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Differential Burden and Determinants of Tobacco Smoking: Population-Based Observations from the Zambia Demographic and Health Survey (2002 and 2007)

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Abstract

Background: Tobacco smoking has been said to be on the increase in sub-Saharan countries which could potentially result in higher rates of associated non-communicable diseases (NCDs). We investigated the prevalence and factors associated with tobacco smoking in Zambian general population, and how they changed over time.

Method: Data stem from the Zambia Demographic and Health Survey conducted in 2002 (n=9803) and 2007 (n=13646). Extracted data on men aged 15-59 and women aged 15-49 was analyzed using a weighted analysis in STATA 12. Descriptive statistics involved investigation of demographic and socio-economic features of the study population. Predictors of tobacco smoking were examined using bivariate and multivariate stepwise binary logistic regression stratified by sex. Tobacco smoking prevalence and its associated factors were compared between 2002 and 2007 to assess the change. Overall non-response rates in these surveys were 5% and 6% respectively.

Results: Of all the respondents in 2002 (n=9803) 22% were men and 78% were women, whereas in 2007 (n=13646) 48% were men and 52% were women. Tobacco smoking prevalence decreased by about 2% in 2007 for both men (26.4% vs. 24.2%, P=0.038) and women (2.7% vs. 0.8%, P<0.001). Prevalence of smoking cigarettes in rural settings increased from 12% to 26% (P<0.001) among men, and from 0.4% to 1.1% (P<0.001) among women while it did not change in urban areas. Older ages, drinking alcohol, and lower education levels were common factors associated with higher odds of tobacco smoking in both 2002 and 2007 survey rounds.

Conclusion: We find contrasting rural urban smoking burden differentials contributing to the unchanging smoking burden overall in this population. The concentration of this burden in rural and less educated groups suggests past limitations to health promotion initiatives. This calls for a reformation in behavior information targeting these most at risk groups.

Keywords: Tobacco smoking; Prevalence; Patterns; Determinants; ZDHS

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Introduction

Tobacco c onsumption and exposure to tobacco smoke are both recognized as global public health problem with epidemic characteristics that has serious health, social, economic, and environmental consequences not only in individual countries but worldwide as well [1]. Given that the tobacco smoking potentially has serious negative consequences on health at both individual and community level, there is thus need to lobby governments' participation in synergizing prevention and control efforts aiming at changing the lifestyle. In sub-Saharan Africa, the emergency of many other lifestyle challenges has intensified the burden of disease in general as a result of the increasing negative effects of TB, Malaria, STI and HIV. Unfortunately, there has been an unbalanced effort titling towards these infections while efforts targeting tobacco control have continued to be less prioritized [2]. This underscores the fact that tobacco smoking is especially dangerous due to a time lag between the exposure to the tobacco smoke and the onset of tobacco-related diseases that can mask a slow but inevitable deterioration of one's health [1]. Among different types of smoked tobacco the most common are widely available cigarettes which are growing cause of death worldwide [3]. Given this presence of smoking lifestyle in sub-Saharan Africa, WHO estimates that one billion people may be at risk of dying in the 21st century globally [4]. However, by 2030, WHO also estimates that more than 80% of tobacco deaths will occur in developing countries [3]. This is attributed to the fact that both direct and second-hand tobacco smoking increases risk of cancer (trachea, bronchus, lungs), respiratory (COPD), cardiovascular (coronary artery disease, and stroke), and other health issues [5]. These non-communicable diseases (NCDs) are among the most common and important diseases associated with mortality in economically developed countries in Europe, and the United States [6].

Tobacco smoking prevalence in sub-Saharan Africa ranges from 7.31% in Ghana to 37.11% in Sierra Leone [7, 8]. However an accelerated economic growth in the region and campaigns by tobacco companies could potentially contribute to the increase in tobacco consumption [3]. Given the established relationship already documented between smoking and lung, as well as cardiac disorders, any increase in tobacco smoking could theoretically be assumed to affect the burden of such related NCDs. Therefore, it is important to not only monitor and evaluate tobacco smoking prevalence figures, but also examine determinants and patterns of tobacco smoking on regular basis. This could help to inform evidence-based decisions on health policies or programs, and consequently contribute to the implementation of effective measures for healthy life style promotion, and prevention of smoking-related diseases.

While tobacco smoking in the sub-Sahara African nations appears to be lower in comparison to other regions of the world the prevalence trends seem to be increasing in majority of them [7, 8]. Zambia, a landlocked country in Southern Africa with tropical climate and population over 13 million is one of them [9]. In order to control tobacco consumption Zambia enacted the 1992 Public Health (Tobacco) Regulation, and ratified the Framework Convention on Tobacco Control in 2008, although the current regulations are not strongly enforced to fulfill demands of the FCTC [10]. Studies of tobacco use in Zambia in the early epidemic stages have shown that most smokers were men living in urban areas, had a low socio-economic status, lower education and manual occupations [11]. Results being similar to DHS-based estimates from 16 sub-Saharan countries, especially indicating that highly educated and wealthier avoid smoking tobacco likely due to greater awareness of associated health risks [8]. Relatively recent study found that the tobacco smoking epidemic in Zambia is still in an early stage, and the prevalence of smoking among urban males was found at 17.5% [12]. The study of tobacco smoking determinants conducted in mining town Kitwe found sex, education, and alcohol consumption to be the main determinants of smoking [13]. In another study in rural Chongwe district, smoking among adolescents was associated with parental and peer smoking, exposure to cigarette promoting advertisements, and lack of awareness of harmful effects of tobacco smoke [14]. Despite previous studies in Zambia, there is limited evidence on tobacco smoking patterns and trends as well as the factors that might be driving them. We investigated the prevalence, patterns and determinants of tobacco smoking within the general Zambian population, and how they changed between consecutive ZDHS surveys conducted in 2002 and 2007.

Method

ZDHS study design

ZDHS is a nationally representative sample survey of women and men in reproductive age which aims to provide information concerning fertility, childhood mortality, use of family planning methods, and maternal and child health indicators including HIV/AIDS [15]. The national population-based data was collected from the nine provinces of Zambia. The Zambian population according to census data in 1990 and 2000 were reported to be 7.8 and 9.9 million, respectively (Zambia Census Report, ZDHS 2007). Representative probability samples of approximately 8000 households were selected using a two staged stratified sampling procedure. A total of 320 Standard Enumeration Areas (SEAs) were selected with probability proportional to the SEA size from the 2000 Census of Population and Housing frame. A SEA is a convenient geographical area with an average size of 85 households in the 2002 ZDHS and 130 households during ZDHS 2007. The SEAs were further stratified by urban and rural areas of each province into 18 strata. A complete listing of households in the selected SEAs was conducted, and households were selected in every cluster, by equal probability systematic sampling. Detailed sampling methods of the surveys have been reported in the 2001-2002 and 2007 ZDHS reports [15, 16]. The study population in both ZDHS surveys encompassed all women aged 15-49 years and all men aged 15-59 years. The data collection instrument used was Household, Women's, and Men's questionnaires administered to eligible respondents from the selected households. The questionnaires captured variety of information; however our study was mostly interested in questions on socio-demographic and socio-economic features, tobacco smoking, exposure to media, and health-risk behaviors.

Tobacco smoking study design

The study population includes women aged 15-49 years and men aged 15-59 years interviewed during Zambian Demographic and Health Surveys (ZDHS) conducted in 2002, and 2007. Only respondents who answered "Do you currently smoke cigarettes?", or "Do you currently smoke or use any other type of tobacco?" question were included in the study. The outcome variable in this study was binomial and called "tobacco smoking". It was constructed by merging "Yes" and "No" answers given to different methods of tobacco smoking, such as "smoking cigarettes", "pipe", or "other" by survey respondents. Independent variables were: age, sex, residence, religion, education, literacy, marital status, occupation, alcohol, wealth, listening to radio, reading newspaper, watching television, risky behavior, times away from home, and self-rated "health risk self-assessment". The wealth variable stems from wealth index recoded from a Likert scale comprising five categories to only three categories (poor, middle, rich) and serves as a proxy of a participant's socio-economic status. Risky behavior variable is a proxy of risky sexual behavior composite index constructed using "Condom used at the last intercourse", "Had any STD in last 12 months", "Number of sex partners including spouse in last 12 months". Health risk self-assessment is a proxy of personal HIV/AIDS risk assessment question "Do you think your risk of getting infected with HIV is low, medium or high, or do you have no risk at all?" recoded into three categories: "Don't know", "Perceived risk", and "Perceived no risk".

Data analysis

Data analysis was done in STATA version 12 software using commands supporting complex survey data with sampling weights [17]. Descriptive statistics of individual characteristics and testing for associations was performed using Chi Square test and logistic regression. Correlation analysis and interaction testing between variables was also performed, and effect modifications examined. The relationship between tobacco smoking prevalence and independent variables were tested through bivariate analysis of odds ratios (OR) at 95% CI. The covariates that were found to be significantly associated ($P<0.10$) with tobacco smoking were included for further analysis in the multivariate model. Consequently, the multivariate logistic regression model was used in order to detect which independent variables had the strongest associations with tobacco smoking, and what were the most common patterns in relation to specific determinants and risk factors. Stepwise regression modelling and post-estimation analysis were used to examine the predictors of smoking. Best fit model was identified by the likelihood ratio (LR) test comparing regression coefficients between consecutive models until p-value ≤ 0.05 indicated that the next reduced model had no better fit. The LR test was performed using standard "logistic" regression command with "sampling weights" and "robust estimator of variance" option to produce weighted estimates of parameters and predicted probabilities identical with svy command output [18]. The data analysis described above was conducted for 2002 and 2007 surveys separately, and then results were compared to examine changes in tobacco smoking prevalence and factor trends over time using chi square test for differences in proportions assuming independence of populations.

Ethical considerations

The ZHDS as a program has a running ethical clearance since 1996 but is renewed every time another survey is conducted. In both the 2002 and 2007 data was de-identified to protect participant's privacy and confidentiality of data. The tobacco smoking study was assumed to have minimum to no risk as it is based on "already collected data" categorization given to it. Nonetheless, ethical approval was sought and a waiver was obtained from ERES Converge for conducting the study (Ref. No. 2014-May-013). The Central Statistics Office (CSO) and Measure Evaluation granted permission for the usage of the Zambia Demographic and Health Survey data sets. The study benefits is assumed to be to the general population in that results will inform policies and health promotional efforts that are likely to inform healthy life styles in individuals and communities.

Results

Population and distribution

Among all eligible interviewed respondents (n=9803 in 2002 and n=13646 in 2007), with complete data there were 2100 (21.8%) men and 7547 (78.2%) women in 2002, whereas there were 6199 (47.2%) men and 6942 (52.8%) women in 2007. In 2002 and 2007 the overall mean age was 28.2 (SD ± 9.8) and 29 (SD ± 10.3) years respectively. Mean years in school was 5.2 (SD ± 3.5) and 6.5 (SD ± 3.7) years for women, and 6.7 (SD ± 3.7) and 8 (SD ± 6.4) years for men in 2002 and 2007, respectively. Respondent's age characteristic were the same in 2002 and 2007, however the education attainment was higher in 2007. Proportion of participants living in rural settings was 67% in 2002, and 56% in 2007.

Tobacco smoking prevalence

Results of tobacco smoking prevalence are summarized in **Table 1**. Weighted results show that tobacco smoking prevalence in 2007 was 24.2% for men and 0.8% for women that accounts for 2.2% ($P=0.038$) and 1.9% ($P<0.001$) decrease by 2007 from 2002 respectively. Trends of tobacco smoking prevalence between 2002 and 2007 are shown in **Figure 1**. The big difference of 23% between male and female smokers observed in 2002 also remained the same in 2007. By region, tobacco prevalence remained highest in Luapula, and in Western province. The combined male and female prevalence of tobacco smoking remains highest in Western province despite seeing the biggest drop of female smokers in 2007. Furthermore, the biggest drop in male smokers took place in Southern province, whereas in two provinces, Central and Copperbelt, the prevalence of male smokers increased. By age factor, the biggest increase in prevalence of smoking from 3.7% to 16.7% occurred between first two age groups, 15-19 and 20-24, respectively. Further analysis showed that in 2007 tobacco smoking prevalence in 15-19 age group was highest for those living in wealthy households. However, general trends presented in **Figure 2** indicate that starting from the age of 30 years the tobacco smoking prevalence is clearly highest among poor, and lowest among rich. Tobacco smoking prevalence was also examined by educational attainment and illustrated in **Figure 3.** Results show that education has an effect on tobacco smoking

Table 1 The prevalence of tobacco smoking in Zambia (2002 and 2007).

Prevalence (%)	2002			2007		
	Men n=2145	Women n=7658	Overall n=9803	Men n=6500	Women n=7146	Overall n=13646
Crude	26.77	2.73	7.99	23.96	0.87	11.87
Adjusted (Weighted)	**26.40**	**2.70**	7.89	**24.18**	**0.81**	11.95
Age-standardized*	26.32	2.62	7.38	23.44	0.83	10.73
Sex-standardized**	26.91	2.75	**14.18**	23.96	0.87	**11.87**

*Age-standardized prevalence computed using Zambian Census 2010 report as a standard population
Age range: men 15-59; women 15-49; overall 15-49
**Sex-standardized prevalence computed using 2007 study population as a standard population

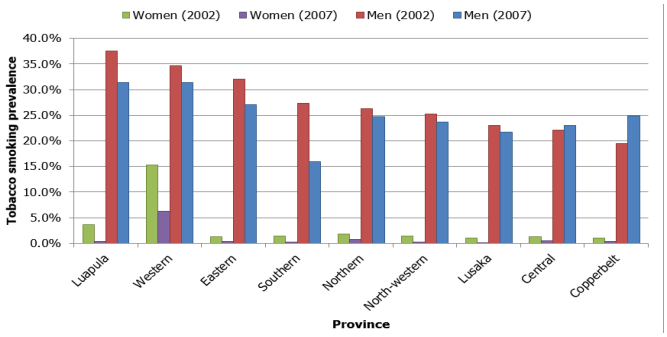

Figure 1 Tobacco smoking prevalence trends by sex and province in Zambia between 2002 and 2007.

prevalence being highest in no education group, and lowest in higher education group.

Table 2 illustrates prevalence of tobacco smoking by type. It shows that in rural areas prevalence of smoking cigarettes more than doubled from 0.4% to 1.1% (P<0.001) among females, and from 12% to 26% (P<0.001) among males while prevalence of smoking tobacco using other method than cigarettes and pipe dropped more than three times. Prevalence of smoking cigarettes by men in urban areas remained unchanged at 21%.

Determinants of tobacco smoking

Overall bivariate analysis of data demonstrated that being a man, living in rural settings, being married, which included living as married or being formerly married namely widowed, separated, or divorced, having an occupation, drinking alcohol, engaging in risky behavior, and being in older age were all positively and significantly (P<0.05) associated with tobacco smoking across both 2002 and 2007 surveys. In multivariate logistic regression, the most constant predictors irrespective of participant gender and time elapsed between surveys were age, sex, education, and alcohol. While stratified by gender, the most consistently occurring determinants for men were age, education, alcohol, marital status, and occupation. For women, age, education, alcohol, and residence. From 2007 survey data, men aged 30 and above had nearly three-fold increase in likelihood of smoking comparing to younger 15-24 age group (AOR=2.7 95% CI: 2.01-3.61), higher education decreased chances of male smoking by almost 80% (AOR=0.23 95% CI: 0.14-0.39), and rich men were 43% (AOR=0.57 95% CI: 0.41-0.79) less likely to smoke compared to the poor. Women aged 29 and below had 70% less chances of smoking than oldest 40-49 age group (AOR=0.3 95% CI: 0.12-0.75), having primary education decreased chances of female smoking by nearly 75% (AOR=0.26 95% CI: 0.13-0.5), and women living in rural areas had three-fold increase in likelihood of smoking (AOR=3.07 95% CI: 1.26-7.52) compared to those in urban areas. **Table 3** summarizes all results of multivariate logistic regression modelling. Notably, residence variable changed the direction of its measure of association with tobacco smoking in 2002 multivariate analysis for women, and in 2007 multivariate analysis for men. It appears that after adjusting for wealth and other factors, the residence in rural settings became negatively associated with tobacco smoking for men (AOR=0.72 95% CI: 0.56-0.94). The number of times respondents spent away from home within a year, specifically three and more times, was positively associated with tobacco smoking for women and negatively associated for men in both bivariate and multivariate regression without significant change in odds ratios. The explanatory variable of literacy was removed from the modeling process due to its correlation and interacting with education variable. Higher education impact on exposure to media was tested. Removing education variable from the model did not reduce effect of exposure to media on tobacco smoking estimates.

Discussion

We find evidence of high tobacco smoking prevalence in this population which is unchanging over the period of the study. Further, this burden is heavily concentrated in older males residing in highly urbanized areas of the country in contrast to females, who nonetheless seem to use smokeless tobacco more than men, especially in rural areas. We also find evidence suggesting that tobacco smoking is also steadily increasing in younger groups less than 24 years suggesting that the age at first smoking might be getting lower than before in general. The reasons for this are unclear and were beyond the scope of this study, but we postulate that this may be associated with changing household economies driven by changing national economy. We say so because we observed that it was the teens from wealthier households that tended to smoke the most. In addition to this, we also observed from sex stratified analysis that the patterns and characteristics of smoking determinants were similar to what was reported by previous studies, unchanging in character over time too [11]. Finding that teens from wealthier homes smoked more was an interesting strategic observation given the fact that age continues to be a strong predictor of tobacco smoking in that it increases chances of smoking among older individuals, which

Table 2 The prevalence of tobacco smoking by method and residence in Zambia (2002 and 2007).

	2002						2007					
	Cigarettes		Pipe		Other		Cigarettes		Pipe		Other	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Residence												
Urban	21.06	0.61	0.0	0.0	3.21	0.65	21.05	0.25	1.51	0.0	3.0	0.1<
Rural	**11.83**	**0.42**	0.15	0.1<	**18.9**	**3.22**	**25.97**	**1.11**	1.04	0.23	**5.06**	**0.1<**
Total	15.49	0.5	0.1<	0.1<	12.67	2.19	23.84	0.75	1.24	0.13	4.17	0.1<

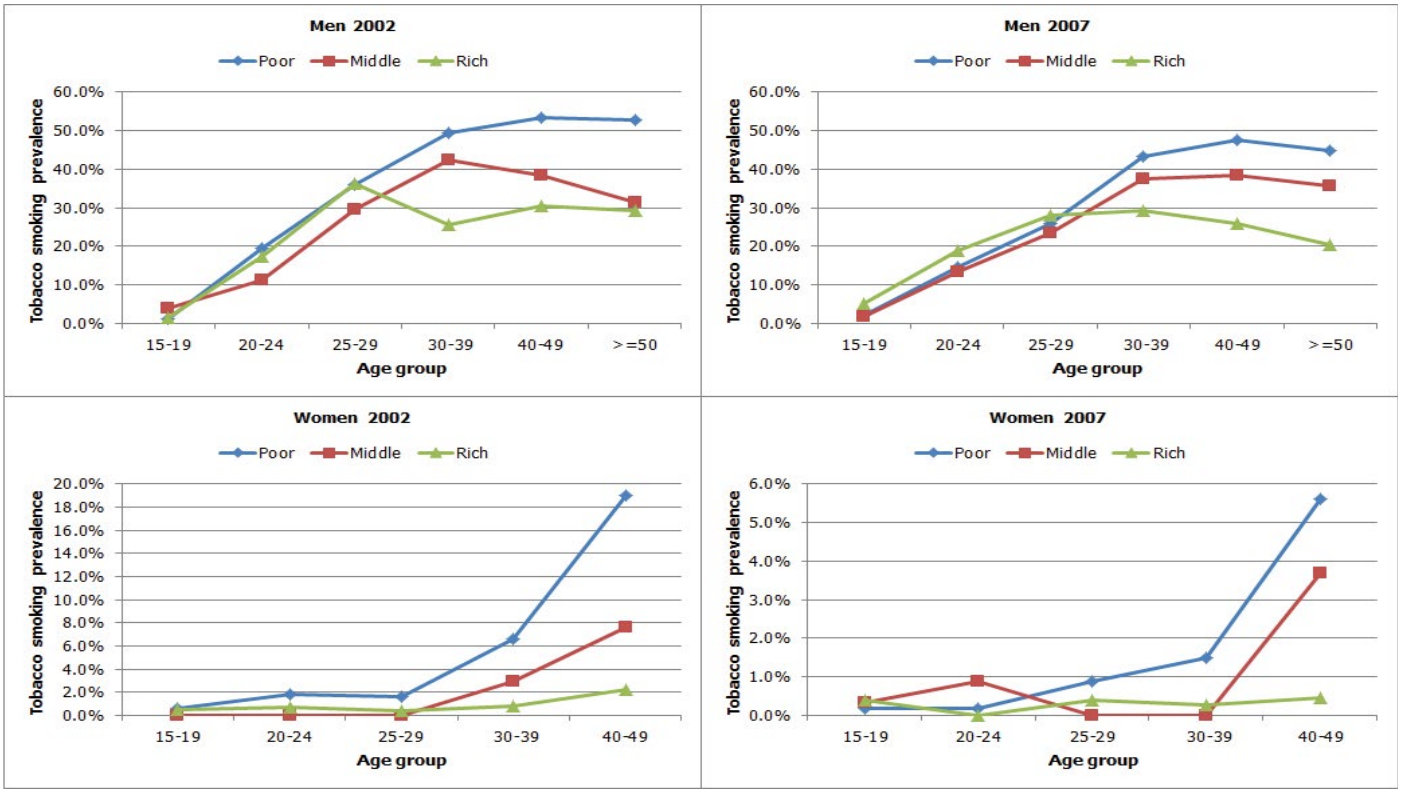

Figure 2 Tobacco smoking prevalence trends by age and wealth in Zambia between 2002 and 2007.

could potentially increase the exposure to smoke in such groups when they start smoking at that age. The opportunity here is to follow these individuals as a health promotional intervention so as to prevent by targeting early detection of associated NCDs.

In this population, we observed that smoking rose between consecutive age groups with the highest surge in male tobacco smokers between 15-19 years and 20-24 years age groups. This suggests that a significant number of young men enter tobacco smoker status between 18 and 21 years of age which is consistent with available evidence that shows that in sub-Saharan countries tobacco use among young adult males commence during their late adolescence or early adulthood [2]. The presence of advertisements that show the availability of cigarettes could thus and possibly explain why we persistently find that Zambian adolescents constitute a sub-group at high risk. These subtle marketing approaches together with peer pressure dynamics and lack of knowledge of health risks associated with smoking could thus make them susceptible to the vice [14]. It underscores importance of targeting adolescents in overall efforts to curb tobacco smoking epidemic, especially with support from evidence that those who manage to avoid smoking before age of 21 most likely will never begin [3]. Due limitation of the study stemming from the ZDHS sampling process we could not examine and compare prevalence and factors associated with tobacco smoking among young teenage group aged 13-15 with findings reported in other studies [14, 19].

Other than age, we also found sex, education and drinking alcohol were all associated with tobacco smoking and this association remained unchanged over time, all matching core factors determined by findings from a study in a local mining town of Kitwe [13]. We therefore argue that in general, smoking tobacco appears to be driven by socio-economic factors, such as wealth and education. Higher socio-economic status seems to have a protective effect. Consequently, tobacco smoking remains

Table 3 Summary of final determinants associated with tobacco smoking in Zambia (2002 and 2007) with AORs (95% CI).

Age group	Men (2002)	Women (2002)	Overall (2002)	Men (2007)	Women (2007)	Overall (2007)
15-24	ref	0.1 (0.06, 0.18)**	ref	ref	0.25 (0.1, 0.64)*	ref
25-29	4.29 (2.42, 7.6)**	0.1 (0.05, 0.2)**	2.93 (1.86, 4.61)**	1.95 (1.41, 2.69)**	0.3 (0.12, 0.75)*	1.92 (1.4, 2.64)**
30-39	4.43 (2.47, 7.97)**	0.39 (0.26, 0.58)**	3.99 (2.56, 6.2)**	2.7 (2.01, 3.61)**	0.33 (0.15, 0.72)*	2.63 (1.98, 3.48)**
40-49	5.11 (2.88, 9.07)**	ref	7.05 (4.45, 11.16)**	2.77 (1.96, 3.92)**	ref	3.01 (2.13, 4.24)**
50+	5.32 (2.72, 10.4)**		4.92 (2.69, 8.97)**	2.39 (1.59, 3.59)**	n/a	2.42 (1.62, 3.62)**
Sex (ref Female)						
Male			12.1 (8.8, 16.6)**			27.1 (19.6, 37.4)**
Residence (ref Urban)						
Rural		0.42 (0.24, 0.75)*		0.72 (0.56, 0.94)*	3.07 (1.26, 7.52)*	0.74 (0.57, 0.95)*
Religion (ref Catholic)						
Non-Catholic	0.73 (0.54, 0.99)*					
Education (ref None)						
Primary	0.62 (0.37, 1.02)	0.44 (0.29, 0.64)**	0.42 (0.31, 0.58)**	0.64 (0.48, 0.87)*	0.26 (0.13, 0.5)**	0.53 (0.4, 0.69)**
Secondary	0.53 (0.31, 0.89)*	0.18 (0.08, 0.42)**	0.34 (0.24, 0.48)**	0.43 (0.31, 0.6)**	0.29 (0.1, 0.83)*	0.38 (0.28, 0.51)**
Higher	0.2 (0.08, 0.48)**	n/a	0.14 (0.06, 0.3)**	0.23 (0.14, 0.39)**	0.25 (0.03, 2.24)	0.21 (0.13, 0.35)**
Marital Status (ref Never)						
Currently married	1.25 (0.73, 2.13)		1.19 (0.77, 1.84)	0.88 (0.69, 1.12)		0.87 (0.68, 1.1)
Formerly married	3.25 (1.63, 6.48)*		2.22 (1.29, 3.82)*	1.6 (1.05, 2.43)*		1.57 (1.05, 2.34)*
Occupation (ref None)						
Sale & services	1.51 (0.9, 2.54)	1.36 (0.65, 2.87)	1.65 (1.09, 2.5)*	2.19 (1.52, 3.14)**		2.04 (1.46, 2.85)**
Agriculture	1.65 (1.05, 2.6)*	2.94 (1.73, 4.99)**	2.06 (1.45, 2.93)**	1.84 (1.31, 2.57)**		1.61 (1.19, 2.18)*
Professional	0.73 (0.3, 1.78)	n/a	0.78 (0.33, 1.82)	1.98 (1.1, 3.58)*		1.9 (1.06, 3.41)*
Manual	1.12 (0.61, 2.06)	1.76 (0.64, 4.85)	1.41 (0.85, 2.32)	2.33 (1.67, 3.26)**		2.18 (1.58, 3.01)**
Alcohol (ref None)						
Drinks alcohol	4.8 (3.79, 6.07)**	4.84 (3.32, 7.04)**	5.31 (4.35, 6.49)**	8.77 (7.41, 10.38)**	11.38 (6.5, 19.94)**	9.13 (7.77, 10.73)**
Wealth (ref Poor)						
Middle		0.3 (0.18, 0.49)**	0.6 (0.47, 0.78)**	0.83 (0.67, 1.02)		0.79 (0.64, 0.97)*
Rich		0.17 (0.09, 0.32)**	0.62 (0.46, 0.83)*	0.57 (0.41, 0.79)*		0.53 (0.39, 0.73)**
Listen to radio (ref <1/w)						
≥ 1/week	0.63 (0.48, 0.83)*		0.73 (0.58, 0.93)*		0.35 (0.18, 0.68)*	
Read newspaper (ref <1/w)						
≥ 1/week	0.6 (0.43, 0.84)*		0.72 (0.51, 1.01)			0.83 (0.68, 1.01)
Watch TV (ref <1/w)						
≥ 1/week				0.72 (0.58, 0.91)*		0.76 (0.61, 0.94)*
Risky behavior (ref No)						
Yes		2.42 (0.86, 6.79)			5.17 (1.05, 25.49)*	
Away from home (ref <3/y)						
≥ 3 times in 1 year				0.77 (0.64, 0.91)*	2.66 (1.37, 5.19)*	0.84 (0.7, 1.01)
For all models regression coefficients and confidence intervals in parenthesis have been reported. (** p<0.001; * p<=0.05)						

highest among poor individuals and lowest among rich, even though results suggest that middle and rich individuals in late twenties could start smoking more than other age groups. This distinct division between poor and rich on prevalence scale is repeatedly formed in 25-29 age groups, most likely due to social position being established at that age adequately to acquired education and corresponding professional career opportunities.

The strong effect that education attainment has on tobacco smoking was found to be unchanging in this study as well. Higher educated groups had a decreased likelihood of smoking tobacco in overall. Although economic and lifestyle changes that accompany educational attainment may have been associated with behaviors that increased the risk of smoking in young people particularly, this relationship seems to be dissolving with increasing age and number of years in school in this population. This is reasonable evolution in that highly educated groups may be the first to

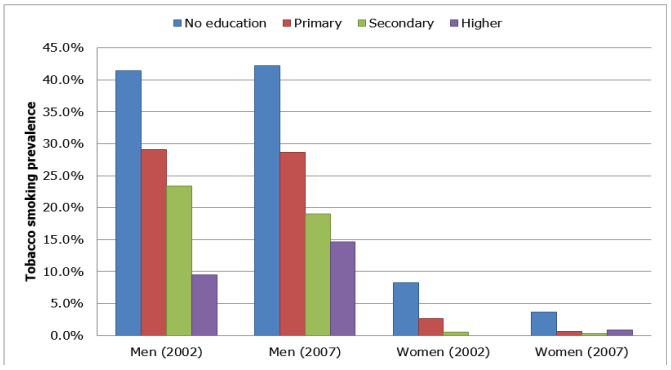

Figure 3 Tobacco smoking prevalence by educational attainment in Zambia (2002 and 2007).

respond positively to preventive messages on smoking. Despite this, educational attainment is still seen as a risk factor in teens from wealthier communities suggesting that there may be interplay of several factors interacting with age and development in this association. Hence, the relationship between educational attainment and smoking and other associated factors should be investigated in order to understand the dynamics that might be associated with the smoking burden observed in this population and how different groups respond. One of those dynamics could focus on how low literacy among those without, or with poor education may affect their ability to read health warnings despite the presence of indigenous knowledge systems which can convey the same message. This may help to explore on the value and role of health promotional innovations, such as the implementation of pictorial warnings on tobacco products packaging in addition to, or instead of text warnings.

We also find that geographical contrasts associated with smoking exist in this population. Although proportionally, higher number of smokers lives in rural areas, in as far as tobacco smoking is concerned; men and women in urban areas smoke more. Furthermore, it was surprising to note that in rural areas smoking cigarettes by men and women more than doubled between 2002 and 2007 suggesting both the popularity of tobacco smoking, but also the potential for emergency of health outcomes that are associated with this behavior. This picture seemed to be unchanging between the two time periods. This may also be suggesting that cigarettes could have become more accessible and affordable to rural residents, thus a preferred choice of smoked tobacco replacing other methods of smoking. This transition could be dictated by increased market penetration, more aggressive promotion of cigarettes, and their higher sales in rural settings reducing consumption of other types of smoked tobacco. Increased consumption of cigarettes may be also linked to changing individuals income and their high affordability since the cigarettes price was one of the least reasons leading Zambian smokers to think about quitting [10]. We suspect that observed trend of increased cigarette consumption likely through replacement of other ways of smoking tobacco continued in years following this study period.

Lifestyle in general was thus a critical factor dictating the likelihood of one to smoke or not. One of the lifestyle factors examined was alcohol consumption. Alcohol remained to be a second strongest determinant of smoking after sex. Both men and women who drink alcohol were much more likely to smoke tobacco than those who don't drink which we think may be attributable to co-addiction. This is consistent with epidemiological estimates that 80 percent of alcohol addicts smoke frequently, which may be attributable not only to the lifestyle but to co-addiction due to genetic correlation as well [20].

Among other less prominent determinants, odds of smoking tobacco were higher among women with risky behavior factor constructed as a proxy of risky sexual behavior. This suggests that women who exhibit risky behavior may be generally careless about own health irrespective of having knowledge of potential various health risks. Therefore, even if they are aware of harmful effects of tobacco smoke it may not stop them from smoking.

The association between tobacco smoking and number of times spent away from home may indicate community impact on smoking behavior. Women who are away from home and not having their family and community members around can feel freer to smoke while refraining from doing it at home, or use smokeless tobacco instead due to social roles, norms and standards in the community. Men, however, may smoke more at home while socializing with usual friends at work, or in public and drinking places within the community.

Finally, ability to self-assess health risks by an individual that could possibly help in reducing chances of smoking tobacco was not significant while adjusted for other factors suggesting that awareness of harmful effects of tobacco smoking alone may not be sufficient to stop an individual from smoking, especially in cases of habitual smoking or addiction. This is reflected in findings from International Tobacco Control (ITC) Zambia surveys which indicate that almost 90 percent of Zambian smokers actually think that smoking cigarettes is harmful to one's health, and even more of them agree that cigarettes are addictive and are willing to quit [10]. This creates an opportunity for reaching out to those individuals to help them initiate process of quitting and provide assistance until complete cessation.

The unchanging smoking burden and associated factors observed in this study nonetheless masked geographical and demographical differential contrasts which could be important in choosing where to roll out health promotional strategies. This also calls for innovations on how best to do this. Finding that exposure to at least one media continually helps to reduce odds of smoking thus confirms that media could be used in prevention efforts. We argue, for example, that both men and women could be reached through a radio and television and the message could be packaged in such a way that they would be able to understand the message irrespective of education level and literacy. Combining geographical contrasts and choice of health promotional messages, we further postulate that interventional efforts could be put in places, such as mining towns, which are likely to have high concentration of males matching typical Zambian smoker characteristics [11, 13].

Conclusion

The findings have revealed an unchanging pattern of tobacco smoking concentrated predominantly in rural adult populations

with lower educational attainment, showing a universal shift towards reduced risk in groups with higher education and mainly in urban areas over the period 2002-2007. The most convincing unchanging sign was the marked risk among more educated younger groups where most of this behavior can be assumed to have been commenced recently. Nonetheless and furthermore, education uniquely appeared to be an effective preventive factor in reducing the likelihood of smoking with increasing age opening the opportunity of repackaging health promotional and life changing messages to both sexes among young people as a national opportunity. This targeted response being suggested is grounded on the fact that tobacco smoking burden did not change significantly in Zambia between 2002 and 2007 despite rather small reduction in overall tobacco smoking prevalence. Also, we think that in the years that will follow tobacco smoking prevalence could remain a big burden and similar to 2007 year level, thereby justifying the need for innovative health promotion and preventional approaches. These responses together with regulatory frameworks implemented since ratification of WHO Framework Convention on Tobacco Control by Zambia in 2008 could contribute significantly in the fight against smoking. However, increasing popularity and consumption of cigarettes among men and women in rural settings is worrisome. This could mean a failure, or low effectiveness of tobacco control policy in rural Zambia which should be examined. The high concentration of smokers among uneducated and poor people also underlines possible inequalities resulting in unequal access to education and health information. Although the message may not be reaching underprivileged groups through education system, public media could play a role of prevention tool increasing awareness of health risks among both men and women. Using more radio and TV ads to increase awareness of health risks associated with smoking tobacco could be beneficial.

We conclude with an urgent call for a public health action as a response to this past limitation and failure of health promotion initiatives that has left the poor and vulnerable exposed to eternal and lasting dangers associated with long term effects of smoking. This intervention needs to be grounded in primary preventive strategies that focus on a reformation in behavior information targeting these most at risk groups. Unless this is done, the potential emergence of associated lifestyle population disorders is a sure recipe that will reverse national development as resources will be concentrated in care and support given that prevention will then be a late affair.

Author's Contributions

PO took part in the cleaning, analysis and interpretation of the data, also drafted the manuscript. CM actively participated in interpreting results and revising the manuscript. The final manuscript was read by all authors and approved.

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