographic factors in urban Zambia

|  |  | Urban |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |
|  |  |  |  |  |


| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pearson: Uncorrected chi2 16 ) $=405.5742$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(12.31,3631.48)=16.2815$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Marital Status |  |  |  |  |  |  |  |
| Never in union | 94 | [93.0-94.8] | 6 | [5.2-7.0] |  |  | 5,888 |
| Married | 90.7 | [89.7-91.5] | 9.2 | [8.3-10.2] | 0.1 | [0.1-0.3] | 7,064 |
| Living with partner | 91.2 | [80.9-96.2] | 8.8 | [3.8-19.1] |  |  | 87 |
| Widowed | 95.2 | [90.6-97.6] | 4.8 | [2.4-9.4] |  |  | 385 |
| Divorced | 87.4 | [83.7-90.3] | 12.5 | [9.6-16.2] | 0.1 | [0.0-0.3] | 668 |
| No longer living |  |  |  |  |  |  |  |
| Together/separated | 84.4 | [78.1-89.1] | 15.5 | [10.8-21.7] | 0.1 | [0.0-0.8] | 296 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |

Pearson: Uncorrected chi2(10) $=100.3434$
Design-based $\mathrm{F}(6.95,2051.56)=7.1598$ P-value $<0.001$

| Province |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Central | 92.8 | [90.3-94.7] | 7.1 | [5.2-9.6] | 0.1 | [0.0-0.9] | 742 |
| Copperbelt | 90.2 | [88.5-91.7] | 9.7 | [8.2-11.5] | 0.1 | [0.0-0.4] | 4,572 |
| Eastern | 93.2 | [91.1-94.9] | 6.7 | [5.1-8.8] | 0.1 | [0.0-0.4] | 524 |
| Luapula | 90.4 | [88.0-92.4] | 9.5 | [7.5-11.9] | 0.1 | [0.0-0.6] | 462 |
| Lusaka | 93 | [91.9-93.9] | 7 | [6.0-8.1] |  |  | 5,545 |
| Muchinga | 92.5 | [90.1-94.3] | 7.2 | [5.5-9.4] | 0.3 | [0.1-0.9] | 350 |
| Northern | 89.3 | [86.8-91.4] | 10.7 | [8.6-13.2] |  |  | 473 |
| North western | 93.7 | [92.0-95.0] | 5.7 | [4.4-7.5] | 0.6 | [0.3-1.3] | 363 |
| Southern | 93.1 | [91.3-94.5] | 6.9 | [5.5-8.7] |  |  | 986 |
| Western | 90.7 | [88.0-92.9] | 8.9 | [6.8-11.6] | 0.4 | [0.1-1.0] | 371 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |
| Pearson: Uncorrected chi2 (18) $=59.9506$ |  |  |  |  |  |  |  |
| Design-based F(9.62, 2838.63) $=2.7270$ P-value $=0.003$ |  |  |  |  |  |  |  |
| Education Status |  |  |  |  |  |  |  |
| No education | 93.4 | [89.6-95.9] | 6.6 | [4.1-10.4] |  |  | 335 |
| Primary | 89.3 | [88.0-90.5] | 10.6 | [9.4-11.8] | 0.2 | [0.1-0.4] | 3,853 |
| Secondary | 92.4 | [91.6-93.1] | 7.6 | [6.8-8.4] | 0.1 | [0.0-0.2] | 8,510 |
| Higher | 94.8 | [93.2-96.0] | 5.2 | [4.0-6.7] |  |  | 1,686 |
| Total | 91.9 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,384 |

Pearson: Uncorrected chi2(6) $=60.3249$
Design-based F(5.20, 1534.67) $=7.7282$ P-value $<0.001$

| Sex |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Male | 83.1 | $[81.6-84.5]$ | 16.7 | $[15.3-18.2]$ | 0.2 | $[0.1-0.3]$ | 6,803 |
| Female | 99.7 | $[99.5-99.8]$ | 0.3 | $[0.2-0.5]$ |  |  | 7,585 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,388 |

Pearson: Uncorrected chi2(2) $=1340.6624$

## Religion

Catholic
Protestant
Muslim
Other
Total

| 88.5 | $[86.7-90.1]$ |
| :--- | :--- |
| 92.9 | $[92.2-93.6]$ |
| 86.8 | $[76.2-93.1]$ |
| 70.9 | $[53.8-83.6]$ |
| 91.8 | $[91.1-92.5]$ |


| 11.5 | $[9.8-13.3]$ |
| :---: | :---: |
| 7 | $[6.4-7.7]$ |
| 13.2 | $[6.9-23.8]$ |
| 29.1 | $[16.4-46.2]$ |
| 8.1 | $[7.4-8.8]$ |


| 0.1 | $[0.0-0.1]$ | 2,830 |
| :---: | :---: | :---: |
| 0.1 | $[0.0-0.2]$ | 11,249 |
|  |  | 194 |
|  |  | 82 |
| 0.1 | $[0.0-0.2]$ | 14,356 |

Pearson: Uncorrected chi2(6) $=119.4077$
Design-based $\mathrm{F}(2.89,851.69)=6.5833$ P-value $<0.001$

| Wealth Index |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Low | 82 | $[78.5-85.0]$ | 17.8 | $[14.8-21.3]$ | 0.2 | $[0.1-0.6]$ | 384 |
| Middle | 86.2 | $[84.1-88.0]$ | 13.7 | $[11.9-15.8]$ | 0.1 | $[0.0-0.3]$ | 1,667 |
| High | 92.9 | $[92.2-93.0]$ | 7 | $[6.3-7.7]$ | 0.1 | $[0.0-0.2]$ | 12,338 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,388 |

Pearson: Uncorrected chi2(4) $=143.9332$
Design-based F(2.90, 855.70) $=41.9643$ P-value $<0.001$


| Less than once a week | 83.4 | [80.5-86.0] | 16.5 | [13.9-19.4] | 0.1 | [0.0-0.4] | 1,118 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| At least once a week | 88.8 | [86.2-90.9] | 11.2 | [9.1-13.8] |  | [0.0-0.1] | 1,763 |
| Almost every day | 94 | [93.2-94.8] | 5.9 | [5.1-6.8] | 0.1 | [0.0-0.2] | 8,689 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,375 |
| Pearson: Uncorrected chi2 $(6)=198.0866$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(4.21,1241.79)=22.6512 \mathrm{P}$-value $<0.001$ |  |  |  |  |  |  |  |
| Relationship to household head |  |  |  |  |  |  |  |
| Head | 84.6 | [82.9-86.1] | 15.2 | [13.7-16.8] | 0.2 | [0.1-0.5] | 4,463 |
| Spouse | 99.1 | [98.6-99.5] | 0.8 | [0.5-1.4] | 0.1 | [0.0-0.2] | 3,448 |
| Son/Daughter | 99.6 | [98.9-99.8] | 0.4 | [0.2-1.1] |  |  | 1,568 |
| Daughter-in-law | 87 | [84.6-89.0] | 13 | [11.0-15.4] |  |  | 1,748 |
| Granddaughter/son | 97.9 | [94.1-99.3] | 2.1 | [0.7-5.9] |  |  | 252 |
| Father/Mother | 90.5 | [84.8-94.3] | 9.2 | [5.5-14.9] | 0.3 | [0.1-1.1] | 228 |
| Father/Mother-in-law | 69.3 | [25.0-93.9] | 30.7 | [6.1-75.0] |  |  | 7 |
| Brother/Sister | 100 |  |  |  |  |  | 330 |
| Co-spouse | 82.6 | [75.2-88.2] | 17.2 | [11.7-24.6] | 0.1 | [0.0-0.7] | 328 |
| Other relative | 94.4 | [91.4-96.4] | 5.6 | [3.6-8.6] |  |  | 813 |
| Adopted/foster child | 93.5 | [87.0-96.9] | 6.5 | [3.1-13.0] |  |  | 176 |
| Not related | 88.5 | [83.8-92.0] | 11.4 | [8.0-16.1] | 0.1 | [0.0-0.5] | 371 |
| Niece/nephew by blood | 96.2 | [92.8-98.1] | 3.8 | [1.9-7.2] |  |  | 400 |
| Niece/nephew by marriage | 92.4 | [87.8-95.3] | 7.6 | [4.7-12.2] |  |  | 254 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,385 |
| Pearson: Uncorrected chi2 26 ) $=872.7312$ |  |  |  |  |  |  |  |
| Sex of household head |  |  |  |  |  |  |  |
| Male | 91.3 | [90.5-92.1] | 8.6 | [7.8-9.4] | 0.1 | [0.0-0.2] | 11,233 |
| Female | 93.8 | [92.4-95.0] | 6.2 | [5.0-7.6] |  |  | 3,155 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |
| Pearson: Uncorrected chi2 2 ) $=21.3809$ |  |  |  |  |  |  |  |
| Design-based F(1.37, 402 | 7.7563 | lue $=0.002$ |  |  |  |  |  |

A statistical significant association was found between smoking status and the following factors among rural residents; age ( p -value $<0.001$ ), marital status ( p -value $<0.001$ ), province ( p -value $<0.001$ ), education status ( p -value $<0.001$ ), sex ( p -value $<0.001$ ), religion ( p -value $<0.001$ ), wealth index ( p -value $<0.001$ ), occupation ( p -value $<0.001$ ), frequency of listening to the radio ( p -value $<0.001$ ) and watching television ( p value $<0.001$ ), respondents relationship to the household head ( p -value $<0.001$ ) and sex of the household head (p-value $<0.001$ ), (Table 2).

Table2: Percentage distribution and association between smoking, socio-economic and demographic factors in rural Zambia

| Rural |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| smoking |  |  |  |  |  |  |  |
|  | Non- <br> Smokers | Non- <br> Smokers | Cigarette Smokers | Cigarette Smokers | Pipe \& Other Smokers | Pipe \& Other Smokers | Population estimates |
|  | \% | 95\% CI | \% | 95\% CI | \% | 95\% CI |  |
| age in 5-year groups |  |  |  |  |  |  |  |
| 15-19 | 98.7 | [98.2-99.0] | 1.3 | [1.0-1.8] |  |  | 3,705 |
| 20-24 | 94.5 | [93.4-95.4] | 5.4 | [4.5-6.5] | 0.1 | [0.0-0.3] | 2,591 |
| 25-29 | 88.9 | [87.6-90.1] | 10.7 | [9.5-12.1] | 0.4 | [0.2-0.7] | 2,477 |
| 30-34 | 87.6 | [85.9-89.0] | 11.9 | [10.5-13.5] | 0.5 | [0.3-1.0] | 2,337 |
| 35-39 | 86.8 | [84.9-88.5] | 12.7 | [11.1-14.6] | 0.5 | [0.2-0.9] | 2,047 |
| 40-44 | 83.1 | [81.1-84.9] | 16.3 | [14.5-18.3] | 0.6 | [0.3-1.2] | 1,691 |
| 45-49 | 77.5 | [74.8-79.9] | 21.8 | [19.4-24.4] | 0.7 | [0.4-1.3] | 1,210 |
| 50-54 | 65 | [59.5-70.1] | 33.8 | [28.6-39.3] | 1.3 | [0.5-3.4] | 415 |
| 55-59 | 62.7 | [56.7-68.3] | 37.1 | [31.5-43.1] | 0.2 | [0.0-1.4] | 319 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |

Pearson: Uncorrected chi2(16) $=1130.6582$
Design-based F $(13.80,5601.60)=67.4280$ P-value $<0.001$

|  |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Marital Status |  |  |  |  |  |  |  |
| never in union | 95.4 | $[94.7-96.1]$ | 4.5 | $[3.8-5.2]$ | 0.1 | $[0.0-0.2]$ | 4,683 |
| married | 86.2 | $[85.4-86.9]$ | 13.4 | $[12.7-14.1]$ | 0.4 | $[0.3-0.6]$ | 10,744 |
| living with partner | 87 | $[77.8-92.8]$ | 11.5 | $[5.8-21.6]$ | 1.4 | $[0.4-5.2]$ | 99 |
| widowed | 92.6 | $[88.5-95.4]$ | 6.6 | $[4.0-10.7]$ | 0.8 | $[0.2-3.1]$ | 280 |
| divorced | 87 | $[84.3-89.3]$ | 12.5 | $[10.2-15.3]$ | 0.5 | $[0.2-1.3]$ | 733 |
|  |  |  |  |  |  |  |  |
| No longer living together/separated | 90.1 | $[86.0-93.1]$ | 9.9 | $[6.9-14.0]$ |  |  | 254 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2(10) $=290.4825$
Design-based $\mathrm{F}(9.16,3720.36)=27.5671 \mathrm{P}$-value $<0.001$

| Province | 91.6 | $[89.6-93.2]$ | 8.3 | $[6.7-10.3]$ | 0.1 | $[0.0-0.4]$ | 1,985 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Central | 87.4 | $[84.7-89.7]$ | 12.4 | $[10.1-15.1]$ | 0.2 | $[0.0-0.9]$ | 876 |
| Copperbelt | 88.8 | $[87.6-89.9]$ | 11 | $[10.0-12.2]$ | 0.2 | $[0.0-0.6]$ | 3,266 |
| Eastern | 85 | $[83.3-86.6]$ | 14.9 | $[13.3-16.7]$ | 0.1 | $[0.0-0.3]$ | 1,610 |
| Luapula | 90.4 | $[88.4-92.0]$ | 9.4 | $[7.8-11.4]$ | 0.2 | $[0.1-0.8]$ | 765 |
| Lusaka | 86.9 | $[84.6-88.9]$ | 12.7 | $[10.7-15.1]$ | 0.4 | $[0.2-0.8]$ | 1,280 |
| Muchinga | 87.6 | $[85.9-89.0]$ | 12.3 | $[10.8-13.9]$ | 0.1 | $[0.0-0.6]$ | 1,774 |
| Northern | 90.5 | $[88.6-92.2]$ | 7.5 | $[5.9-9.4]$ | 2 | $[1.4-2.8]$ | 958 |
| North-Western | 92.9 | $[91.1-94.3]$ | 6.9 | $[5.6-8.5]$ | 0.2 | $[0.0-0.9]$ | 2,932 |
| Southern | 84.7 | $[82.2-86.9]$ | 14.1 | $[12.0-16.5]$ | 1.2 | $[0.7-2.2]$ | 1,346 |
| Western | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |
| Total |  |  |  |  |  |  |  |

Pearson: Uncorrected chi2 $(18)=239.2696$
Design-based F(13.85, 5624.85) $=9.9583$ P-value $<0.001$

| Educational status |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| No education | 88.7 | $[87.0-90.3]$ | 10.9 | $[9.4-12.7]$ | 0.4 | $[0.2-0.7]$ | 1,599 |
| Primary | 87.8 | $[87.0-88.6]$ | 11.9 | $[11.1-12.6]$ | 0.3 | $[0.2-0.5]$ | 9,770 |
| Secondary | 90.9 | $[90.0-91.8]$ | 8.7 | $[7.8-9.6]$ | 0.4 | $[0.3-0.6]$ | 5,077 |
| Higher | 94.9 | $[92.2-96.7]$ | 5.1 | $[3.3-7.8]$ |  |  | 330 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,776 |

Pearson: Uncorrected chi2 $(6)=48.0492$
Design-based $\mathrm{F}(5.41,2198.19)=7.1355 \mathrm{P}$-value $<0.001$

| Sex |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Male | 77.4 | $[76.2-78.6]$ | 21.8 | $[20.7-23.1]$ | 0.7 | $[0.5-1.0]$ | 7,969 |
| Female | 99.4 | $[99.1-99.6]$ | 0.6 | $[0.4-0.8]$ |  |  | 8,823 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |
|  |  |  |  |  |  |  |  |
| Pearson: Uncorrected chi2 2 ( $=2024.5843$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(1.59,645.90)=866.1712$ P-value $<0.001$ |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Religion | 86.7 | $[85.2-88.1]$ | 13 | $[11.7-14.5]$ | 0.3 | $[0.1-0.5]$ | 3,103 |
| Catholic | 89.8 | $[89.2-90.4]$ | 9.8 | $[9.3-10.5]$ | 0.4 | $[0.3-0.5]$ | 13,438 |
| Protestant | 72.2 | $[49.8-87.1]$ | 23.6 | $[10.4-45.2]$ | 4.2 | $[0.6-25.7]$ | 30 |
| Muslim | 71.4 | $[63.3-78.3]$ | 28.6 | $[21.7-36.7]$ |  |  | 166 |
| Other | 89 | $[88.4-89.6]$ | 10.6 | $[10.1-11.2]$ | 0.4 | $[0.3-0.5]$ | 16,736 |
| Total |  |  |  |  |  |  |  |

Pearson: Uncorrected chi2(6) $=100.7914$
Design-based $\mathrm{F}(5.62,2281.12)=13.6607$ P-value $<0.001$

Wealth index

| Low | 86.3 | $[85.5-87.0]$ | 13.2 | $[12.5-14.0]$ | 0.5 | $[0.4-0.7]$ | 10,253 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Middle | 93 | $[92.0-93.8]$ | 6.9 | $[6.1-7.8]$ | 0.1 | $[0.1-0.3]$ | 4,197 |
| High | 93.7 | $[92.4-94.7]$ | 6.3 | $[5.2-7.5]$ | 0.1 | $[0.0-0.3]$ | 2,342 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2(4) $=196.4984$
Design-based F $(3.88,1573.92)=48.2620 \mathrm{P}$-value $<0.001$

## Occupation

Not working
Professional/technical

| 97.5 | $[96.9-98.1]$ | 2.4 | $[1.9-3.1]$ | 0.1 | $[0.0-0.2]$ | 4,855 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 89.1 | $[82.9-93.3]$ | 10.9 | $[6.7-17.1]$ |  |  | 289 |
| 93.4 | $[91.7-94.7]$ | 6.5 | $[5.1-8.1]$ | 0.2 | $[0.1-0.6]$ | 1,444 |
| 83.6 | $[81.6-85.5]$ | 15.5 | $[13.6-17.5]$ | 0.9 | $[0.6-1.3]$ | 2,942 |
|  |  |  |  |  |  |  |
| 85.3 | $[84.2-86.4]$ | 14.4 | $[13.3-15.5]$ | 0.3 | $[0.1-0.5]$ | 6,112 |
| 80.2 | $[72.1-86.4]$ | 18.3 | $[12.4-26.2]$ | 1.5 | $[0.3-7.1]$ | 129 |

0.1 [0.0-0.2]

4,855

Clerical

Agricultural - self employed
80.2 [72.1-86.
18.3
[12.4-26.2]
0.3
1.5
[0.1-0.5]
6,112
Agricultural - employee
Services

| Skilled manual | 77.7 | [73.3-81.5] | 21.9 | [18.1-26.3] | 0.4 | [0.1-1.3] | 582 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Unskilled manual | 80.1 | [72.2-86.2] | 18.6 | [12.7-26.4] | 1.3 | [0.3-5.4] | 144 |
| Other | 85.5 | [79.9-89.7] | 12.7 | [8.7-18.1] | 1.9 | [0.8-4.5] | 240 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,737 |
| Pearson: Uncorrected chi2 $(16)=688.4888$ |  |  |  |  |  |  |  |
| Design-based F(11.23, 4559.07) $=32.9800$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Frequency of listening to radio |  |  |  |  |  |  |  |
| Not at all | 91.6 | [90.7-92.4] | 8.2 | [7.4-9.1] | 0.2 | [0.1-0.4] | 6,119 |
| Less than once a week | 84.8 | [83.0-86.4] | 14.7 | [13.1-16.4] | 0.5 | [0.3-0.9] | 2,100 |
| At least once a week | 87.7 | [86.3-89.1] | 11.9 | [10.6-13.3] | 0.4 | [0.2-0.7] | 3,143 |
| Almost every day | 88.4 | [87.4-89.3] | 11.2 | [10.3-12.1] | 0.4 | [0.3-0.7] | 5,415 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,778 |
| Pearson: Uncorrected chi2 $(6)=87.1177$ |  |  |  |  |  |  |  |
| Design-based F(5.56, 2255.47) $=13.0440$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Frequency of watching television |  |  |  |  |  |  |  |
| Not at all | 89.2 | [88.5-89.9] | 10.4 | [9.7-11.1] | 0.4 | [0.3-0.5] | 12,140 |
| Less than once a week | 82.4 | [80.2-84.4] | 17.3 | [15.3-19.5] | 0.3 | [0.1-0.7] | 1,764 |
| At least once a week | 90.2 | [88.2-91.9] | 9.4 | [7.8-11.4] | 0.4 | [0.1-1.0] | 1,320 |
| Almost every day | 93.1 | [91.6-94.4] | 6.7 | [5.5-8.2] | 0.1 | [0.0-0.4] | 1,553 |
| Total | 89 | [88.4-89.5] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,778 |
| Pearson: Uncorrected chi2(6) $=110.4672$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(5.55,2251.39)=16.6299 \mathrm{P}$-value $<0.001$ |  |  |  |  |  |  |  |
| Relationship to household head |  |  |  |  |  |  |  |
| Head | 75.4 | [74.0-76.7] | 23.8 | [22.5-25.1] | 0.8 | [0.6-1.1] | 5,953 |
| Spouse | 98.3 | [97.8-98.7] | 1.6 | [1.3-2.2] | 0.1 | [0.0-0.2] | 5,115 |
| Son/Daughter | 99.5 | [98.8-99.8] | 0.5 | [0.2-1.2] |  |  | 1,695 |
| Daughter-in-law | 93.5 | [92.1-94.6] | 6.4 | [5.2-7.7] | 0.1 | [0.1-0.4] | 2,027 |
| Granddaughter/son | 94.9 | [91.3-97.0] | 5.1 | [3.0-8.7] | 0 |  | 304 |
| Father/Mother | 89.2 | [84.3-92.7] | 10.3 | [6.8-15.1] | 0.6 | [0.1-2.3] | 262 |
| Father/Mother-in-law |  |  | 100 |  |  |  | 2 |
| Brother/Sister | 100 |  |  |  |  |  | 107 |
| Co-spouse | 80.1 | [72.3-86.2] | 19.9 | [13.8-27.7] |  |  | 174 |
| Other relative | 96.8 | [94.8-98.0] | 2.6 | [1.5-4.5] | 0.6 | [0.2-1.9] | 400 |
| Adopted/foster child | 98.7 | [94.6-99.7] | 1.3 | [0.3-5.4] |  |  | 151 |
| Not related | 83.2 | [77.1-87.9] | 16.2 | [11.6-22.3] | 0.6 | [0.1-4.1] | 251 |
| Niece/nephew by blood | 96 | [91.7-98.1] | 3.8 | [1.7-8.0] | 0.3 | [0.0-1.8] | 220 |
| Niece/nephew by marriage | 88.6 | [81.1-93.3] | 11.4 | [6.7-18.9] |  |  | 131 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |


| Sex of household head |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Male | 87.9 | $[87.2-88.6]$ | 11.7 | $[11.1-12.4]$ | 0.4 | $[0.3-0.5]$ | 13,733 |
| Female | 93.8 | $[92.7-94.7]$ | 6 | $[5.1-7.1]$ | 0.2 | $[0.1-0.4]$ | 3,059 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2 $(2)=86.5974$
Design-based F(1.92, 781.31) $=41.2201$ P-value $<0.001$

Spearman Rank Correlation
A spearman rank correlation was performed between age and wealth index, the findings indicate a statistical significant weak negative correlation (rho $=-0.0668, \mathrm{p}$-value $<0.001$ ) between age and wealth index.

Multinomial Logistic regression: Correlates of smoking in rural and urban Zambia- (Relative Risk Ratios(RRR)).

The results are split into two tables, table3 presenting results of multinomial logistic regression for cigarette smokers while table 4 presenting results of the multinomial logistic regression for pipe \& other smokers. After conducting a multinomial logistic regression and controlling for predictor variables, results in table 3 show that the relative risk of being a cigarette smoker vs a non-smoker increases with each additional age group in both urban and rural areas. In urban areas, the risk of being a cigarette smoker was 3.44 (CI: 1.48 - 7.96), 1.55 (CI: 1.25-1.93) and 2.08 (CI: 1.24-3.49) times higher for sons/daughters, Son/Daughter-in-Law and Niece/Nephew by Marriage to the household head relative to the head of the household respectively while in rural areasthe risk was 0.66 (CI: $0.51-0.85$ ) and 0.49 (CI: $0.26-0.89$ ) lower for Son/Daughter-in-Law and others related to the household head respectively.

Similarly in urban areas, the risk of being a cigarette smoker vs a non-smoker was 2.31 (CI: 1.69-3.16) and 2.03 (CI: 1.36-3.02) times higher for the divorced and separated relative to the never married respectively were as in rural areas the risk was lower for the married (RRR: 0.69, CI: $0.55-0.86$ ) and those living with a partner (RRR: 0.45, CI: 0.23-0.90) relative to the never married. Further, the risk of being a cigarette smoker vs a non-smoker for urban residents was higher for those working or with an occupation relative to those who were not doing anything. On the contrary, the risk of being a cigarette smoker vs a non-smoker in both urban and rural was lower for the following; those with an education relative to those with no form of education; Protestants relative to Catholics and lastly those in the middle wealth quintileas well as high wealth quintile relative to those in the low wealth quintile.

Table3: Correlates of cigarette smoking in rural and urban Zambia-Multinomial logistic regression (Relative Risk Ratios-(RRR))

|  |  | Urban | Rural |
| :--- | :---: | :---: | :---: |
|  |  | Relative Risk Ratio (RRR) |  |
| Base outcome: | Non Smokers |  |  |
| Type of smoking: | Cigarette Smokers |  |  |
| Socio-economic and demographic <br> variables |  |  |  |
| Age | $\mathbf{1 5 - 1 9}$ (RC) | 1 | 1 |


|  | 20-24 | $4.33 * * *$ | 5.77*** |
| :---: | :---: | :---: | :---: |
|  |  | (3.08-6.09) | (4.08-8.15) |
|  | 25-29 | 9.27*** | $12.97 * * *$ |
|  |  | (6.51-13.22) | (9.00-18.68) |
|  | 30-34 | 9.16*** | 13.82*** |
|  |  | (6.3-13.2) | (9.47-20.16) |
|  | 35-39 | 7.71*** | 15.21*** |
|  |  | (5.28-11.25) | (10.38-22.28) |
|  | 40-44 | 9.95*** | 19.96*** |
|  |  | (6.75-14.67) | (13.63-29.25) |
|  | 45-49 | 10.96*** | 28.52*** |
|  |  | (7.28-16.51) | (19.31-42.13) |
|  | 50-54 | 8.96*** | $22.00 * * *$ |
|  |  | (5.78-13.91) | (14.56-33.25) |
|  | 55-59 | 10.93*** | 20.17*** |
|  |  | (6.76-17.67) | (13.15-30.93) |
| Relationship to the Household Head |  |  |  |
|  | Head (RC) | 1 | 1 |
|  | Son/Daughter | 3.44*** |  |
|  |  | (1.48-7.96) |  |
|  | Son/Daughter-in-Law | $\begin{gathered} 1.55 * * * \\ (1.25-1.93) \end{gathered}$ | $\begin{gathered} 0.66 * * * \\ (0.51-0.85) \end{gathered}$ |
|  | Niece/Nephew by Marriage | $2.08 * * *$ |  |
|  |  | (1.24-3.49) |  |
|  | Other relative |  | $\begin{gathered} 0.49 * * \\ (0.26-0.89) \end{gathered}$ |
| Marital status |  |  |  |
|  | Never in union (RC) |  | 1 |
|  | Married |  | 0.69*** |
|  |  |  | (0.55-0.86) |
|  | Living with a partner |  | $\begin{gathered} 0.45^{* *} \\ (0.23-0.90) \end{gathered}$ |
|  | Divorced | 2.31 *** | 1.84*** |
|  |  | (1.69-3.16) | (1.30-2.61) |
|  | No longer living together/separated | 2.03*** |  |
|  |  | (1.36-3.02) |  |
| Occupation |  |  |  |
|  | Not occupied (RC) | 1 |  |
|  | Professional/Technical/Managerial | 1.37** |  |
|  |  | (1.07-1.76) |  |
|  | Agricultural - Self employed | 1.65** |  |
|  |  | (1.11-2.45) |  |
|  | Agricultural - Employee | 1.62*** |  |
|  |  | (1.23-2.14) |  |
|  | Services | 2.16 *** |  |
|  |  | (1.56-2.98) |  |


| Skilled Manual | $1.74^{* * *}$ |
| :--- | :---: |
|  | $(1.36-2.24)$ |
| Unskilled Manual | $1.85^{* * *}$ |
|  | $(1.35-2.53)$ |
| Other occupation | $1.72^{* * *}$ |
|  | $(1.26-2.35)$ |


| Frequency of watching TV |  |  |  |
| :---: | :---: | :---: | :---: |
|  | Not at all (RC) | 1 |  |
|  | At least once a week | 0.75*** |  |
|  |  | (0.64-0.88) |  |
| Frequency of Listening to the Radio |  |  |  |
|  | Not at all (RC) | 1 |  |
|  | At least once a week | 0.82*** |  |
|  |  | (0.72-0.92) |  |
| Education Status |  |  |  |
|  | No Education (RC) | 1 | 1 |
|  | Primary | $0.67^{* * *}$ | 0.72*** |
|  |  | (0.57-0.78) | (0.63-0.82) |
|  | Secondary | $0.41^{* * *}$ |  |
|  |  | (0.31-0.54) | (0.18-0.48) |
| Gender |  |  |  |
|  | Male (RC) | 1 | 1 |
|  | Female | 0.01*** | 0.01*** |
|  |  | $(0.01-0.02)$ | $(0.01-0.02)$ |
| Religion (Denomination) |  |  |  |
|  | Catholic (RC) | 1 |  |
|  | Protestant | 0.64*** | 0.65*** |
|  |  | (0.55-0.75) | (0.57-0.75) |
| Wealth Index |  |  |  |
|  | Low (RC) | 1 | 1 |
|  | Middle | 0.60*** | 0.49*** |
|  |  | (0.46-0.77) | (0.42-0.57) |
|  | High | 0.35*** | 0.50*** |
| C |  | (0.27-0.45) | (0.40-0.62) |

Confidence Interval (CI) in parentheses, Reference Category (RC)
${ }^{* * *} \mathrm{p}<0.01,{ }^{* *} \mathrm{p}<0.05,{ }^{*} \mathrm{p}<0.1$

On the other hand, table 4 shows that the risk of being a pipe \& other smoker vs a non-smoker increases with each additional age in rural areas. In urban areas, the risk of being a pipe $\&$ other smoker was higher for fathers/mothers to the household head (RRR: 14.29, CI: 1.66-122.79) relative to the head of the household. Similarly, in rural areas, the risk of being a pipe \& other smoker was higher for those who were selfemployed (RRR: 8.46, CI: 2.95-24.20) or with an occupation (RRR: 2.37, CI: 1.39-4.02) relative to those who were not doing anything and was higher for Muslims (RRR: 18.55, CI: 1.81-189.77) relatives to Catholics.

Conversely, in urban areas, the risk of being a pipe \& other smoker was lower for those with a primary education (RRR: 0.36, CI: 0.11-1.16) relative to those without any form of education; and for protestants (RRR: 0.39, CI: 0.14-1.11) relative to Catholics. Similarly, in rural areas, the risk of being a pipe $\&$ other smoker was lower for those in the middle wealth quintile (RRR: 0.31, CI: 0.14-0.67) and high wealth quintile (RRR: $0.16, \mathrm{CI}: 0.04-0.73$ ) relative to those in the low wealth quintile. However, in both urban and rural, the risk of being a pipe \& other smoker was lower for women relative to men.

Table 4: Correlates of smoking in rural and urban Zambia-Multinomial logistic regression (Relative Risk Ratios-(RRR))

|  |  | Utban | Rural |
| :---: | :---: | :---: | :---: |
|  |  | Relative Risk Ratio (RRR) |  |
| Base outcome: Non Smokers |  |  |  |
| Type of smoking: |  | Pipe \& Other Smokers |  |
| Socio-economic and demographic variables |  |  |  |
| Age |  |  |  |
|  | 15-19 (RC) |  | 1 |
|  | 25-29 |  | 14.71*** |
|  |  |  | (2.65-81.72) |
|  | 30-34 |  | 16.75*** |
|  |  |  | (2.85-98.60) |
|  | 35-39 |  | 15.72*** |
|  |  |  | (2.56-96.36) |
|  | 40-44 |  | 17.87*** |
|  |  |  | (2.86-111.64) |
|  | 45-49 |  | 41.51*** |
|  |  |  | (6.87-250.65) |
|  | 50-54 |  | 20.08*** |
|  |  |  | (2.99-134.92) |
| Relationship to the Household Head |  |  |  |
|  | Head (RC)Father/Mother | 1 |  |
|  |  | 14.29** |  |
|  |  | $(1.66-122.79)$ |  |
| Occupation |  |  |  |
|  | Not working (RC) |  | 1 |
|  | Other occupation |  | 8.46*** |
|  |  |  | (2.95-24.20) |
|  | Agricultural - Self employed |  | 2.37*** |
|  |  |  | (1.39-4.02) |
| Education Status |  |  |  |
|  | No Education (RC) | 1 |  |
|  | Primary | 0.36* |  |
|  |  | (0.11-1.16) |  |
| Gender |  |  |  |
|  | Male (RC) | 1 | 1 |



Confidence Interval (CI) in parentheses, Reference Category (RC)
${ }^{* * *} \mathrm{p}<0.01,{ }^{* *} \mathrm{p}<0.05,{ }^{*} \mathrm{p}<0.1$

## Discussion

The findings of our current study indicate that the prevalence of smoking in Zambia is a notable public health problem and it is consistent with the prevailing prevalence in Sub-Saharan Africa [9]. The overall prevalence of smoking in our current study is slightly higher in the overall urban Zambia compared to the prevalence obtained in Lusaka alone, the capital city of Zambia by Siziya et al [16]. The prevalence of male cigarette smokers in our study was high compared to that of females both in the rural and urban areas. This is consistent with the findings of Siziya et al in Lusaka [16] and of Zyaambo et al in Kitwe, the mining city of Zambia [17] and of Mulenga et al in Kaoma and Kasama, rural towns in Zambia [18]. To the best of our knowledge, the current study is the first of its kind to evaluate and compare smoking between rural and urban in the same study in Zambia, the other studies only focused on either rural or urban areas alone. The findings are similar to findings by Pampel who found high cigarette use among urban residents [9].

In many previous studies, the risk of cigarette smoking has been correlated to various demographic, socio-economic and cultural factors by different researchers. Our study found age, gender, education, occupation, marital status, religion, wealth index, relationship to head of household, frequency of watching television and listening to the radio as significantly associated with the risk of being a cigarette smoker. This study documents a significant association between age and risk of cigarette smoking both in the rural and urban areas of Zambia. The observation by our study is that the risk of being a cigarette smoker in both rural and urban area increases with the increase in age. The findings conquer with findings by Sreeramareddy whound found that older ages were strongly associated with smoking [11]. This stands in contrast with the finding by Townsend and colleagues who relates age to ability to afford the cost of cigarette as opposed to simply increase in age [19]. Similar findings were found by Mamudu in Madagascar indicating that age, education, wealth, employment, marriage, religion and place of residence as factors significantly associated with the choice of tobacco use among males, while age, wealth, and employment were significantly associated with that of females [14].

Gender showed significant association with the risk of cigarette smoking in our study, females presented a reduced risk of cigarette smoking compared to males and this is in accord with what is obtaining
in sub-Saharan Africa where the estimated prevalence of tobacco consumption is $14 \%$ in males and $2 \%$ in females in 2010 [16]. Similarly, another study conducted in the rural parts of Zambia, Kaoma and Kasama by Mulenga et al indicate a high prevalence of smoking at $39.6 \%$ among males and $10.8 \%$ among female and $40.4 \%$ among males and $7.2 \%$ among females respectively [20]. Pampel also found that women had much lower prevalence than men but similar social patterns of use [9]. Similarly, a study by Sreeramareddy found that fewer females who smoked in most countries [11]. However, a study by Kwamena in Ghana and Lesotho showed that Smoking prevalence was smaller in men with higher level of education compared to men with no education [12]. According to Hsia low tobacco use for men is generally found in countries in sub-Saharan Africa and Latin America/Caribbean while women have less likely than men to use tobacco [15].

In our study religion was significantly associated with cigarette smoking. Non Catholics were at low risk of cigarette smoking compared to catholic participants. This is supported by the religion-based public health interventions: relevance for tobacco control by Jabbour and Fouad [21]. Religious affiliation was also noted by Kwamena, who found that tobacco use was higher in men who are traditionalist/spiritualists or who had no religion compared to Christians [12].

Compared with those in the low wealth index, those in the middle and high wealth index were at a reduced risk of cigarette smoking. This finding is incomparable with the finding of Townsend and colleagues [19]. that individuals in lower socio-economic groups are more responsive than are those in higher socioeconomic groups to changes in price of cigarettes. On the other hand, individuals with an occupation in our study were at an increased risk of being cigarette smokers compared to those not having job. This aspect agrees with Townsend who states that those with an income are less responsive to the health information and promotion regarding tobacco smoking. According to Kwamena, tobacco use was lower among professional workers compared to men in the Agricultural sector in both Ghana and Lesotho [12].

Individuals in this study from the rural areas were at an increased risk of cigarette smoking compared to those from the urban areas. This finding is comparable with the findings in Tunisia by Fakhfakf et al [22] who also observed a higher prevalence of smoking in the rural area compared to the urban areas. It is also important to note that the prevalence of cigarette smoking in 2014 [19] is consistent with the prevalence obtained in previous Zambia Demographic Health Survey cigarette smoking statistics.

Our findings show that those with primary and secondary education were at a lower risk of cigarette smoking compared to those who had never been educated, similarly, individuals who watched television or listened to the radio at least once a week were at a reduced risk of cigarette smoking compared to those who never watched television or listened to radio at all. This observation correlates with the statement documented by Chapman [23] stating that evidence that health information and promotion, advertising, and smoking restrictions can be effective interventions of cigarette smoking exists and education, television and radio are cardinal in this regard. The study findings also correlate with findings by Pampel who found that the less educated and lower status workers had high cigarette use [9].

Relatives to head of household in the urban area were at a higher risk of smoking cigarette compared to the head of household. This finding agrees with the results in Chongwe, Zambia and Nigeria where the adolescents whose parents were smokers were more likely to start smoking [24,25] compare to individuals whose parents were not smokers. However, in the rural areas, our results indicate that relatives to head of household are at reduced risk of smoking compared to the head of household and this can be attributed to

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local customs, implying some form of respect for the head of household. The married/living with a partner were at a lower risk of cigarette smoking compared to those never been in union before. On the contrary, the divorced/separated were at a higher risk of smoking cigarette compared to the never been in union both in rural and urban area. This is more likely to be attributed to ways of reducing stress and feeling loneliness. The study was limited to the available indicators in the DHS dataset hence could not associate there correlates of smoking to health outcomes as tobacco use is a risk factor to many Non Communicable diseases.

## Conclusion

Factors influencing tobacco smoking vary between and within regions as well as provinces. The geographic disparities play a role in tobacco consumption between rural and urban areas. Therefore, interventions to curb smoking should target specific demographic, socio-economic and cultural factors.

## Declarations

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Availability of data and materials
The data is available in soft copy in different formats and can be accessed from the Zambia Central Statistics Office, P.O. Box 31908, Lusaka, Zambia; Telephone: (260-211) 251377/85 257604/05; Fax: (260-211) 1253468; E-mail: Info@zamstats.gov.zm; Internet: http:www.zamstats gov.zm; Data Portal: http://zambia.africadata.org.

## Authors' contributions

All authors were responsible for facets of the study. However, Herbert Tato Nyirenda was responsible for the formulation, methods, data analysis, results and discussion of the study. David Mulenga \& Tambulani Nyirenda contributed to the design, formulation and study discussion. Herbert B.C Nyirenda \& Moono Silitongo contributed to all facets of this research including writing, proof reading, and discussion. The paper was read and reviewed by all authors read.

## Competing interests

The authors declare that they have no competing interests.

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Figure 1: Spatial distribution of cigarette smoking by province

Cigarette Smoking


Spatial distribution of cigarette smoking by province
$255 \times 219 \mathrm{~mm}$ (72 x 72 DPI)

|  | $\begin{gathered} \text { Item } \\ \text { No } \\ \hline \end{gathered}$ | Recommendation | Page No |
| :---: | :---: | :---: | :---: |
| Title and abstract | 1 | (a) Indicate the study's design with a commonly used term in the title or the abstract | 2 |
|  |  | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| Introduction |  |  |  |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 3 |
| Methods |  |  |  |
| Study design | 4 | Present key elements of study design early in the paper | 3 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 3 |
| Participants | 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants | 4 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 4 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 4 |
| Study size | 10 | Explain how the study size was arrived at | 4 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 4 |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding | 4 |
|  |  | (b) Describe any methods used to examine subgroups and interactions | 4 |
|  |  | (c) Explain how missing data were addressed | 4 |
|  |  | (d) If applicable, describe analytical methods taking account of sampling strategy | 4 |
|  |  | (e) Describe any sensitivity analyses |  |
| Results |  |  |  |
| Participants | 13* | (a) Report numbers of individuals at each stage of study-eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 5 |
|  |  | (b) Give reasons for non-participation at each stage | 5 |
|  |  | (c) Consider use of a flow diagram |  |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 5 |
|  |  | (b) Indicate number of participants with missing data for each variable of interest | 5 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 5 |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, $95 \%$ confidence interval). Make clear which confounders were adjusted for and why they were included | 6 |


|  |  | (b) Report category boundaries when continuous variables were <br> categorized | (c) If relevant, consider translating estimates of relative risk into absolute <br> risk for a meaningful time period | 6 |
| :--- | :--- | :--- | :--- | :--- |
| Other analyses | 17 | Report other analyses done-eg analyses of subgroups and interactions, <br> and sensitivity analyses | 6 |  |
| Discussion | 18 | Summarise key results with reference to study objectives | 7 |  |
| Key results | 19 | Discuss limitations of the study, taking into account sources of potential <br> bias or imprecision. Discuss both direction and magnitude of any potential <br> bias | 7 |  |
| Limitations | 20 | Give a cautious overall interpretation of results considering objectives, <br> limitations, multiplicity of analyses, results from similar studies, and other <br> relevant evidence | 7 |  |
| 7 Interpretation | 21 | Discuss the generalisability (external validity) of the study results | 7 |  |
| Generalisability | 22 | Give the source of funding and the role of the funders for the present study <br> and, if applicable, for the original study on which the present article is <br> based | 9 |  |
| Other information |  |  |  |  |

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

## BMJ Open

## The Spatial Distribution and Correlates of Smoking in Zambia

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## Title: The Spatial Distribution and Correlates of Smoking in Zambia

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#### Abstract

Objective: The objective of the paper was to investigate the spatial distribution and correlates of tobacco smoking in various regions of Zambia.

Methods: This paper adopts a cross sectional study design. The study used data from the 2013/2014 Zambia Demographic Health Survey (ZDHS) which is a nationwide health survey conducted in all the 10 provinces. A random sample of men and women from 15,920 households were successfully interviewed. All women aged 15-49 and men aged 15-59 who were either permanent residents of the households or visitors present in the households on the night before the survey were eligible to be interviewed.

Results: The results show that $8.2 \%$ and $11 \%$ of Zambians in urban and rural areas smoke, respectively. In urban areas, the risk of being a cigarette smoker was 2.31 (CI: 1.69-3.16) and 2.03 (CI: 1.36-3.02) times higher for the divorced and separated. However, the risk of being a cigarette smoker was lower for those with some formal education. In rural areas, the risk of being a cigarette smoker was lower for the married (RRR: 0.69, CI: $0.55-0.86)$ and those with a formal education. Nevertheless, in rural areas, the risk of being a pipe \& other smoker was higher for those who were self-employed (RRR: 8.46, CI: 2.95-24.20) and with an occupation (RRR: 2.37, CI: 1.39-4.02) but was lower among women.


Conclusion: Tobacco smoking varies between and within regions as well as provinces. . Therefore, interventions to curb smoking should target specific demographic, socio-economic and cultural factors and how they are spatially distributed.

Keywords: Smoking, Correlates, Urban, Rural, Tobacco, Relative Risk Ratios (RRR), Spatial Distribution

## Strengths and limitations of this study

- The paper uses a large sample size and is nationally representative providing depths for generalization and making inferences.
- This paper assesses the status of forms or types (cigarette, pipe and other forms) of smoking fundamental to regions of Zambia.
- The paper builds a body of knowledge on the variations in smoking hence enhancing decision making on public health surveillance on smoking behaviour and the evaluation of policy and program development at regional level.
- The study is limited to the available indicators hence could not associate the correlates of smoking to health outcomes such the effect of tobacco smoking on Non Communicable Diseases (NCDs). The data could not provide other indicators/variables such as reasons for smoking as it is limited to available data.


## Introduction

Smoking and other forms of tobacco use can cause a wide variety of diseases and can lead to death as it is one of the common causes of preventable morbidity and mortality globally [1, 2]. Smoking is a risk factor for cardiovascular diseases, lung cancer, and other forms of cancer, and it contributes to the severity of pneumonia, emphysema, and chronic bronchitis symptoms. The prevalence of smoking differs widely between populations in different localities which results in disparities at national, regional and global level [3].

Studies in Zambia and elsewhere have had varied findings on rural and urban disparities on the influences of demographic characteristics on tobacco smoking [4]. In Zambia, having a primary education decreased chances of female smoking and women living in rural areas had a three-fold increased likelihood of smoking compared to those in urban areas [5]. In Cameroon, Proctor et al reported no significant differences in smoking between children in rural and urban areas, but Finau et al reported significantly higher tobacco consumption in Tongan [6, 7]. Notably, in a report on Sub-Saharan African Countries, the greatest difference in current smoking prevalence between urban and rural areas was observed in Zambia were $22.4 \%$ in rural Zambia, compared to $6.8 \%$ in urban arears were tobacco smokers. Further, with regard to urban/rural differences, urban dwellers were more likely to be cigarette smokers while subjects living in rural areas were more often consumers of other forms of tobacco that are more accessible in these settings [8].

Various Demographic Health Surveys (DHS) have shown regional variations in tobacco use. High cigarette use was reported among men in several nations of east central Africa and Madagascar and lowest use in nations of west central Africa, and medium use in nations of southern Africa. However, Global estimates indicate that high rates of tobacco use and tobacco-related deaths are in America and lowest in Africa [9]. The burden of tobacco-related deaths in Africa revealed an increase of about 70\% highest in Eastern Africa and the lowest in Central Africa [10]. Findings also show that among men, the prevalence of smoking was high in Sierra Leone, Lesotho, and Madagascar and low ( $<10 \%$ ) in Ethiopia, Benin, Ghana, Nigeria, and Sao Tome \& Principe while among women, the prevalence rates were low ( $<5 \%$ ) in most countries except for Burundi and Sierra Leone [11]. In Ghana and Lesotho, tobacco use was lower among men in urban areas compared to rural areas [12]. Variations of tobacco use among men in Indonesia and among women in Nepal were also observed [13]. Despite the existence of differences in tobacco use in Sub Sahara Africa (SSA), Madagascar has exceptionally higher prevalence rates almost 5 times higher in males than females [14]. Another study indicates that tobacco use varies significantly globally for men and women as it exceeds 40 percent for men in all the countries examined in North Africa,West Asia,Europe, Central Asia,South and Southeast Asia [15]. Age and Socioeconomic status in Zambia were influential determinants of tobacco smoking. According to the 2007 Zambia Demographic Health Survey (ZDHS), the prevalence of smoking among females aged 15-49 years old living in rural areas was three times higher compared tofemales living in urban areas. Lower education and lower socioeconomic status were also found to be a significant predictor of smoking prevalence [1].

It's vital to assess rural-urban differentials in tobacco smoking as Zambia is a land-locked country that has administratively been divided into 10 provinces of which two are predominantly urban and the remaining 8 are predominantly rural. The country has a mixed economy consisting of a rural agricultural sector and a modern urban sector that, geographically, follows the rail line. Poverty continued to be more prevalent among rural than urban residents (1). The paper was aimed at estimating correlates of tobacco smoking among Rural and urbans Zambians. Understanding the correlates of smoking in rural and urban areas can contribute to filling the gap on how to deal with Non-Communicable Diseases (NCDs) which generally develop over a long period and, if addressed at an early stage, are often preventable [10].

## Methods

Population characteristics and setting

Zambia covers a land area of 752,612 square kilometres. This study was conducted in Zambia's 10 provinces. The provinces include Central, Copperbelt, Eastern, Lusaka, Southern, Luapula, Muchinga, Northern, North-Western and Western Provinces.

Data source

This paper used data from the 2013/2014 Zambia Demographic Health Survey (ZDHS), which is a nationally representative sample survey of women and men of reproductive age designed to provide up-to-date information on health status and behaviour. This study adopted a cross sectional study design. The study was purely quantitative and was conducted through structured interviews. Three questionnaires were used and these include; the Household Questionnaire, the Woman's Questionnaire, and the Man's Questionnaire. The three instruments were based on the questionnaires developed by the Demographic and Health Surveys Program and adapted to Zambia's specific data needs.

The 2013-14 ZDHS used an updated list of enumeration areas (EAs) for the 2010 Population and Housing Census as the sampling frame for the survey. The frame comprised 25,631 EAs and 2,815,897 households. An EA is a convenient geographical area with an average size of 130 households or 600 people. For each EA, information is available on its location, type of residence (rural or urban), number of households, and total population. Each EA has a cartographical map with delimited boundaries and main landmarks of the area. A 2013-14 ZDHS cluster is essentially representative of an EA.

The survey used a two-stage stratified cluster sample design, with EAs (or clusters) selected during the first stage and households selected during the second stage. In the first stage, 722 EAs ( 305 in urban areas and 417 in rural areas) were selected with probability proportional to the size. The 10 provinces were stratified into 20 sampling strata and a complete list of households served as the sampling frame in the selection of households for enumeration with an average of 25 households being selected in each EA. Therefore, a random sample of 18,052 households across Zambia were selected from 722 clusters, of which only 16,258 were occupied at the time of the fieldwork. Of the occupied households, 15,920 were successfully interviewed, yielding a household response rate of 98 percent. "All women aged 15-49 and men aged 15-59 who were either permanent residents of the households or visitors present in the households on the night before the survey were eligible to be interviewed", (2013/14, ZDHS).

Measurement and definition

Dependent variable

Smoking in this paper refers to the act or habit of inhaling and exhaling the smoke of tobacco by men and women in rural and urban Zambia. Therefore, tobacco use status is a composite variable from the various questions on the mode of tobacco smoking and was classified into three categories namely; Non-smoker, Cigarette smoker and lastly pipe and other smokers. The variable was thus measured on a nominal scale.

## Independent variables

The independent variables include respondents; Age, Province, Region, Years lived in place of residence, Highest educational level, Religion, Wealth index, marital status, gender, occupation, sex of the household head, frequency of listening to radio and television and relationship to the household head.

The wealth index is a composite measure of a household's cumulative living standard and was calculated using easy-to-collect data on a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities. The wealth index was thus generated with a statistical procedure known as principal components analysis, the wealth index places individual households on a continuous scale of relative wealth. DHS classified households into five wealth quintiles which are lowest, second, middle, fourth and Highest. This study classified the wealth index into three categories as follows: lowest and second as low, middle as middle, fourth and highest as high.

Data analysis
Data analysis was done using Stata version 13 and the data was survey weighted to factor in population estimates. Bivariate analysis or Chi-square analysis was conducted in an attempt to describe and establish the association between smoking and socio-economic as well as demographic factors. A multivariate analysis involving multinomial logistic regression was conducted to ascertain the risk associated with smoking. Therefore, Relative Risk Ratios associated with smoking were generated for the socio-economic and demographic factors that were significant at bivariate analysis (Chi-square). The study also conducted a spatial distribution analysis indicating the regional differences in tobacco smoking and Moran's 1 to ascertain autocorrelation

Patient and Public Involvement

This was a household survey which involved the participation of the general public. Participants are made aware of the study results through publication and statistical bulletins. There were no patients involved in the study.

## Ethical Consideration

The paper used secondary data hence posed no risk or harm to the respondents. The data did not contain any of the respondent's names nor traces of the respondents. This paper, therefore holds respondents information with the highest confidentiality. Permission to use the data was sought from Central Statistics Office (CSO) Zambia and approval to use the data was granted. However, in the parent study, participants gave informed consent and participation was voluntary.

## Results

Socio-economic and Demographic Characteristics
The results reveal that $46.1 \%$ of $Z a m b i a n s$ live in urban areas while $53.9 \%$ live in rural areas. In the urban area, $22.6 \%$ of the study participants were aged between 15 to 19 years. Almost half ( $49.1 \%$ ) were married, about 6 in $10(59.2 \%)$ had a secondary school education, over half ( $52.7 \%$ ) were females, over three quarters $(78.4 \%)$ were protestants, $85.8 \%$ were in the high wealth quintile, 4 in $10(40.6 \%)$ were not working, $45.4 \%$

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listened to the radio almost every day and 6 in 10 ( $60.4 \%$ ) watched television almost every day, $31 \%$ were the household heads and over three quarters (78.1\%) of the households were male headed households.

In the rural area, $22.1 \%$ of the study participants were aged between 15 to19 years. Close to two thirds ( $64 \%$ ) were married, over half ( $58.2 \%$ ) had a primary school education, slightly over half ( $52.5 \%$ ) were females, about 8 in $10(80.3 \%)$ were protestants, $61.1 \%$ were in the low wealth quintile, over one third ( $36.5 \%$ ) were employed in the agriculture sector, $36.5 \%$ never listened to the radio and almost three quarters ( $72.4 \%$ ) never watched television, over one third were ( $35.5 \%$ ) were household heads and eight in ten ( $81.1 \%$ ) of the households were male headed households.

Prevalence of smoking
The results show that only $8.2 \%$ of Zambians in urban areas smoke. However, $8.1 \%$ were cigarette smokers and only $0.1 \%$ smoked pipe and other. With regards to gender, $16.7 \%$ of the males smoked cigarette compared to only $0.3 \%$ of females.

Results also showed that $11 \%$ of Zambians in rural areas smoke. One in $10(10.7 \%)$ were cigarette smokers and only $0.3 \%$ smoked pipe and other. With regards to gender, $21.8 \%$ of the males smoked cigarette compared to only $0.6 \%$ of females

Spatial distribution of cigarette smoking
Figure 1 shows the spatial distribution of cigarette smoking in Zambia. The prevalence of cigarette smoking was highest in Eastern and Luapula provinces and Lowest in Western and Muchinga Province in Zambia. After running the Moran's I to assess for autocorrelation, the results show that there was clustering of dissimilar values in tobacco use among province. However the results were not statistically significant (p value $=0.152$ )

Chi-square: Association between smoking and socio-economic and demographic factors
The chi-square results indicate that among residents in urban areas, a statistical significant association existed between smoking status and the following factors; age ( p -value $<0.001$ ), marital status ( p -value $<0.001$ ), province ( p -value $=0.003$ ), education status ( p -value $<0.001$ ), sex ( p -value $<0.001$ ), religion ( p -value $<0.001$ ), wealth index ( p -value $<0.001$ ), occupation ( p -value $<0.001$ ), frequency of listening to the radio ( p -value $<0.001$ ) and watching television ( p -value $<0.001$ ), respondents relationship to the household head ( p -value $<0.001$ ) and sex of the household head $(\mathrm{p}$-value $=0.002)$, $($ Table 1)

Table1: Percentage distribution and association between smoking, socio-economic and demographic factors in urban Zambia

| Urban |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Smoking status |  |  |  |  |  |  |  |
|  | NonSmokers | Non- <br> Smokers | Cigarette <br> Smokers | Cigarette Smokers | Pipe \& Other Smokers | Pipe \& Other Smokers | Population estimates |
|  | \% | 95\% CI | \% | 95\% CI | \% | 95\% CI |  |
| age in 5-year groups |  |  |  |  |  |  |  |
| 15-19 | 98.2 | [97.4-98.8] | 1.8 | [1.2-2.6] |  |  | 3,258 |
| 20-24 | 93.5 | [92.3-94.5] | 6.5 | [5.4-7.7] |  |  | 2,748 |
| 25-29 | 90.4 | [88.4-92.1] | 9.6 | [7.9-11.6] |  |  | 2,281 |
| 30-34 | 89.1 | [87.3-90.6] | 10.7 | [9.2-12.5] | 0.2 | [0.1-0.7] | 2,066 |


| $35-39$ | 90.7 | $[88.4-92.5]$ | 9 | $[7.1-11.3]$ | 0.3 | $[0.1-0.9]$ | 1,626 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $40-44$ | 87.1 | $[84.2-89.6]$ | 12.8 | $[10.4-15.8]$ | 0.1 | $[0.0-0.3]$ | 1,157 |
| $45-49$ | 88.1 | $[84.7-90.8]$ | 11.9 | $[9.2-15.2]$ |  |  | 777 |
| $50-54$ | 77.5 | $[70.0-83.5]$ | 22.5 | $[16.5-30.0]$ |  |  | 286 |
| $55-59$ | 81.5 | $[73.6-87.4]$ | 18.5 | $[12.6-26.4]$ |  |  | 191 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,388 |

Pearson: Uncorrected chi2(16) $=405.5742$
Design-based $\mathrm{F}(12.31,3631.48)=16.2815 \mathrm{P}$-value $<0.001$

| Marital Status |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Never in union | 94 | $[93.0-94.8]$ | 6 | $[5.2-7.0]$ |  | 5,888 |  |
| Married | 90.7 | $[89.7-91.5]$ | 9.2 | $[8.3-10.2]$ | 0.1 | $[0.1-0.3]$ | 7,064 |
| Living with partner | 91.2 | $[80.9-96.2]$ | 8.8 | $[3.8-19.1]$ |  |  | 87 |
| Widowed | 95.2 | $[90.6-97.6]$ | 4.8 | $[2.4-9.4]$ |  | 385 |  |
| Divorced | 87.4 | $[83.7-90.3]$ | 12.5 | $[9.6-16.2]$ | 0.1 | $[0.0-0.3]$ | 668 |
| No longer living |  |  |  |  |  |  |  |
| Together/separated | 84.4 | $[78.1-89.1]$ | 15.5 | $[10.8-21.7]$ | 0.1 | $[0.0-0.8]$ | 296 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,388 |

Pearson: Uncorrected chi2(10) $=100.3434$
Design-based F(6.95, 2051.56) $=7.1598$ P-value $<0.001$

| Province |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Central | 92.8 | [90.3-94.7] | 7.1 | [5.2-9.6] | 0.1 | [0.0-0.9] | 742 |
| Copperbelt | 90.2 | [88.5-91.7] | 9.7 | [8.2-11.5] | 0.1 | [0.0-0.4] | 4,572 |
| Eastern | 93.2 | [91.1-94.9] | 6.7 | [5.1-8.8] | 0.1 | [0.0-0.4] | 524 |
| Luapula | 90.4 | [88.0-92.4] | 9.5 | [7.5-11.9] | 0.1 | [0.0-0.6] | 462 |
| Lusaka | 93 | [91.9-93.9] | 7 | [6.0-8.1] |  |  | 5,545 |
| Muchinga | 92.5 | [90.1-94.3] | 7.2 | [5.5-9.4] | 0.3 | [0.1-0.9] | 350 |
| Northern | 89.3 | [86.8-91.4] | 10.7 | [8.6-13.2] |  |  | 473 |
| North western | 93.7 | [92.0-95.0] | 5.7 | [4.4-7.5] | 0.6 | [0.3-1.3] | 363 |
| Southern | 93.1 | [91.3-94.5] | 6.9 | [5.5-8.7] |  |  | 986 |
| Western | 90.7 | [88.0-92.9] | 8.9 | [6.8-11.6] | 0.4 | [0.1-1.0] | 371 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |
| Pearson: Uncorrected chi2(18) $=59.9506$ |  |  |  |  |  |  |  |
| Design-based F $(9.62,2838.63)=2.7270$ P-value $=0.003$ |  |  |  |  |  |  |  |
| Education Status |  |  |  |  |  |  |  |
| No education | 93.4 | [89.6-95.9] | 6.6 | [4.1-10.4] |  |  | 335 |
| Primary | 89.3 | [88.0-90.5] | 10.6 | [9.4-11.8] | 0.2 | [0.1-0.4] | 3,853 |
| Secondary | 92.4 | [91.6-93.1] | 7.6 | [6.8-8.4] | 0.1 | [0.0-0.2] | 8,510 |
| Higher | 94.8 | [93.2-96.0] | 5.2 | [4.0-6.7] |  |  | 1,686 |
| Total | 91.9 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,384 |

Pearson: Uncorrected chi2(6) $=60.3249$
Design-based F(5.20, 1534.67) $=7.7282$ P-value $<0.001$

## Sex

| Male | 83.1 | [81.6-84.5] | 16.7 | [15.3-18.2] | 0.2 | [0.1-0.3] | 6,803 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Female | 99.7 | [99.5-99.8] | 0.3 | [0.2-0.5] |  |  | 7,585 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |
| Pearson: Uncorrected chi2 2 ) $=1340.6624$ |  |  |  |  |  |  |  |
| Design-based F $(1.95,574.01)=571.3623$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Religion |  |  |  |  |  |  |  |
| Catholic | 88.5 | [86.7-90.1] | 11.5 | [9.8-13.3] | 0.1 | [0.0-0.1] | 2,830 |
| Protestant | 92.9 | [92.2-93.6] | 7 | [6.4-7.7] | 0.1 | [0.0-0.2] | 11,249 |
| Muslim | 86.8 | [76.2-93.1] | 13.2 | [6.9-23.8] |  |  | 194 |
| Other | 70.9 | [53.8-83.6] | 29.1 | [16.4-46.2] |  |  | 82 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,356 |
| Pearson: Uncorrected chi2(6) $=119.4077$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(2.89,851.69)=6.5833$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Wealth Index |  |  |  |  |  |  |  |
| Low | 82 | [78.5-85.0] | 17.8 | [14.8-21.3] | 0.2 | [0.1-0.6] | 384 |
| Middle | 86.2 | [84.1-88.0] | 13.7 | [11.9-15.8] | 0.1 | [0.0-0.3] | 1,667 |
| High | 92.9 | [92.2-93.6] | 7 | [6.3-7.7] | 0.1 | [0.0-0.2] | 12,338 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,388 |
| Pearson: Uncorrected chi2 4 ) $=143.9332$ |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Occupation |  |  |  |  |  |  |  |
| Not working | 98.1 | [97.4-98.6] | 1.9 | [1.4-2.6] |  |  | 5,815 |
| Professional/technical | 95.9 | [94.1-97.2] | 4.1 | [2.8-5.9] |  |  | 881 |
| Clerical | 92.4 | [90.9-93.6] | 7.5 | [6.3-8.9] | 0.1 | [0.0-0.4] | 3,560 |
| Agricultural - self employed | 81.7 | [74.0-87.5] | 18.2 | [12.4-25.9] | 0.1 | [0.0-0.8] | 165 |
| Agricultural - employee | 84.6 | [81.5-87.2] | 15.3 | [12.7-18.4] | 0.1 | [0.0-0.4] | 752 |
| Services | 86.4 | [82.3-89.7] | 13.6 | [10.3-17.7] |  |  | 655 |
| Skilled manual | 79.6 | [76.6-82.3] | 20.2 | [17.5-23.2] | 0.2 | [0.1-0.4] | 1,354 |
| Unskilled manual | 77.5 | [71.9-82.3] | 22.3 | [17.6-27.9] | 0.2 | [0.0-0.6] | 540 |
| Other | 82 | [76.8-86.3] | 17.5 | [13.2-22.8] | 0.5 | [0.1-2.7] | 615 |
| Total | 91.9 | [91.2-92.6] | 8 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,336 |
| Pearson: Uncorrected chi2(16) $=956.0431$ |  |  |  |  |  |  |  |
| Design-based F(9.70, 2862.46) $=36.6685$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Frequency of listening to radio |  |  |  |  |  |  |  |
| Not at all | 94.7 | [93.3-95.8] | 5.3 | [4.2-6.7] |  |  | 2,944 |
| Less than once a week | 91.3 | [89.1-93.1] | 8.5 | [6.8-10.7] | 0.1 | [0.1-0.4] | 1,682 |
| At least once a week | 90.3 | [88.7-91.7] | 9.7 | [8.3-11.2] |  | [0.0-0.1] | 3,220 |
| Almost every day | 91.4 | [90.3-92.5] | 8.4 | [7.4-9.6] | 0.1 | [0.1-0.3] | 6,529 |
| Total | 91.8 | [91.1-92.5] | 8.1 | [7.4-8.8] | 0.1 | [0.0-0.2] | 14,375 |

Pearson: Uncorrected chi2(6) $=51.3026$
Design-based F(4.69, 1384.79) $=5.4160$ P-value $<0.001$

Frequency of watching television

| Not at all | 90.4 | $[88.8-91.7]$ | 9.5 | $[8.2-11.1]$ | 0.1 | $[0.0-0.2]$ | 2,805 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Less than once a week | 83.4 | $[80.5-86.0]$ | 16.5 | $[13.9-19.4]$ | 0.1 | $[0.0-0.4]$ | 1,118 |
| At least once a week | 88.8 | $[86.2-90.9]$ | 11.2 | $[9.1-13.8]$ |  | $[0.0-0.1]$ | 1,763 |
| Almost every day | 94 | $[93.2-94.8]$ | 5.9 | $[5.1-6.8]$ | 0.1 | $[0.0-0.2]$ | 8,689 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,375 |

Pearson: Uncorrected chi2(6) $=198.0866$
Design-based $\mathrm{F}(4.21,1241.79)=22.6512$ P-value $<0.001$

Relationship to household head

| Head | 84.6 | $[82.9-86.1]$ | 15.2 | $[13.7-16.8]$ | 0.2 | $[0.1-0.5]$ | 4,463 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Spouse | 99.1 | $[98.6-99.5]$ | 0.8 | $[0.5-1.4]$ | 0.1 | $[0.0-0.2]$ | 3,448 |
| Son/Daughter | 99.6 | $[98.9-99.8]$ | 0.4 | $[0.2-1.1]$ |  |  | 1,568 |
| Daughter-in-law | 87 | $[84.6-89.0]$ | 13 | $[11.0-15.4]$ |  |  | 1,748 |
| Granddaughter/son | 97.9 | $[94.1-99.3]$ | 2.1 | $[0.7-5.9]$ |  |  | 252 |
| Father/Mother | 90.5 | $[84.8-94.3]$ | 9.2 | $[5.5-14.9]$ | 0.3 | $[0.1-1.1]$ | 228 |
| Father/Mother-in-law | 69.3 | $[25.0-93.9]$ | 30.7 | $[6.1-75.0]$ |  |  | 7 |
| Brother/Sister | 100 |  |  |  |  |  | 330 |
| Co-spouse | 82.6 | $[75.2-88.2]$ | 17.2 | $[11.7-24.6]$ | 0.1 | $[0.0-0.7]$ | 328 |
| Other relative | 94.4 | $[91.4-96.4]$ | 5.6 | $[3.6-8.6]$ |  | 813 |  |
| Adopted/foster child | 93.5 | $[87.0-96.9]$ | 6.5 | $[3.1-13.0]$ |  |  | 176 |
| Not related | 88.5 | $[83.8-92.0]$ | 11.4 | $[8.0-16.1]$ | 0.1 | $[0.0-0.5]$ | 371 |
| Niece/nephew by blood | 96.2 | $[92.8-98.1]$ | 3.8 | $[1.9-7.2]$ |  |  | 400 |
| Niece/nephew by |  |  |  |  |  |  |  |
| marriage | 92.4 | $[87.8-95.3]$ | 7.6 | $[4.7-12.2]$ |  |  | 254 |
| Total | 91.8 | $[91.1-92.5]$ | 8.1 | $[7.4-8.8]$ | 0.1 | $[0.0-0.2]$ | 14,385 |

Pearson: Uncorrected chi2(26) $=872.7312$
Design-based F(16.59, 4893.34) $=20.5155$ P-value $<0.001$

Table2: Percentage distribution and association between smoking, socio-economic and demographic factors in rural Zambia

| Rural |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| smoking |  |  |  |  |  |  |  |
|  | NonSmokers | NonSmokers | Cigarette Smokers | Cigarette Smokers | Pipe \& Other Smokers | Pipe \& Other Smokers | Population estimates |
|  | \% | 95\% CI | \% | 95\% CI | \% | 95\% CI |  |
| age in 5-year groups |  |  |  |  |  |  |  |
| 15-19 | 98.7 | [98.2-99.0] | 1.3 | [1.0-1.8] |  |  | 3,705 |
| 20-24 | 94.5 | [93.4-95.4] | 5.4 | [4.5-6.5] | 0.1 | [0.0-0.3] | 2,591 |
| 25-29 | 88.9 | [87.6-90.1] | 10.7 | [9.5-12.1] | 0.4 | [0.2-0.7] | 2,477 |
| 30-34 | 87.6 | [85.9-89.0] | 11.9 | [10.5-13.5] | 0.5 | [0.3-1.0] | 2,337 |
| 35-39 | 86.8 | [84.9-88.5] | 12.7 | [11.1-14.6] | 0.5 | [0.2-0.9] | 2,047 |
| 40-44 | 83.1 | [81.1-84.9] | 16.3 | [14.5-18.3] | 0.6 | [0.3-1.2] | 1,691 |
| 45-49 | 77.5 | [74.8-79.9] | 21.8 | [19.4-24.4] | 0.7 | [0.4-1.3] | 1,210 |
| 50-54 | 65 | [59.5-70.1] | 33.8 | [28.6-39.3] | 1.3 | [0.5-3.4] | 415 |
| 55-59 | 62.7 | [56.7-68.3] | 37.1 | [31.5-43.1] | 0.2 | [0.0-1.4] | 319 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |

Pearson: Uncorrected chi2(16) $=1130.6582$
Design-based $\mathrm{F}(13.80,5601.60)=67.4280 \mathrm{P}$-value $<0.001$

|  |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Marital Status |  |  |  |  |  |  |  |
| never in union | 95.4 | $[94.7-96.1]$ | 4.5 | $[3.8-5.2]$ | 0.1 | $[0.0-0.2]$ | 4,683 |
| married | 86.2 | $[85.4-86.9]$ | 13.4 | $[12.7-14.1]$ | 0.4 | $[0.3-0.6]$ | 10,744 |
| living with partner | 87 | $[77.8-92.8]$ | 11.5 | $[5.8-21.6]$ | 1.4 | $[0.4-5.2]$ | 99 |
| widowed | 92.6 | $[88.5-95.4]$ | 6.6 | $[4.0-10.7]$ | 0.8 | $[0.2-3.1]$ | 280 |
| divorced | 87 | $[84.3-89.3]$ | 12.5 | $[10.2-15.3]$ | 0.5 | $[0.2-1.3]$ | 733 |
|  |  |  |  |  |  |  | 250 |
| No longer living together/separated | 90.1 | $[86.0-93.1]$ | 9.9 | $[6.9-14.0]$ |  |  | 254 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2(10) $=290.4825$
Design-based $\mathrm{F}(9.16,3720.36)=27.5671 \mathrm{P}$-value $<0.001$

| Province | 91.6 | $[89.6-93.2]$ | 8.3 | $[6.7-10.3]$ | 0.1 | $[0.0-0.4]$ | 1,985 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Central | 87.4 | $[84.7-89.7]$ | 12.4 | $[10.1-15.1]$ | 0.2 | $[0.0-0.9]$ | 876 |
| Copperbelt | 88.8 | $[87.6-89.9]$ | 11 | $[10.0-12.2]$ | 0.2 | $[0.0-0.6]$ | 3,266 |
| Eastern | 85 | $[83.3-86.6]$ | 14.9 | $[13.3-16.7]$ | 0.1 | $[0.0-0.3]$ | 1,610 |
| Luapula | 90.4 | $[88.4-92.0]$ | 9.4 | $[7.8-11.4]$ | 0.2 | $[0.1-0.8]$ | 765 |
| Lusaka | 86.9 | $[84.6-88.9]$ | 12.7 | $[10.7-15.1]$ | 0.4 | $[0.2-0.8]$ | 1,280 |
| Muchinga | 87.6 | $[85.9-89.0]$ | 12.3 | $[10.8-13.9]$ | 0.1 | $[0.0-0.6]$ | 1,774 |
| Northern | 90.5 | $[88.6-92.2]$ | 7.5 | $[5.9-9.4]$ | 2 | $[1.4-2.8]$ | 958 |
| North-Western | 92.9 | $[91.1-94.3]$ | 6.9 | $[5.6-8.5]$ | 0.2 | $[0.0-0.9]$ | 2,932 |
| Southern | 84.7 | $[82.2-86.9]$ | 14.1 | $[12.0-16.5]$ | 1.2 | $[0.7-2.2]$ | 1,346 |


| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pearson: Uncorrected chi2(18) $=239.2696$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(13.85,5624.85)=9.9583$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Educational status |  |  |  |  |  |  |  |
| No education | 88.7 | [87.0-90.3] | 10.9 | [9.4-12.7] | 0.4 | [0.2-0.7] | 1,599 |
| Primary | 87.8 | [87.0-88.6] | 11.9 | [11.1-12.6] | 0.3 | [0.2-0.5] | 9,770 |
| Secondary | 90.9 | [90.0-91.8] | 8.7 | [7.8-9.6] | 0.4 | [0.3-0.6] | 5,077 |
| Higher | 94.9 | [92.2-96.7] | 5.1 | [3.3-7.8] |  |  | 330 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,776 |
| Pearson: Uncorrected chi2 $(6)=48.0492$ |  |  |  |  |  |  |  |
| Design-based F $(5.41,2198.19)=7.1355$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Sex |  |  |  |  |  |  |  |
| Male | 77.4 | [76.2-78.6] | 21.8 | [20.7-23.1] | 0.7 | [0.5-1.0] | 7,969 |
| Female | 99.4 | [99.1-99.6] | 0.6 | [0.4-0.8] |  |  | 8,823 |
| Total |  | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |
| Pearson: Uncorrected chi2(2) $=2024.5843$ |  |  |  |  |  |  |  |
| Design-based F $(1.59,645.90)=866.1712$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Religion |  |  |  |  |  |  |  |
| Catholic | 86.7 | [85.2-88.1] | 13 | [11.7-14.5] | 0.3 | [0.1-0.5] | 3,103 |
| Protestant | 89.8 | [89.2-90.4] | 9.8 | [9.3-10.5] | 0.4 | [0.3-0.5] | 13,438 |
| Muslim | 72.2 | [49.8-87.1] | 23.6 | [10.4-45.2] | 4.2 | [0.6-25.7] | 30 |
| Other | 71.4 | [63.3-78.3] | 28.6 | [21.7-36.7] |  |  | 166 |
| Total | 89 | [88.4-89.6] | 10.6 | [10.1-11.2] | 0.4 | [0.3-0.5] | 16,736 |
| Pearson: Uncorrected chi2(6) $=100.7914$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(5.62,2281.12)=13.6607 \mathrm{P}$-value $<0.001$ |  |  |  |  |  |  |  |
| Wealth index |  |  |  |  |  |  |  |
| Low | 86.3 | [85.5-87.0] | 13.2 | [12.5-14.0] | 0.5 | [0.4-0.7] | 10,253 |
| Middle | 93 | [92.0-93.8] | 6.9 | [6.1-7.8] | 0.1 | [0.1-0.3] | 4,197 |
| High | 93.7 | [92.4-94.7] | 6.3 | [5.2-7.5] | 0.1 | [0.0-0.3] | 2,342 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |
| Pearson: Uncorrected chi2 4 ) $=196.4984$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(3.88,1573.92)=48.2620 \mathrm{P}$-value $<0.001$ |  |  |  |  |  |  |  |
| Occupation |  |  |  |  |  |  |  |
| Not working | 97.5 | [96.9-98.1] | 2.4 | [1.9-3.1] | 0.1 | [0.0-0.2] | 4,855 |
| Professional/technical | 89.1 | [82.9-93.3] | 10.9 | [6.7-17.1] |  |  | 289 |
| Clerical | 93.4 | [91.7-94.7] | 6.5 | [5.1-8.1] | 0.2 | [0.1-0.6] | 1,444 |
| Agricultural - self employed | 83.6 | [81.6-85.5] | 15.5 | [13.6-17.5] | 0.9 | [0.6-1.3] | 2,942 |


| Agricultural - employee | 85.3 | [84.2-86.4] | 14.4 | [13.3-15.5] | 0.3 | [0.1-0.5] | 6,112 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Services | 80.2 | [72.1-86.4] | 18.3 | [12.4-26.2] | 1.5 | [0.3-7.1] | 129 |
| Skilled manual | 77.7 | [73.3-81.5] | 21.9 | [18.1-26.3] | 0.4 | [0.1-1.3] | 582 |
| Unskilled manual | 80.1 | [72.2-86.2] | 18.6 | [12.7-26.4] | 1.3 | [0.3-5.4] | 144 |
| Other | 85.5 | [79.9-89.7] | 12.7 | [8.7-18.1] | 1.9 | [0.8-4.5] | 240 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,737 |
| Pearson: Uncorrected chi2(16) $=688.4888$ |  |  |  |  |  |  |  |
| Design-based F(11.23, 4559.07) $=32.9800$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Frequency of listening to radio |  |  |  |  |  |  |  |
| Not at all | 91.6 | [90.7-92.4] | 8.2 | [7.4-9.1] | 0.2 | [0.1-0.4] | 6,119 |
| Less than once a week | 84.8 | [83.0-86.4] | 14.7 | [13.1-16.4] | 0.5 | [0.3-0.9] | 2,100 |
| At least once a week | 87.7 | [86.3-89.1] | 11.9 | [10.6-13.3] | 0.4 | [0.2-0.7] | 3,143 |
| Almost every day | 88.4 | [87.4-89.3] | 11.2 | [10.3-12.1] | 0.4 | [0.3-0.7] | 5,415 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,778 |
| Pearson: Uncorrected chi2(6) $=87.1177$ <br> Design-based $\mathrm{F}(5.56,2255.47)=13.0440 \mathrm{P}$-value $<0.001$ |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Frequency of watching television |  |  |  |  |  |  |  |
| Not at all | 89.2 | [88.5-89.9] | 10.4 | [9.7-11.1] | 0.4 | [0.3-0.5] | 12,140 |
| Less than once a week | 82.4 | [80.2-84.4] | 17.3 | [15.3-19.5] | 0.3 | [0.1-0.7] | 1,764 |
| At least once a week | 90.2 | [88.2-91.9] | 9.4 | [7.8-11.4] | 0.4 | [0.1-1.0] | 1,320 |
| Almost every day | 93.1 | [91.6-94.4] | 6.7 | [5.5-8.2] | 0.1 | [0.0-0.4] | 1,553 |
| Total | 89 | [88.4-89.5] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,778 |
| Pearson: Uncorrected chi2 $(6)=110.4672$ |  |  |  |  |  |  |  |
| Design-based $\mathrm{F}(5.55,2251.39)=16.6299$ P-value $<0.001$ |  |  |  |  |  |  |  |
| Relationship to household head |  |  |  |  |  |  |  |
| Head | 75.4 | [74.0-76.7] | 23.8 | [22.5-25.1] | 0.8 | [0.6-1.1] | 5,953 |
| Spouse | 98.3 | [97.8-98.7] | 1.6 | [1.3-2.2] | 0.1 | [0.0-0.2] | 5,115 |
| Son/Daughter | 99.5 | [98.8-99.8] | 0.5 | [0.2-1.2] |  |  | 1,695 |
| Daughter-in-law | 93.5 | [92.1-94.6] | 6.4 | [5.2-7.7] | 0.1 | [0.1-0.4] | 2,027 |
| Granddaughter/son | 94.9 | [91.3-97.0] | 5.1 | [3.0-8.7] |  |  | 304 |
| Father/Mother | 89.2 | [84.3-92.7] | 10.3 | [6.8-15.1] | 0.6 | [0.1-2.3] | 262 |
| Father/Mother-in-law |  |  | 100 |  |  |  | 2 |
| Brother/Sister | 100 |  |  |  |  |  | 107 |
| Co-spouse | 80.1 | [72.3-86.2] | 19.9 | [13.8-27.7] |  |  | 174 |
| Other relative | 96.8 | [94.8-98.0] | 2.6 | [1.5-4.5] | 0.6 | [0.2-1.9] | 400 |
| Adopted/foster child | 98.7 | [94.6-99.7] | 1.3 | [0.3-5.4] |  |  | 151 |
| Not related | 83.2 | [77.1-87.9] | 16.2 | [11.6-22.3] | 0.6 | [0.1-4.1] | 251 |
| Niece/nephew by blood | 96 | [91.7-98.1] | 3.8 | [1.7-8.0] | 0.3 | [0.0-1.8] | 220 |
| Niece/nephew by marriage | 88.6 | [81.1-93.3] | 11.4 | [6.7-18.9] |  |  | 131 |
| Total | 89 | [88.4-89.6] | 10.7 | [10.1-11.3] | 0.3 | [0.3-0.5] | 16,793 |

Pearson: Uncorrected chi2 26 (26) $=1885.3640$
Design-based $F(20.98,8518.16)=56.9133$ P-value $<0.001$

| Sex of household head |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Male | 87.9 | $[87.2-88.6]$ | 11.7 | $[11.1-12.4]$ | 0.4 | $[0.3-0.5]$ | 13,733 |
| Female | 93.8 | $[92.7-94.7]$ | 6 | $[5.1-7.1]$ | 0.2 | $[0.1-0.4]$ | 3,059 |
| Total | 89 | $[88.4-89.6]$ | 10.7 | $[10.1-11.3]$ | 0.3 | $[0.3-0.5]$ | 16,793 |

Pearson: Uncorrected chi2(2) $=86.5974$
Design-based $\mathrm{F}(1.92,781.31)=41.2201 \mathrm{P}$-value $<0.001$

Spearman Rank Correlation
A spearman rank correlation was performed between age and wealth index, the findings indicate a statistical significant weak negative correlation (rho $=-0.0668, \mathrm{p}$-value $<0.001$ ) between age and wealth index.

Multinomial Logistic regression: Correlates of smoking in rural and urban Zambia- (Relative Risk Ratios(RRR)).

The results are split into two tables, table3 presenting results of multinomial logistic regression for cigarette smokers while table 4 presenting results of the multinomial logistic regression for pipe \& other smokers. After conducting a multinomial logistic regression and controlling for predictor variables, results in table 3 show that the relative risk of being a cigarette smoker versus s a non-smoker increases with each additional age group in both urban and rural areas. In urban areas, the risk of being a cigarette smoker was 3.44 (CI: 1.48-7.96), 1.55 (CI: 1.25-1.93) and 2.08 (CI: 1.24-3.49) times higher for sons/daughters, Son/Daughter-in-Law and Niece/Nephew by Marriage to the household head relative to the head of the household respectively while in rural areas the risk was 0.66 (CI: $0.51-0.85$ ) and 0.49 (CI: $0.26-0.89$ ) lower for Son/Daughter-in-Law and others related to the household head respectively.

Similarly in urban areas, the risk of being a cigarette smoker versus a non-smoker was 2.31 (CI: 1.693.16) and 2.03 (CI: $1.36-3.02$ ) times higher for the divorced and separated relative to the never married respectively were as in rural areas the risk was lower for the married (RRR: 0.69, CI: 0.55-0.86) and those living with a partner (RRR: $0.45, \mathrm{CI}: 0.23-0.90$ ) relative to the never married. Further, the risk of being a cigarette smoker versus a non-smoker for urban residents was higher for those working or with an occupation relative to those who were not doing anything. On the contrary, the risk of being a cigarette smoker versus a nonsmoker in both urban and rural was lower for the following; those with an education relative to those with no form of education; Protestants relative to Catholics and lastly those in the middle wealth quintile as well as high wealth quintile relative to those in the low wealth quintile.

Table3: Correlates of cigarette smoking in rural and urban Zambia-Multinomial logistic regression (Relative $\underline{\text { Risk Ratios-(RRR)) }}$

|  |  | Urban | Rural |
| :---: | :---: | :---: | :---: |
|  |  | Relative Risk Ratio (RRR) |  |
| Base outcome: Non Smokers |  |  |  |
| Type of smoking: C |  | Cigarette Smokers |  |
| Socio-economic and demographic variables |  |  |  |
| Age |  |  |  |
|  | 15-19 (RC) | 1 | 1 |
|  | 20-24 | $4.33 * * *$ | 5.77*** |
|  |  | (3.08-6.09) | (4.08-8.15) |
|  | 25-29 | 9.27*** | $12.97 * * *$ |
|  |  | (6.51-13.22) | (9.00-18.68) |
|  | 30-34 | 9.16*** | 13.82*** |
|  |  | (6.3-13.2) | (9.47-20.16) |
|  | 35-39 | 7.71*** | 15.21*** |
|  |  | (5.28-11.25) | (10.38-22.28) |
|  | 40-44 | 9.95*** | 19.96*** |
|  |  | (6.75-14.67) | (13.63-29.25) |
|  | 45-49 | 10.96*** | 28.52*** |
|  |  | (7.28-16.51) | (19.31-42.13) |
|  | 50-54 | 8.96*** | $22.00 * * *$ |
|  |  | (5.78-13.91) | $(14.56-33.25)$ |
|  | 55-59 | $10.93^{* * *}$ | $20.17^{* * *}$ |
|  |  | (6.76-17.67) |  |
| Relationship to the Household Head |  |  |  |
|  | Head (RC) | 1 | 1 |
|  | Son/Daughter | 3.44*** |  |
|  |  | (1.48-7.96) |  |
|  | Son/Daughter-in-Law | $1.55 * * *$ | $0.66^{* * *}$ |
|  |  | (1.25-1.93) | (0.51-0.85) |
|  | Niece/Nephew by Marriage | 2.08*** |  |
|  |  | (1.24-3.49) |  |
|  | Other relative |  | $\begin{gathered} 0.49 * * \\ (0.26-0.89) \end{gathered}$ |
| Marital status |  |  |  |
|  | Never in union (RC) |  | 1 |
|  | Married |  | ${ }_{0}^{0.69 * * *}$ |
|  |  |  | (0.55-0.86) |
|  | Living with a partner |  | $\begin{gathered} 0.45 * * \\ (0.23-0.90) \end{gathered}$ |
|  | Divorced | 2.31*** | 1.84*** |
|  |  | (1.69-3.16) |  |
|  | No longer living together/separated | $2.03 * * *$ |  |
| - |  | (1.36-3.02) |  |

## Occupation



Confidence Interval (CI) in parentheses, Reference Category (RC)
${ }^{* * *} \mathrm{p}<0.01,{ }^{* *} \mathrm{p}<0.05,{ }^{*} \mathrm{p}<0.1$

On the other hand, table 4 shows that the risk of being a pipe \& other smoker versus a non-smoker increases with each additional age in rural areas. In urban areas, the risk of being a pipe \& other smoker was higher for fathers/mothers to the household head (RRR: 14.29, CI: 1.66-122.79) relative to the head of the household. Similarly, in rural areas, the risk of being a pipe \& other smoker was higher for those who were selfemployed (RRR: 8.46, CI: 2.95-24.20) or with an occupation (RRR: 2.37, CI: 1.39-4.02) relative to those who were not doing anything and was higher for Muslims (RRR: 18.55, CI: 1.81-189.77) relatives to Catholics.

Conversely, in urban areas, the risk of being a pipe \& other smoker was lower for those with a primary education (RRR: 0.36, CI: 0.11 - 1.16) relative to those without any form of education; and for protestants (RRR: 0.39, CI: 0.14-1.11) relative to Catholics. Similarly, in rural areas, the risk of being a pipe \& other smoker was lower for those in the middle wealth quintile (RRR: 0.31, CI: $0.14-0.67$ ) and high wealth quintile (RRR: 0.16 , CI: $0.04-0.73$ ) relative to those in the low wealth quintile. However, in both urban and rural, the risk of being a pipe \& other smoker was lower for women relative to men.

Table 4: Correlates of smoking in rural and urban Zambia-Multinomial logistic regression (Relative Risk Ratios-(RRR))


Relationship to the Household Head

| Head (RC) | 1 |
| :--- | :---: |
| Father/Mother | $14.29^{* *}$ |
|  |  |

Occupation

| Not working (RC) | 1 |
| :--- | :---: |
| Other occupation | $8.46^{* * *}$ |
|  | $(2.95-24.20)$ |
| Agricultural - Self employed | $2.37 * * *$ |


| No Education (RC) | 1 |
| :--- | :---: |
| Primary | $0.36^{*}$ |



Confidence Interval (CI) in parentheses, Reference Category (RC)
${ }^{* * *} \mathrm{p}<0.01,{ }^{* *} \mathrm{p}<0.05,{ }^{*} \mathrm{p}<0.1$

## Discussion

The findings of this study indicate that the prevalence of smoking in Zambia is a notable public health problem and it is consistent with the prevailing prevalence in Sub-Saharan Africa [9]. The overall prevalence of smoking in this study is slightly higher in the overall urban Zambia compared to the prevalence obtained in Lusaka alone, the capital city of Zambia by Siziya et al [16]. The findings are similar to findings by Pampel who found high cigarette use among urban residents [9]. The prevalence of male cigarette smokers in this study was high compared to that of females both in the rural and urban areas. This is consistent with the findings of Siziya et al in Lusaka [16] and of Zyaambo et al in Kitwe, the mining city of Zambia [17] and of Mulenga et al in Kaoma and Kasama, rural towns in Zambia [18]. To the best of our knowledge, the current study is the first of its kind to evaluate and compare smoking between rural and urban in the same study in Zambia, the other studies only focused on either rural or urban areas alone.

In many previous studies, the risk of cigarette smoking has been correlated to various demographic, socio-economic and cultural factors by different researchers. Our study found that; age, gender, education, occupation, marital status, religion, wealth index, relationship to head of household, frequency of watching television and listening to the radio are significantly associated with the risk of being a cigarette smoker. This study documents a significant association between age and the risk of cigarette smoking both in the rural and urban areas of Zambia. The observation by our study is that the risk of being a cigarette smoker in both rural and urban area increases with the increase in age. The findings concur with findings by Sreeramareddy who
found that older ages were strongly associated with smoking [11]. Similar findings were found by Mamudu in Madagascar indicating that age, education, wealth, employment, marriage, religion and place of residence as factors significantly associated with the choice of tobacco use among males, while age, wealth, and employment were significantly associated with that of females [14]. This stands in contrast with the finding by Townsend and colleagues who relate age to ability to afford the cost of cigarette as opposed to simply increase in age [19].

Gender showed significant association with the risk of cigarette smoking in our study, females presented a reduced risk of cigarette smoking compared to males and this is in accord with what is obtaining in sub-Saharan Africa where the estimated prevalence of tobacco consumption is $14 \%$ in males and $2 \%$ in females in 2010 [16]. Similarly, another study conducted in the rural parts of Zambia, Kaoma and Kasama by Mulenga et al indicate a high prevalence of smoking at $39.6 \%$ among males and $10.8 \%$ among female and $40.4 \%$ among males and $7.2 \%$ among females respectively [20]. Pampel also found that women had much lower prevalence than men but similar social patterns of use [9]. Similarly, a study by Sreeramareddy found that there were fewer females who smoked in most countries [11]. However, a study by Kwamena in Ghana and Lesotho showed that Smoking prevalence was smaller in men with higher level of education compared to men with no education [12]. According to Hsia low tobacco use for men is generally found in countries in sub-Saharan Africa and Latin America/Caribbean while women are less likely than men to use tobacco [15].

In our study religion was significantly associated with cigarette smoking. Non Catholics were at low risk of cigarette smoking compared to catholic participants. This is supported by the religion-based public health interventions: relevance for tobacco control by Jabbour and Fouad [21]. Religious affiliation was also noted by Kwamena, who found that tobacco use was higher in men who are traditionalist/spiritualists or who had no religion compared to Christians [12].

Compared with those in the low wealth index, those in the middle and high wealth index were at a reduced risk of cigarette smoking. This findings are in contrast with the findings of Townsend and colleagues [19]. On the other hand, individuals with an occupation in our study were at an increased risk of being cigarette smokers compared to those not having a job. This aspect agrees with Townsend who states that those with an income are less responsive to the health information and promotion regarding tobacco smoking. According to Kwamena, tobacco use was lower among professional workers compared to men in the Agricultural sector in both Ghana and Lesotho [12].

Individuals in this study from the rural areas were at an increased risk of cigarette smoking compared to those from the urban areas. This finding is comparable with the findings in Tunisia by Fakhfakf et al [22] who also observed a higher prevalence of smoking in the rural area compared to the urban areas. It is also important to note that the prevalence of cigarette smoking in 2014 [19] is consistent with the prevalence obtained in previous Zambia Demographic Health Survey cigarette smoking statistics.

Our findings show that those with primary and secondary education were at a lower risk of cigarette smoking compared to thosewith no form of education, similarly, individuals who watched television or listened to the radio at least once a week were at a reduced risk of cigarette smoking compared to those who never watched television or listened to radio at all. The study findings also correlate with findings by Pampel who found that the less educated and lower status workers had high cigarette use [9]. This observation is vital for programming and interventions as documented by Chapman [23] stating that there is evidence that health
information, promotion, advertising, and smoking restrictions can be effective interventions of cigarette smoking on television and radio.

Relatives to the head of household in urban areas were at a higher risk of smoking cigarette compared to the head of household. This finding agrees with the results in Chongwe, Zambia and Nigeria where the adolescents whose parents were smokers were more likely to start smoking [24, 25] compared to individuals whose parents were not smokers. However, in rural areas, our results indicate that relatives to the head of household were at low risk of smoking compared to the head of household and this can be attributed to local customs, implying some form of respect for the head of household. The married/living with a partner were at a lower risk of smoking cigarette compared to those who have never been in union before. On the contrary, the divorced/separated were at a higher risk of smoking cigarette compared to those who have never been in union both in rural and urban area. This is more likely to be attributed to ways of reducing stress and feeling loneliness. The study was limited to the available indicators in the DHS dataset hence could not associate there correlates of smoking to health outcomes as tobacco use is a risk factor to many Non Communicable Diseases (NCDs).

Conclusion


Factors influencing tobacco smoking vary between and within regions as well as provinces. The geographic disparities play a role in tobacco consumption between rural and urban areas. Therefore, interventions to curb smoking should target specific demographic, socio-economic and cultural factors.

## Declarations

## Acknowledgements

We wish to thank the Zambia Central Statistics Office (CSO) for granting us permission to use the data. More specifically, we thank the Dissemination Office for the quick response to the request.

Availability of data and materials
The data is available in soft copy in different formats and can be accessed from the Zambia Central Statistics Office, P.O. Box 31908, Lusaka, Zambia; Telephone: (260-211) 251377/85 257604/05; Fax: (260-211) 1253468; E-mail: Info@zamstats.gov.zm; Internet: http:www.zamstats gov.zm; Data Portal: http://zambia.africadata.org.

## Authors' contributions

All authors were responsible for facets of the study. However, Herbert Tato Nyirenda was responsible for the formulation, methods, data analysis, results and discussion of the study. David Mulenga \& Tambulani Nyirenda contributed to the design, formulation and study discussion. Herbert B.C Nyirenda \& Moono Silitongo contributed to all facets of this research including writing, proof reading, and discussion. The paper was read and reviewed by all authors read.

## Competing interests

The authors declare that they have no competing interests.

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Figure 1: Spatial distribution of cigarette smoking by province


Cigarette Smoking


Spatial distribution of cigarette smoking by province
$255 \times 219 \mathrm{~mm}$ (72 x 72 DPI)

|  | $\begin{gathered} \text { Item } \\ \text { No } \\ \hline \end{gathered}$ | Recommendation | Page No |
| :---: | :---: | :---: | :---: |
| Title and abstract | 1 | (a) Indicate the study's design with a commonly used term in the title or the abstract | 2 |
|  |  | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| Introduction |  |  |  |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 3 |
| Methods |  |  |  |
| Study design | 4 | Present key elements of study design early in the paper | 3 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 3 |
| Participants | 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants | 4 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 4 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 4 |
| Study size | 10 | Explain how the study size was arrived at | 4 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 4 |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding | 4 |
|  |  | (b) Describe any methods used to examine subgroups and interactions | 4 |
|  |  | (c) Explain how missing data were addressed | 4 |
|  |  | (d) If applicable, describe analytical methods taking account of sampling strategy | 4 |
|  |  | (e) Describe any sensitivity analyses |  |
| Results |  |  |  |
| Participants | 13* | (a) Report numbers of individuals at each stage of study-eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 5 |
|  |  | (b) Give reasons for non-participation at each stage | 5 |
|  |  | (c) Consider use of a flow diagram |  |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 5 |
|  |  | (b) Indicate number of participants with missing data for each variable of interest | 5 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 5 |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, $95 \%$ confidence interval). Make clear which confounders were adjusted for and why they were included | 6 |


|  |  | (b) Report category boundaries when continuous variables were <br> categorized | (c) If relevant, consider translating estimates of relative risk into absolute <br> risk for a meaningful time period | 6 |
| :--- | :--- | :--- | :--- | :--- |
| Other analyses | 17 | Report other analyses done-eg analyses of subgroups and interactions, <br> and sensitivity analyses | 6 |  |
| Discussion | 18 | Summarise key results with reference to study objectives | 7 |  |
| Key results | 19 | Discuss limitations of the study, taking into account sources of potential <br> bias or imprecision. Discuss both direction and magnitude of any potential <br> bias | 7 |  |
| Limitations | 20 | Give a cautious overall interpretation of results considering objectives, <br> limitations, multiplicity of analyses, results from similar studies, and other <br> relevant evidence | 7 |  |
| 7 Interpretation | 21 | Discuss the generalisability (external validity) of the study results | 7 |  |
| Generalisability | 22 | Give the source of funding and the role of the funders for the present study <br> and, if applicable, for the original study on which the present article is <br> based | 9 |  |
| Other information |  |  |  |  |

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.


[^0]:    Education Status

[^1]:    Confidence Interval (CI) in parentheses

