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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 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, 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 **s**moking 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

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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.

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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 non-communicable 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

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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.

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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 to19 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**).

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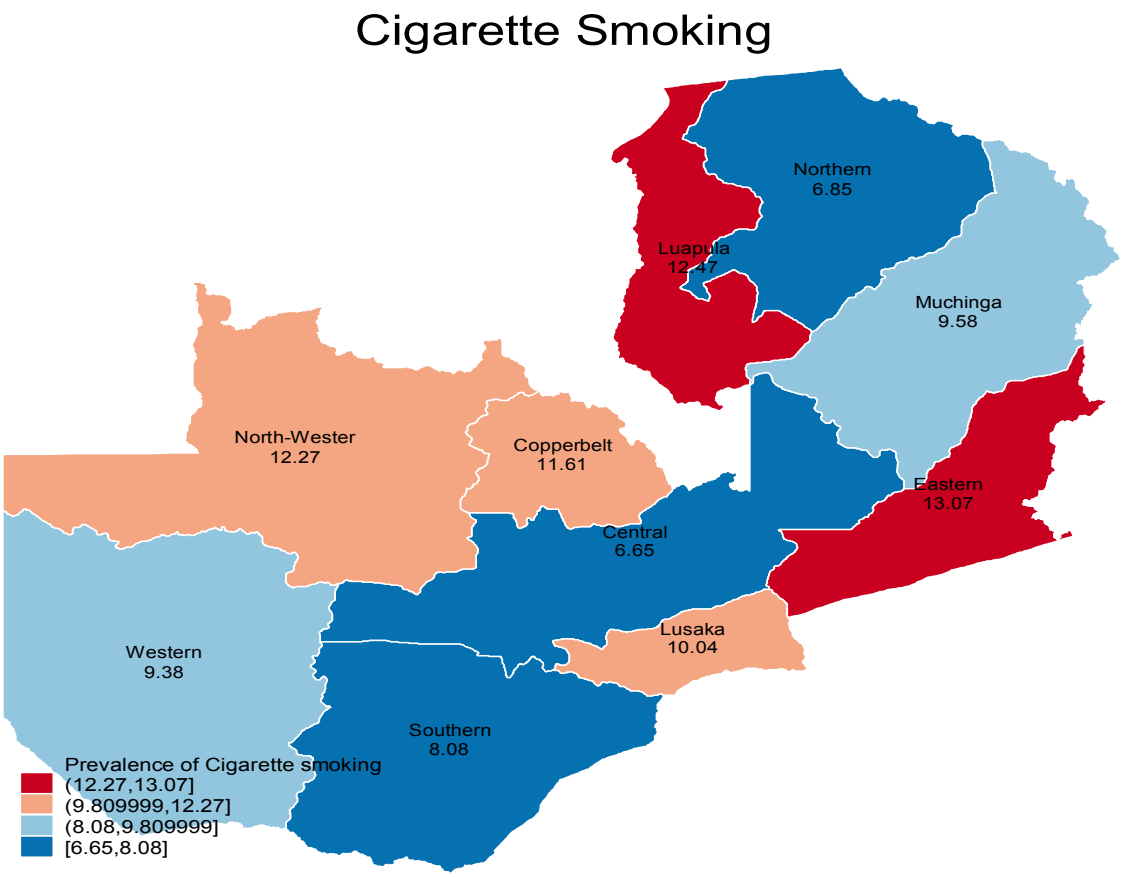
Figure 1: Spatial distribution of cigarette smoking by province



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						
	Non-Smokers	Non-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	98.2	[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

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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 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 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

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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 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							
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 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							

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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 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							
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

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	Non-Smokers	Non-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 F(9.16, 3720.36) = 27.5671 P-value < 0.001							
Region							
Central	91.6	[89.6-93.2]	8.3	[6.7-10.3]	0.1	[0.0-0.4]	1,985
Copperbelt	87.4	[84.7-89.7]	12.4	[10.1-15.1]	0.2	[0.0-0.9]	876
Eastern	88.8	[87.6-89.9]	11	[10.0-12.2]	0.2	[0.0-0.6]	3,266
Luapula	85	[83.3-86.6]	14.9	[13.3-16.7]	0.1	[0.0-0.3]	1,610
Lusaka	90.4	[88.4-92.0]	9.4	[7.8-11.4]	0.2	[0.1-0.8]	765
Muchinga	86.9	[84.6-88.9]	12.7	[10.7-15.1]	0.4	[0.2-0.8]	1,280
Northern	87.6	[85.9-89.0]	12.3	[10.8-13.9]	0.1	[0.0-0.6]	1,774
North-Western	90.5	[88.6-92.2]	7.5	[5.9-9.4]	2	[1.4-2.8]	958
Southern	92.9	[91.1-94.3]	6.9	[5.6-8.5]	0.2	[0.0-0.9]	2,932
Western	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 F(13.85, 5624.85) = 9.9583 P-value < 0.001							
Educational status							

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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	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 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							
Poor	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
Rich	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 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

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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]	0.6	[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) = 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

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

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, 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 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***

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		(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	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		0.49**
			(0.26 - 0.89)
Marital status			
	Never in union		1
	Married		0.69***
			(0.55 - 0.86)
	Living with a partner		0.45**
			(0.23 - 0.90)
	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	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	1	
	At least once a week	0.75***	
		(0.64 - 0.88)	
Frequency of Listening to the Radio			
	Not at all	1	
	At least once a week	0.82***	
		(0.72 - 0.92)	
Education Status			

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	No Education	1	1
	Primary	0.67***	0.72***
		(0.57 - 0.78)	(0.63 - 0.82)
	Secondary	0.41***	0.29***
		(0.31 - 0.54)	(0.18 - 0.48)
Gender			
	Male	1	1
	Female	0.01***	0.01***
		(0.01 - 0.02)	(0.01 - 0.02)
Religion (Denomination)			
	Catholic	1	1
	Protestant	0.64***	0.65***
		(0.55 - 0.75)	(0.57 - 0.75)
Wealth Index			
	Poor	1	1
	Middle	0.60***	0.49***
		(0.46 - 0.77)	(0.42 - 0.57)
	Rich	0.35***	0.50***
		(0.27 - 0.45)	(0.40 - 0.62)

Confidence Interval (CI) in parentheses

*** p<0.01, ** p<0.05, * 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 self-employed (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
		Relative Risk Ratio (RRR)	
Base outcome	**Non Smokers**		
	Pipe & Other Smokers		
Age			
	15-19		1
	25-29		14.71***

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			(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	1	
	Father/Mother	14.29**	
		(1.66 - 122.79)	
Occupation			
	Not working		1
	Other occupation		8.46***
			(2.95 - 24.20)
	Agricultural - Self employed		2.37***
			(1.39 - 4.02)
Education Status			
	No Education	1	
	Primary	0.36*	
		(0.11 - 1.16)	
Gender			
	Male	1	1
	Female	0.05***	0.01***
		(0.01 - 0.39)	(0.01 - 0.07)
Religion (Denomination)			
	Catholic	1	1
	Protestant	0.39*	
		(0.14 - 1.11)	
	Muslims		18.55**
			(1.81 - 189.77)
Wealth Index			
	Poor		1
	Middle		0.31***
			(0.14 - 0.67)
	Rich		0.16**
			(0.04 - 0.73)

Confidence Interval (CI) in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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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

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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

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

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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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Reference

1. Central Statistical Office (CSO), Ministry of Health (MOH), Tropical Diseases Research Centre (TDRC), University of Zambia, and Macro International Inc. Zambia Demographic and Health Survey 2013-14. Calverton, Maryland, USA: CSO and Macro International Inc.

2. Siziya, S; Rudatsikira, E; Muula, AS; Ntata, PRT. Predictors of cigarette smoking among adolescents in rural Zambia: results from a cross sectional study from Chongwe district. Rural and Remote Health 7: 728. (Online), 2007. Available from: http://www.rrh.org.au

3. Brathwaite R, Addo J, Smeeth L, Lock K (2015) A Systematic Review of Tobacco Smoking Prevalence and Description of Tobacco Control Strategies in Sub-Saharan African Countries; 2007 to 2014. PLoS ONE 10(7): e0132401. doi:10.1371/journal.pone.0132401

4. Siziya, S (2009) Higher Prevalence Rates of Smoking in Rural than Urban Areas among School-Going Adolescents in Lusaka Province, Zambia. Medical Journal of Zambia, Volume 36 number (3)

5. Olowski, P; and Michelo, C; (2015) Differential Burden and Determinants of Tobacco Smoking: Population-Based Observations from the Zambia Demographic and Health Survey (2002 and 2007). Journal of Healthcare Communications. Vol. 1 No. 1:3: ISSN 2472-1654

6. Proctor, M. H; Moore, L. L; Singer, M. R; Hood, M. Y; Nguyen, U. U; and Ellison, R. C; (1996) Risk profiles for non-communicable diseases in Rural and Urban Schoolchildren in the Republic of Cameroon, Ethn Dis:235-243

7. Finau, S. A; Stanhope, J. M; and Prior, I. A; (1982) Kava, Alcohol and Tobacco Consumption among Tongans with Urbanization. Social Science medicine: Volume 16: 35-41

8. Araújo, C; Azevedo, A; Damasceno, A; and Lunet, N; (2015) Evolving Tobacco Consumption in Sub-Saharan Africa Plos One| DOI:10.1371/journal.pone.0132401. pp 153-156. Available at www.scielo.mec.pt

9. ITC Project (May, 2014). ITC Zambia National Report. Findings from the Wave 1 (2012) Survey. University of Waterloo, Waterloo, Ontario Canada.

10. The Association of Chartered Certified Accountants [ACCA], (2013) Key health challenges for Zambia.

11. Pamel F. Tobacco use in Sub-Saharan Africa: Estimates from the demographic Health Surveys. Soc Sci Med 2008; 66:1772-83

12. Zyaambo C, Babaniyi O, Songolo P, Muula AS, Rudatsikira E, Siziya S. Prevalence and predictors of cigarette smoking in a mining town in Kitwe, Zambia: A 2011 population-based survey. Health (Irvine Calif) 2013;5:1021-5.

13. Siziya S, Babaniyi O, Songolo P, Nsakashalo-Senkwe M. Prevalence and correlates for tobacco smoking among persons aged 25 years or older in Lusaka Urban district, Zambia. J public health Epidemiol 2011;3:43-8

14. Mulenga D, Siziya S, Rudatsikira E, Mukonka VM, Babaniyi O, Songolo P, Muula AS, District specific correlates for hypertension in Kaoma and Kasama rural districts of Zambia. Rural and Remote Health 13: 2345. (Online) 2013

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15. Townsend J, Roderick P, Cooper J. cigarette smoking by socioeconomic group, sex, and and age: effects of price, income, and health publicity. BMJ 1994;309;923

16. Blecher, E. and Ross, H., Tobacco Use in Africa: Tobacco Control through Prevention, American Cancer Society, 2013.

17. Jabbour S and Fouad FM. Religion-based tobacco control interventions: how should WHO proceed? Bulletin of the World Health Organisation; 2004, 82(12)

18. Fakhfakh R, Hsairi M, Maalej M, Achour N, Nacef T. Tobacco use in Tunisia: behaviour and awareness. Bull Worl Health Organ 2002; 80: 350-6

19. Zambia Demographic Health Survey, 2013-2014
20 Chapman S. The role of Doctors in promoting smoking cessation. BMJ 1993;307:518-9

21. Siziya, S, Rudatsikira, E, Muula, AS and Ntata, PRT; Predictors of Cigarette Smoking Among Adolescents in Rural Zambia: results from a cross-sectional study in Chongwe district, Rural and Remote Health: 2007;7:728.

22. Salawu, FK, Danburum, A, Desalu, OO. Olokoba, AB, Agbo, J and Midala, JK; Meru:; Cigarette Smoking Habits Among Adolescents in Northwest Nigeria, Afri J of Resp Med, 2009.8-11

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	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

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

*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.

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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 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, 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 **s**moking 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

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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.

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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].

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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.

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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 I 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 to19 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.

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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-value =0.002), (**Table 1)**

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

	Urban						
	Smoking status						
	Non-Smokers	Non-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	98.2	[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

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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 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 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							

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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 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							
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 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

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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 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							
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							

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).**

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

	Rural smoking						
	Non-Smokers	Non-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 F(9.16, 3720.36) = 27.5671 P-value < 0.001							
Province							
Central	91.6	[89.6-93.2]	8.3	[6.7-10.3]	0.1	[0.0-0.4]	1,985
Copperbelt	87.4	[84.7-89.7]	12.4	[10.1-15.1]	0.2	[0.0-0.9]	876
Eastern	88.8	[87.6-89.9]	11	[10.0-12.2]	0.2	[0.0-0.6]	3,266
Luapula	85	[83.3-86.6]	14.9	[13.3-16.7]	0.1	[0.0-0.3]	1,610
Lusaka	90.4	[88.4-92.0]	9.4	[7.8-11.4]	0.2	[0.1-0.8]	765
Muchinga	86.9	[84.6-88.9]	12.7	[10.7-15.1]	0.4	[0.2-0.8]	1,280
Northern	87.6	[85.9-89.0]	12.3	[10.8-13.9]	0.1	[0.0-0.6]	1,774
North-Western	90.5	[88.6-92.2]	7.5	[5.9-9.4]	2	[1.4-2.8]	958
Southern	92.9	[91.1-94.3]	6.9	[5.6-8.5]	0.2	[0.0-0.9]	2,932
Western	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

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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 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	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 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							
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 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

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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]	0.6	[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) = 1885.3640							
Design-based F(20.98, 8518.16) = 56.9133 P-value < 0.001							

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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, 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 variables			
Age			
	15-19 (RC)	1	1

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	20-24	4.33*** (3.08 - 6.09)	5.77*** (4.08 - 8.15)
	25-29	9.27*** (6.51 - 13.22)	12.97*** (9.00 - 18.68)
	30-34	9.16*** (6.3 - 13.2)	13.82*** (9.47 - 20.16)
	35-39	7.71*** (5.28 - 11.25)	15.21*** (10.38 - 22.28)
	40-44	9.95*** (6.75 - 14.67)	19.96*** (13.63 - 29.25)
	45-49	10.96*** (7.28 - 16.51)	28.52*** (19.31 - 42.13)
	50-54	8.96*** (5.78 - 13.91)	22.00*** (14.56 - 33.25)
	55-59	10.93*** (6.76 - 17.67)	20.17*** (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	1.55*** (1.25 - 1.93)	0.66*** (0.51 - 0.85)
	Niece/Nephew by Marriage	2.08*** (1.24 - 3.49)	
	Other relative		0.49** (0.26 - 0.89)
Marital status			
	Never in union (RC)		1
	Married		0.69*** (0.55 – 0.86)
	Living with a partner		0.45** (0.23 – 0.90)
	Divorced	2.31*** (1.69 – 3.16)	1.84*** (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)	

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	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*** (0.57 - 0.78)	0.72*** (0.63 - 0.82)
	Secondary	0.41*** (0.31 - 0.54)	0.29*** (0.18 - 0.48)
Gender			
	Male (RC)	1	1
	Female	0.01*** (0.01 - 0.02)	0.01*** (0.01 - 0.02)
Religion (Denomination)			
	Catholic (RC)	1	1
	Protestant	0.64*** (0.55 - 0.75)	0.65*** (0.57 - 0.75)
Wealth Index			
	Low (RC)	1	1
	Middle	0.60*** (0.46 - 0.77)	0.49*** (0.42 - 0.57)
	High	0.35*** (0.27 - 0.45)	0.50*** (0.40 - 0.62)

Confidence Interval (CI) in parentheses, Reference Category (RC)
*** p<0.01, ** p<0.05, * 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 self-employed (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.

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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))

		Urban	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)	1	
	Father/Mother	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

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	Female	0.05*** (0.01 - 0.39)	0.01*** (0.01 - 0.07)
Religion (Denomination)			
	Catholic (RC)	1	1
	Protestant	0.39* (0.14 - 1.11)	
	Muslims		18.55** (1.81 - 189.77)
Wealth Index			
	Low (RC)		1
	Middle		0.31*** (0.14 - 0.67)
	High		0.16** (0.04 - 0.73)

Confidence Interval (CI) in parentheses, Reference Category (RC)
*** p<0.01, ** p<0.05, * 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

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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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Reference

1. Central Statistical Office (CSO), Ministry of Health (MOH), Tropical Diseases Research Centre (TDRC), University of Zambia, and Macro International Inc. Zambia Demographic and Health Survey 2013-14. Calverton, Maryland, USA: CSO and Macro International Inc.

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2. Siziya, S; Rudatsikira, E; Muula, AS; Ntata, PRT. Predictors of cigarette smoking among adolescents in rural Zambia: results from a cross sectional study from Chongwe district. Rural and Remote Health 7: 728. (Online), 2007. Available from: http://www.rrh.org.au

3. Brathwaite R, Addo J, Smeeth L, Lock K (2015) A Systematic Review of Tobacco Smoking Prevalence and Description of Tobacco Control Strategies in Sub-Saharan African Countries; 2007 to 2014. PLoS ONE 10(7): e0132401. doi:10.1371/journal.pone.0132401

4. Siziya, S (2009) Higher Prevalence Rates of Smoking in Rural than Urban Areas among School-Going Adolescents in Lusaka Province, Zambia. Medical Journal of Zambia, Volume 36 number (3)

5. Olowski, P; and Michelo, C; (2015) Differential Burden and Determinants of Tobacco Smoking: Population-Based Observations from the Zambia Demographic and Health Survey (2002 and 2007). Journal of Healthcare Communications. Vol. 1 No. 1:3: ISSN 2472-1654

6. Proctor, M. H; Moore, L. L; Singer, M. R; Hood, M. Y; Nguyen, U. U; and Ellison, R. C; (1996) Risk profiles for non-communicable diseases in Rural and Urban Schoolchildren in the Republic of Cameroon, Ethn Dis:235-243

7. Finau, S. A; Stanhope, J. M; and Prior, I. A; (1982) Kava, Alcohol and Tobacco Consumption among Tongans with Urbanization. Social Science medicine: Volume 16: 35-41

8. Araújo, C; Azevedo, A; Damasceno, A; and Lunet, N; (2015) Evolving Tobacco Consumption in Sub-Saharan Africa Plos One| DOI:10.1371/journal.pone.0132401. pp 153-156. Available at www.scielo.mec.pt

9. Pampel F (2008) Tobacco use in sub-Sahara Africa: estimates from the demographic health surveys. Social science & medicine 66: 1772–1783. 10.1001/jama.2014.16363 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

10. Ng'weina Francis Magitta (2018). Epidemiology of tobacco use and dependence in Sub-Saharan Africa: A systematic review. Department of Biochemistry and Department of Clinical Pharmacology, Mbeya College of Health and Allied Sciences, University of Dar es Salaam, Mbeya, Tanzania. Journal of Pulmonology and Clinical Research (2018) Volume 2, Issue 1.

11. Sreeramareddy CT, Pradhan PM, & Sin S (2014). Prevalence, distribution, and social determinants of tobacco use in 30 sub-Saharan African countries. BMC Med. doi: 10.1186/s12916-014-0243-x.

12. Dickson, Kwamena & Ahinkorah, Bright. (2017). Understanding tobacco use and socioeconomic inequalities among men in Ghana, and Lesotho. Archives of Public Health. 75. 10.1186/s13690-017-0197-5

13. Sinha, Dhirendra & Suliankatchi, Rizwan & Amarchand, Ritvik & Krishnan, Anand. (2016). Prevalence and socio-demographic determinants of any tobacco use and dual use in six countries of the WHO South-East Asia Region: Findings from the Demographic and Health Surveys (DHS). Nicotine & Tobacco Research. 18. 10.1093/ntr/ntv286..

14. Hadii M MamuduEmail author, Rijo M John, Sreenivas P Veeranki and Ahmed E Ogwell Ouma (2013). The odd man out in Sub-Saharan Africa: understanding the tobacco use prevalence in Madagascar. BMC Public Health201313:856. https://doi.org/10.1186/1471-2458-13-856

15. Jason Hsia, and Rachel Kaufmann. 2013. Tobacco Use By Men and Women in 49 Countries with Demographic and Health Surveys. DHS Comparative Reports No. 31. Calverton, Maryland, USA: ICF International

16. Siziya S, Babaniyi O, Songolo P, Nsakashalo-Senkwe M. Prevalence and correlates for tobacco smoking among persons aged 25 years or older in Lusaka Urban district, Zambia. J public health Epidemiol 2011;3:43-8

17. Zyaambo C, Babaniyi O, Songolo P, Muula AS, Rudatsikira E, Siziya S. Prevalence and predictors of cigarette smoking in a mining town in Kitwe, Zambia: A 2011 population-based survey. Health (Irvine Calif) 2013;5:1021-5.

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18. Mulenga D, Siziya S, Rudatsikira E, Mukonka VM, Babaniyi O, Songolo P, Muula AS, District specific correlates for hypertension in Kaoma and Kasama rural districts of Zambia. Rural and Remote Health 13: 2345. (Online) 2013

19. Townsend J, Roderick P, Cooper J. cigarette smoking by socioeconomic group, sex, and and age: effects of price, income, and health publicity. BMJ 1994;309;923

20. Blecher, E. and Ross, H., Tobacco Use in Africa: Tobacco Control through Prevention, American Cancer Society, 2013.

21. Jabbour S and Fouad FM. Religion-based tobacco control interventions: how should WHO proceed? Bulletin of the World Health Organisation; 2004, 82(12)

22. Fakhfakh R, Hsairi M, Maalej M, Achour N, Nacef T. Tobacco use in Tunisia: behaviour and awareness. Bull Worl Health Organ 2002; 80: 350-6

23 Chapman S (1993). The role of Doctors in promoting smoking cessation. BMJ 1993;307:518-9

24. Siziya, S, Rudatsikira, E, Muula, AS and Ntata, PRT; Predictors of Cigarette Smoking Among Adolescents in Rural Zambia: results from a cross-sectional study in Chongwe district, Rural and Remote Health: 2007;7:728.

25. Salawu, FK, Danburum, A, Desalu, OO. Olokoba, AB, Agbo, J and Midala, JK; Meru:; Cigarette Smoking Habits Among Adolescents in Northwest Nigeria, Afri J of Resp Med, 2009.8-11

Figure 1: Spatial distribution of cigarette smoking by province

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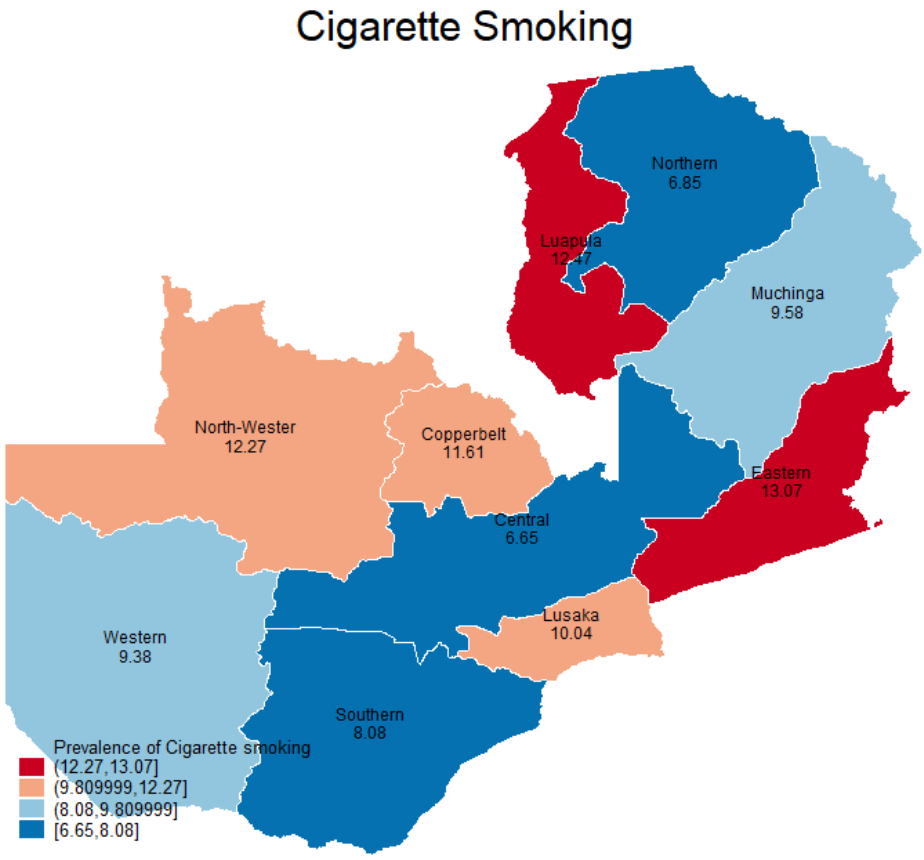

Spatial distribution of cigarette smoking by province

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	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

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

*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.

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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 **s**moking 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

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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.

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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].

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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.

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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 I 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 to19 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 (p-value =0.002), (**Table 1)**

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

	Urban						
	Smoking status						
	Non-Smokers	Non-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	98.2	[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

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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 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 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							

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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 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							
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 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

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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 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							
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							

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).**

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

	Rural smoking						
	Non-Smokers	Non-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 F(9.16, 3720.36) = 27.5671 P-value < 0.001							
Province							
Central	91.6	[89.6-93.2]	8.3	[6.7-10.3]	0.1	[0.0-0.4]	1,985
Copperbelt	87.4	[84.7-89.7]	12.4	[10.1-15.1]	0.2	[0.0-0.9]	876
Eastern	88.8	[87.6-89.9]	11	[10.0-12.2]	0.2	[0.0-0.6]	3,266
Luapula	85	[83.3-86.6]	14.9	[13.3-16.7]	0.1	[0.0-0.3]	1,610
Lusaka	90.4	[88.4-92.0]	9.4	[7.8-11.4]	0.2	[0.1-0.8]	765
Muchinga	86.9	[84.6-88.9]	12.7	[10.7-15.1]	0.4	[0.2-0.8]	1,280
Northern	87.6	[85.9-89.0]	12.3	[10.8-13.9]	0.1	[0.0-0.6]	1,774
North-Western	90.5	[88.6-92.2]	7.5	[5.9-9.4]	2	[1.4-2.8]	958
Southern	92.9	[91.1-94.3]	6.9	[5.6-8.5]	0.2	[0.0-0.9]	2,932
Western	84.7	[82.2-86.9]	14.1	[12.0-16.5]	1.2	[0.7-2.2]	1,346

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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 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	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 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							
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 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

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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]	0.6	[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

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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
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, 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: 1.69 - 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 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 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 quintile as well as high wealth quintile relative to those in the low wealth quintile.

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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 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)	(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	1.55***	0.66***
		(1.25 - 1.93)	(0.51 - 0.85)
	Niece/Nephew by Marriage	2.08***	
		(1.24 - 3.49)	
	Other relative		0.49**
			(0.26 - 0.89)
Marital status			
	Never in union (RC)		1
	Married		0.69***
			(0.55 – 0.86)
	Living with a partner		0.45**
			(0.23 – 0.90)
	Divorced	2.31***	1.84***
		(1.69 – 3.16)	(1.30 – 2.61)
	No longer living together/separated	2.03***	
		(1.36 – 3.02)	

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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***	0.29***
		(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	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***
		(0.27 - 0.45)	(0.40 - 0.62)

Confidence Interval (CI) in parentheses, Reference Category (RC)

*** p<0.01, ** p<0.05, * p<0.1

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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 self-employed (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))

		Urban	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)	1	
	Father/Mother	14.29**	
		(1.66 - 122.79)	
Occupation			
	Not working (RC)		1
	Other occupation		8.46***
			(2.95 - 24.20)
	Agricultural - Self employed		2.37***

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			(1.39 - 4.02)
Education Status			
	No Education (RC)	1	
	Primary	0.36*	
		(0.11 - 1.16)	
Gender			
	Male (RC)	1	1
	Female	0.05***	0.01***
		(0.01 - 0.39)	(0.01 - 0.07)
Religion (Denomination)			
	Catholic (RC)	1	1
	Protestant	0.39*	
		(0.14 - 1.11)	
	Muslims		18.55**
			(1.81 - 189.77)
Wealth Index			
	Low (RC)		1
	Middle		0.31***
			(0.14 - 0.67)
	High		0.16**
			(0.04 - 0.73)

Confidence Interval (CI) in parentheses, Reference Category (RC)
*** p<0.01, ** p<0.05, * 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

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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

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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 **s**moking should target specific demographic, socio-economic and cultural factors.

Declarations

Acknowledgements

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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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Reference

1. Central Statistical Office (CSO), Ministry of Health (MOH), Tropical Diseases Research Centre (TDRC), University of Zambia, and Macro International Inc. Zambia Demographic and Health Survey 2013-14. Calverton, Maryland, USA: CSO and Macro International Inc.

2. Siziya, S; Rudatsikira, E; Muula, AS; Ntata, PRT. Predictors of cigarette smoking among adolescents in rural Zambia: results from a cross sectional study from Chongwe district. Rural and Remote Health 7: 728. (Online), 2007. Available from: http://www.rrh.org.au

3. Brathwaite R, Addo J, Smeeth L, Lock K (2015) A Systematic Review of Tobacco Smoking Prevalence and Description of Tobacco Control Strategies in Sub-Saharan African Countries; 2007 to 2014. PLoS ONE 10(7): e0132401. doi:10.1371/journal.pone.0132401

4. Siziya, S (2009) Higher Prevalence Rates of Smoking in Rural than Urban Areas among School-Going Adolescents in Lusaka Province, Zambia. Medical Journal of Zambia, Volume 36 number (3)

5. Olowski, P; and Michelo, C; (2015) Differential Burden and Determinants of Tobacco Smoking: Population-Based Observations from the Zambia Demographic and Health Survey (2002 and 2007). Journal of Healthcare Communications. Vol. 1 No. 1:3: ISSN 2472-1654

6. Proctor, M. H; Moore, L. L; Singer, M. R; Hood, M. Y; Nguyen, U. U; and Ellison, R. C; (1996) Risk profiles for non-communicable diseases in Rural and Urban Schoolchildren in the Republic of Cameroon, Ethn Dis:235-243

7. Finau, S. A; Stanhope, J. M; and Prior, I. A; (1982) Kava, Alcohol and Tobacco Consumption among Tongans with Urbanization. Social Science medicine: Volume 16: 35-41

8. Araújo, C; Azevedo, A; Damasceno, A; and Lunet, N; (2015) Evolving Tobacco Consumption in Sub-Saharan Africa Plos One| DOI:10.1371/journal.pone.0132401. pp 153-156. Available at www.scielo.mec.pt

9. Pampel F (2008) Tobacco use in sub-Sahara Africa: estimates from the demographic health surveys. Social science & medicine 66: 1772–1783. 10.1001/jama.2014.16363 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

10. Ng'weina Francis Magitta (2018). Epidemiology of tobacco use and dependence in Sub-Saharan Africa: A systematic review. Department of Biochemistry and Department of Clinical Pharmacology, Mbeya College of Health and Allied Sciences, University of Dar es Salaam, Mbeya, Tanzania. Journal of Pulmonology and Clinical Research (2018) Volume 2, Issue 1.

11. Sreeramareddy CT, Pradhan PM, & Sin S (2014). Prevalence, distribution, and social determinants of tobacco use in 30 sub-Saharan African countries. BMC Med. doi: 10.1186/s12916-014-0243-x.

12. Dickson, Kwamena & Ahinkorah, Bright. (2017). Understanding tobacco use and socioeconomic inequalities among men in Ghana, and Lesotho. Archives of Public Health. 75. 10.1186/s13690-017-0197-5

13. Sinha, Dhirendra & Suliankatchi, Rizwan & Amarchand, Ritvik & Krishnan, Anand. (2016). Prevalence and socio-demographic determinants of any tobacco use and dual use in six countries of the WHO South-East Asia Region: Findings from the Demographic and Health Surveys (DHS). Nicotine & Tobacco Research. 18. 10.1093/ntr/ntv286..

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14. Hadii M MamuduEmail author, Rijo M John, Sreenivas P Veeranki and Ahmed E Ogwell Ouma (2013). The odd man out in Sub-Saharan Africa: understanding the tobacco use prevalence in Madagascar. BMC Public Health201313:856. https://doi.org/10.1186/1471-2458-13-856

15. Jason Hsia, and Rachel Kaufmann. 2013. Tobacco Use By Men and Women in 49 Countries with Demographic and Health Surveys. DHS Comparative Reports No. 31. Calverton, Maryland, USA: ICF International

16. Siziya S, Babaniyi O, Songolo P, Nsakashalo-Senkwe M. Prevalence and correlates for tobacco smoking among persons aged 25 years or older in Lusaka Urban district, Zambia. J public health Epidemiol 2011;3:43-8

17. Zyaambo C, Babaniyi O, Songolo P, Muula AS, Rudatsikira E, Siziya S. Prevalence and predictors of cigarette smoking in a mining town in Kitwe, Zambia: A 2011 population-based survey. Health (Irvine Calif) 2013;5:1021-5.

18. Mulenga D, Siziya S, Rudatsikira E, Mukonka VM, Babaniyi O, Songolo P, Muula AS, District specific correlates for hypertension in Kaoma and Kasama rural districts of Zambia. Rural and Remote Health 13: 2345. (Online) 2013

19. Townsend J, Roderick P, Cooper J. cigarette smoking by socioeconomic group, sex, and and age: effects of price, income, and health publicity. BMJ 1994;309;923

20. Blecher, E. and Ross, H., Tobacco Use in Africa: Tobacco Control through Prevention, American Cancer Society, 2013.

21. Jabbour S and Fouad FM. Religion-based tobacco control interventions: how should WHO proceed? Bulletin of the World Health Organisation; 2004, 82(12)

22. Fakhfakh R, Hsairi M, Maalej M, Achour N, Nacef T. Tobacco use in Tunisia: behaviour and awareness. Bull Worl Health Organ 2002; 80: 350-6

23 Chapman S (1993). The role of Doctors in promoting smoking cessation. BMJ 1993;307:518-9

24. Siziya, S, Rudatsikira, E, Muula, AS and Ntata, PRT; Predictors of Cigarette Smoking Among Adolescents in Rural Zambia: results from a cross-sectional study in Chongwe district, Rural and Remote Health: 2007;7:728.

25. Salawu, FK, Danburum, A, Desalu, OO. Olokoba, AB, Agbo, J and Midala, JK; Meru:; Cigarette Smoking Habits Among Adolescents in Northwest Nigeria, Afri J of Resp Med, 2009.8-11

Figure 1: Spatial distribution of cigarette smoking by province

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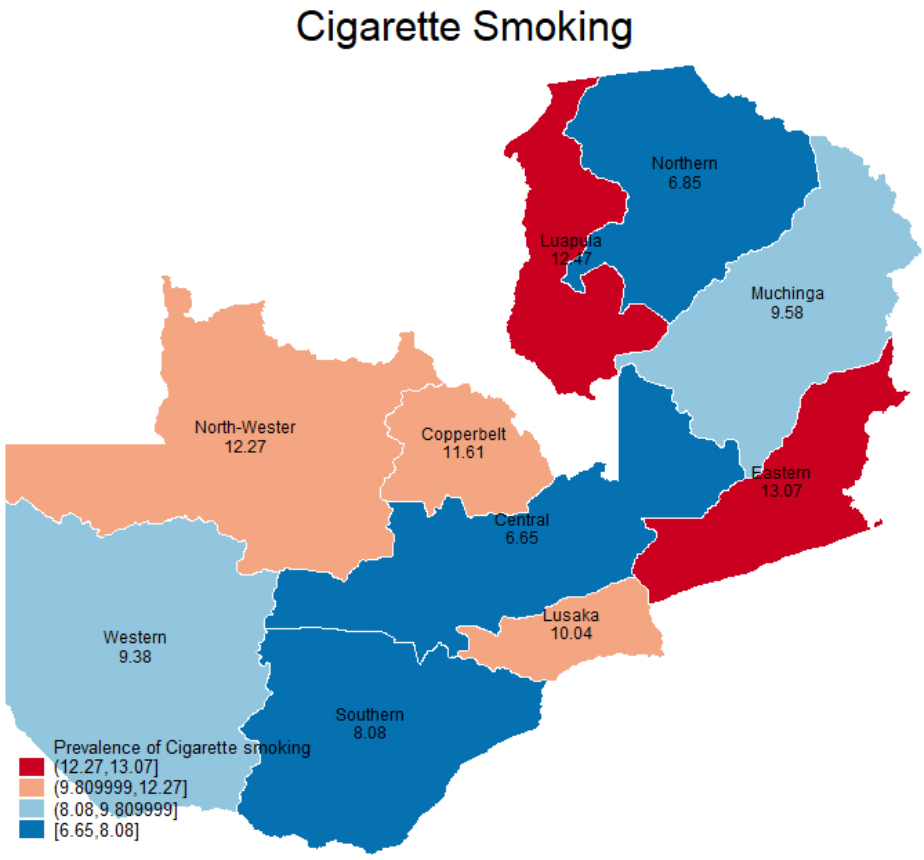

Spatial distribution of cigarette smoking by province

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	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

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

*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.

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